# LD6004

Product Manual

Rev 1.0

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# I Module Introduction

## 1.1 Overview

LD6004 is a radar sensing module developed by  based on the ADT6101P chip. It monolithically integrates a 57~64GHz RF transceiver system, 2T2R AIP packaged antenna, 1MB flash, radar signal processing unit, and ARM® Cortex®-M3 core. Based on the FMCW signal processing mechanism and combined with radar signal processing algorithms, this module achieves high-sensitivity human state sensing, which can identify moving, slightly moving, and stationary human bodies, and calculate auxiliary information such as target distance and speed.This module adopts a two-transmit and two-receive antenna configuration, featuring a wide beam angle, suitable for ceiling mounting. It supports GPIO and UART signal output, and can be flexibly applied to different intelligent scenarios and product.

## 1.2 Product Features

- Radar detection based on FMCW (Frequency Modulated Continuous Wave) signals
- Large detection angle, supporting horizontal ±60° and pitch ±60° detection
- Supports side-mounted mode switching, with a maximum sensing distance of 6m
- Supports motion tracking of up to 3 human targets, outputting x, y, z coordinates of personnel positions
- Enables detection of moving and stationary personnel indoors, accurate identification within the area, supports division of sensing areas, and shields interference inside and outside the area
- Universal UART interface with communication protocol provided
- Supports UART parameter adjustment to meet the needs of different scenarios
- Compact size of only 25*31.5mm, supporting two connection methods: pin header insertion and SMD (Surface Mount Device) connection
- Unaffected by environmental factors such as temperature, humidity, noise, air flow, dust, and light

## 1.3 Application Scenarios

- Smart Home Appliance Applications

Based on the detection of the presence or absence of personnel in the room, real-time adjustment of the working mode of home appliances (working, standby, shutdown) to achieve home appliance intelligence.

- Human Body Sensing Light Applications

Perceive the presence of human bodies in the current space and automatically control the switching of lights, such as public scene lighting, office lighting, and various types of sensing lights.

- Smart Home Scene Applications

For places such as homes, hotels, offices, and toilets that require real-time detection of the entry or presence of personnel, so as to realize security, electrical control, personnel monitoring, etc. It can be combined with relevant IoT support platforms to achieve effective applications in relevant places.

# II Electrical Characteristics and Parameters

## 2.1 Functional Parameters

| Parameter Content | Minimum Value | Typical Value | Maximum Value | Unit | Remarks |
|---|---|---|---|---|---|
| Detection Target | | | 3 | Person | |
| Distance Accuracy | | 0.4 | | m | |
| Side-mounted Sensing Distance | 0 | | 6 | m | |
| Recognition Accuracy | | 95 | | % | |

## 2.2 Electrical Characteristics

| Operating Parameter | Minimum Value | Typical Value | Maximum Value | Unit |
|---|---|---|---|---|
| Operating Voltage (VCC) | 3.1 | 3.3 | 3.5 | V |
| Operating Current (ICC) | | 135 | 600 | mA |
| Operating Temperature (TOP) | -20 | | 85 | ℃ |
| Storage Temperature (TST) | -40 | | 85 | ℃ |

## 2.3 RF Characteristics

| Operating Parameter | Minimum Value | Typical Value | Maximum Value | Unit |
|---|---|---|---|---|
| Operating Frequency | 58 | | 64 | GHZ |
| Transmit Power (Pout) | | 12 | | dBm |
| Antenna Gain | | 4 | | d Bi |
| Horizontal Beam (-3dB) | -60 | | 60 | ° |
| Vertical Beam (-3dB) | -60 | | 60 | ° |

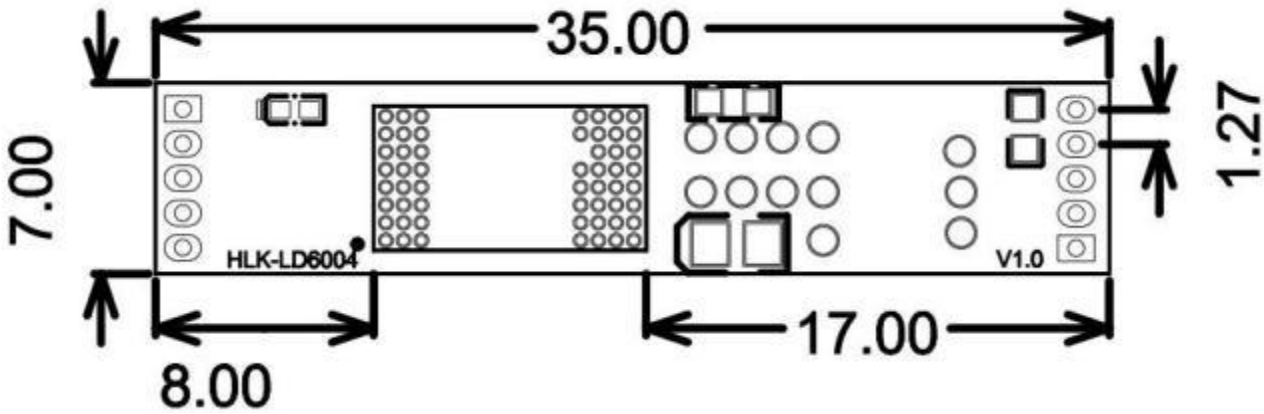
# III Hardware Description

## 3.1 Dimensions

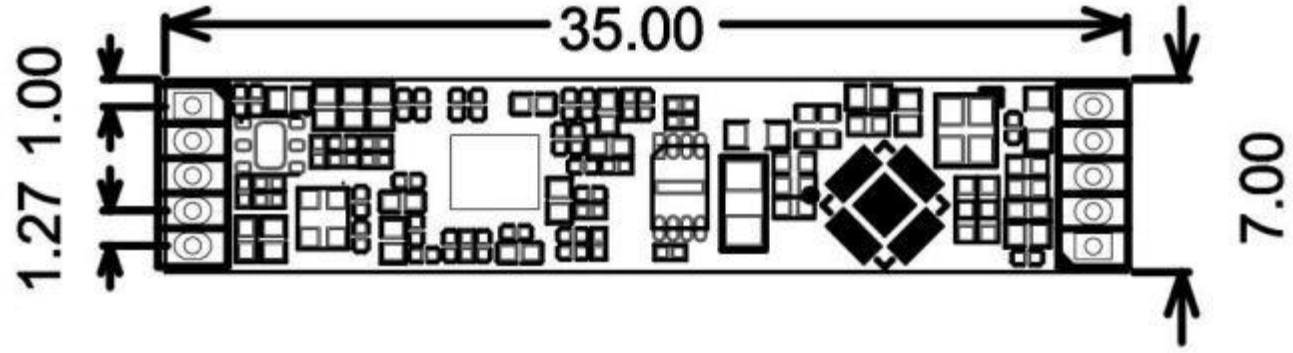

Module Physical Front View


Module Physical Back View


Module Pin Diagram



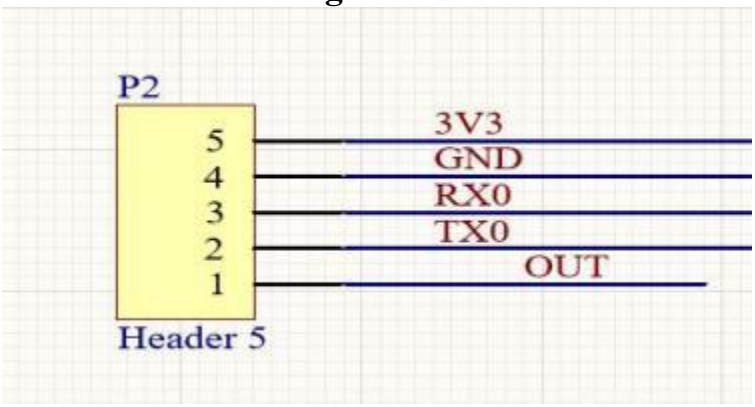
TOP View




## 3.2 Pin Definition

| Pin Name | Description | Remarks |
|---|---|---|
| 3.3V | POWER_INPUT 3.3V | |
| OUT | GPIO_P20/uart2 txd | High level output when there are people in the area |
| RX0 | GPIO_P01/uart0 _txd | |
| TX0 | GPIO_P00/uart0 _txd | |
| GND | GND | |
| 3.3V | POWER_INPUT 3.3V | |
| SWCLK | SWD Debug Clock | For debugging use |
| SWDIO | SWD Debug Signal | For debugging use |
| GND | GND | |

## 3.3 Module Peripheral Reference Design




## 3.4 Startup Configuration

| | BOOT1 | BOOT0 | Remarks |
|---|---|---|---|
| Configuration Level | 0 | 1 | Boot from on-module Flash |
| Pin Number | Pin8 | Pin12 | |

* Both BOOT1 and BOOT0 have internal pull-up resistors on the module. BOOT1 must be connected to low level before the module starts.

# IV.Usage and Configuration

## 4.1 Typical Application Circuit

The LD6004 module can directly use the TX2 pin to output the detected target information (high level when there are people, low level when there are no people), and UART0 outputs the detection results according to the specified protocol. The serial data includes target

position and speed auxiliary information, which users can flexibly use according to specific application scenarios.

The module is powered by 3.3V, and the input power supply capacity is required to be greater than 1A.

The output voltage of the module's IO port is 3.3V. The default baud rate of the serial port is 115200, with no parity check.

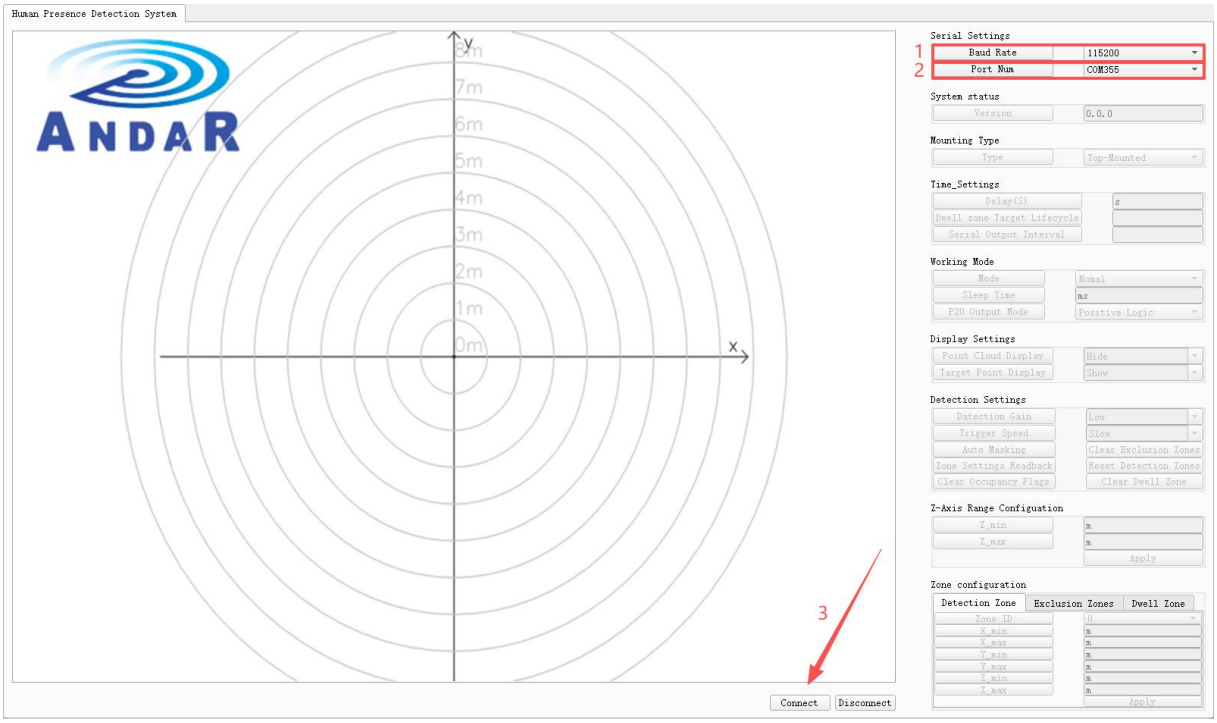
## 4.2 GUI Visualization Tool Application

1.Device Connection

1)Set the baud rate to 115200

2)Select the corresponding serial port number for connection

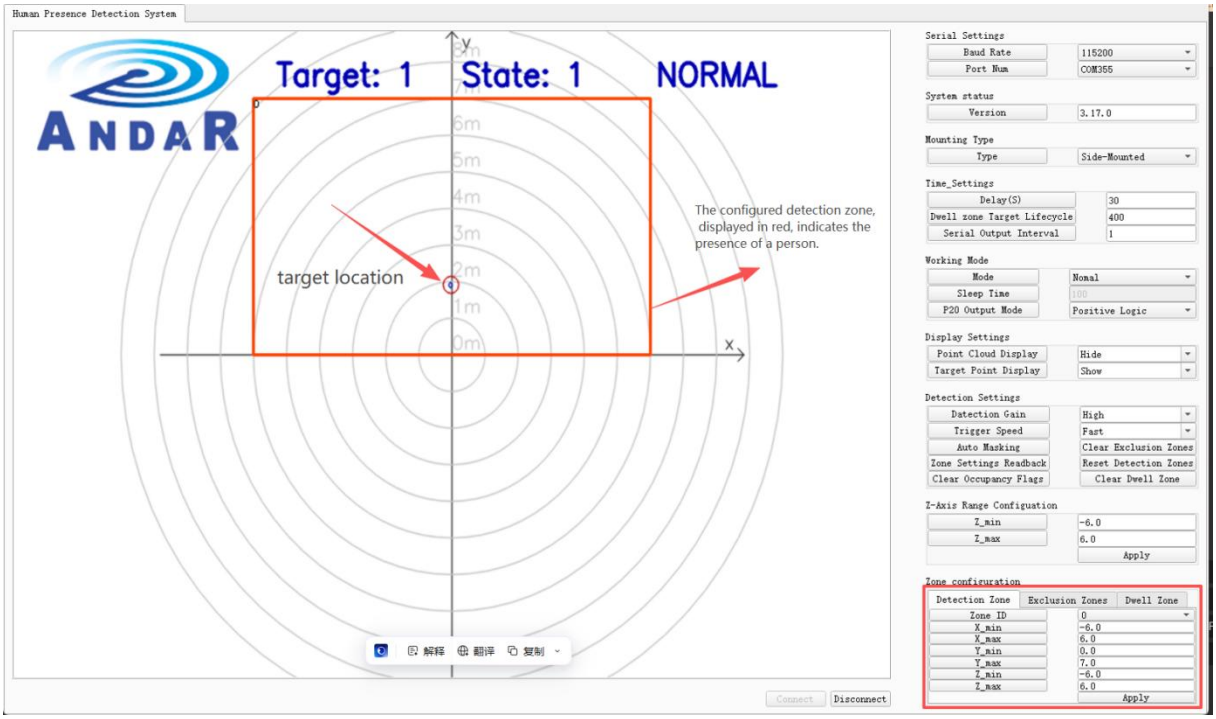
3)Click the [Start] button, and the module starts detection

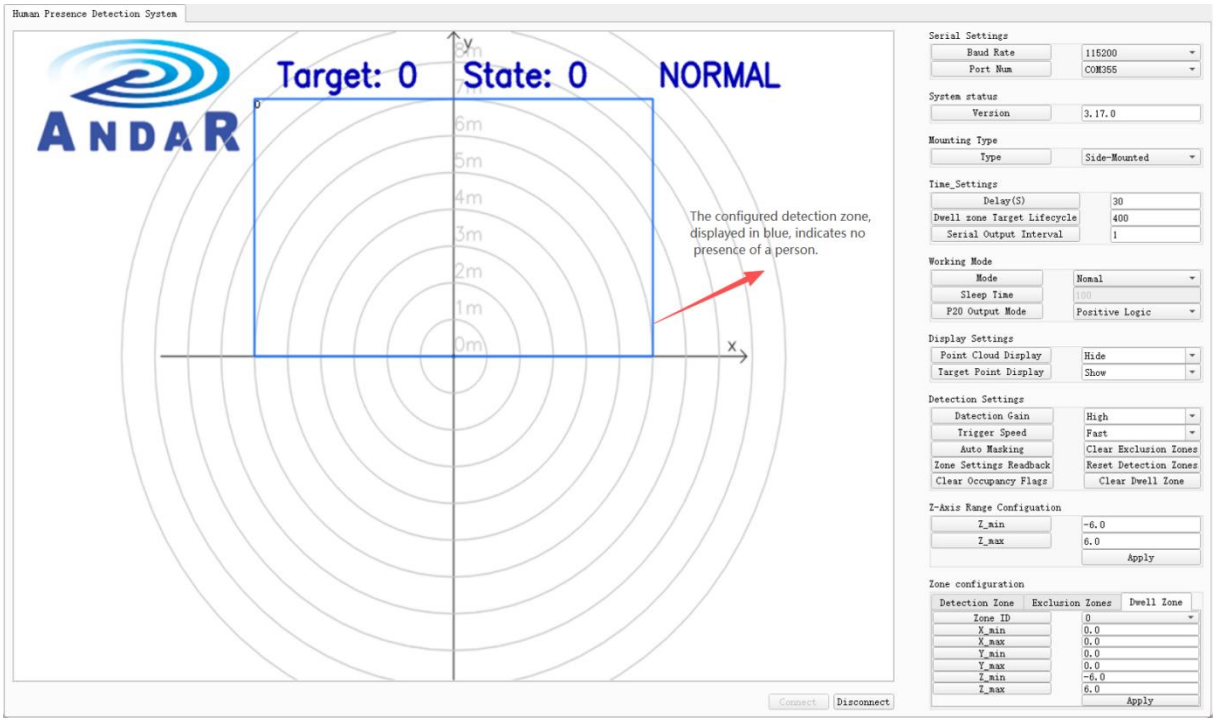


2. Set Detection Area

1) Set the coordinates of the detection area (with the module as the origin). Up to 4 detection areas can be set. If there is a wall-mounted air conditioner installed in the room, the z-axis range can be limited to filter out air conditioner interference.

2) Click the [Set Detection Area] button. After setting the detection area, the module can still detect the range outside the detection area, but TX2 will output a high level only when triggered within the detection range. Saved after power-off.

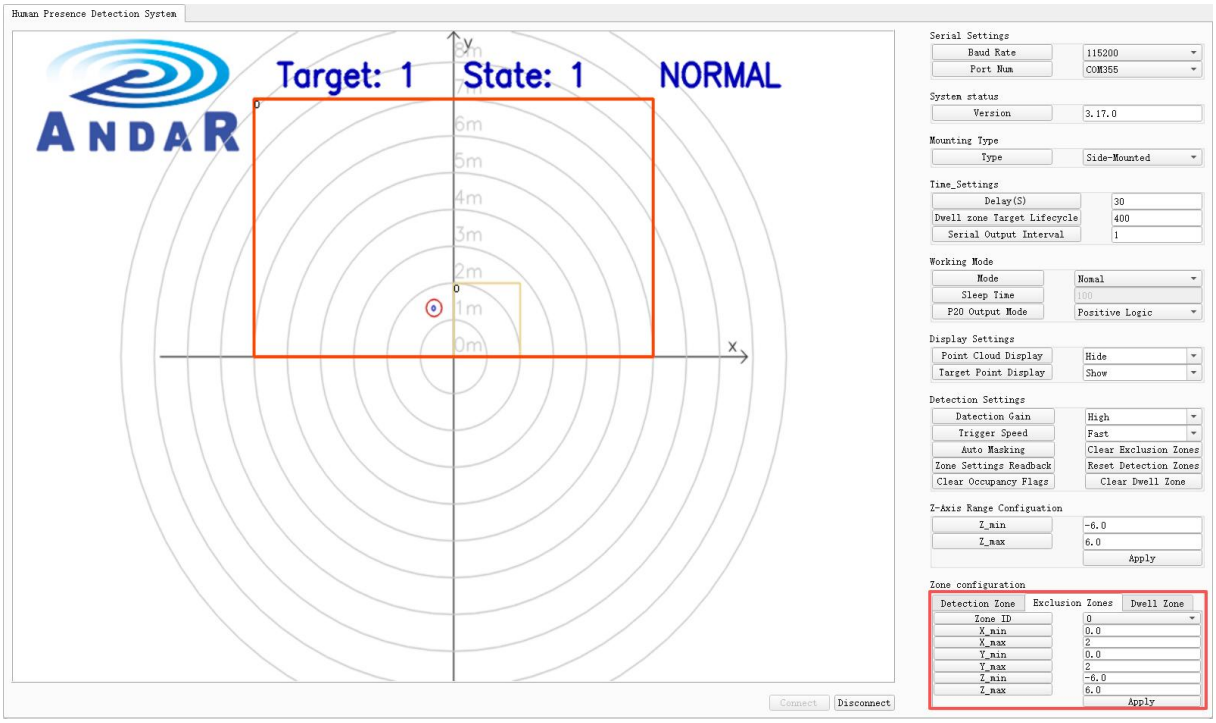





3. Set Interference Area

1) Set the coordinates of the interference area (according to the actual use scenario, shield some areas that may cause interference to the radar sensor, such as air conditioners, fans, curtains, etc.). Targets in this area will not trigger the sensor, that is, TX2 will not output a high level. Up to 4 interference areas can be set.

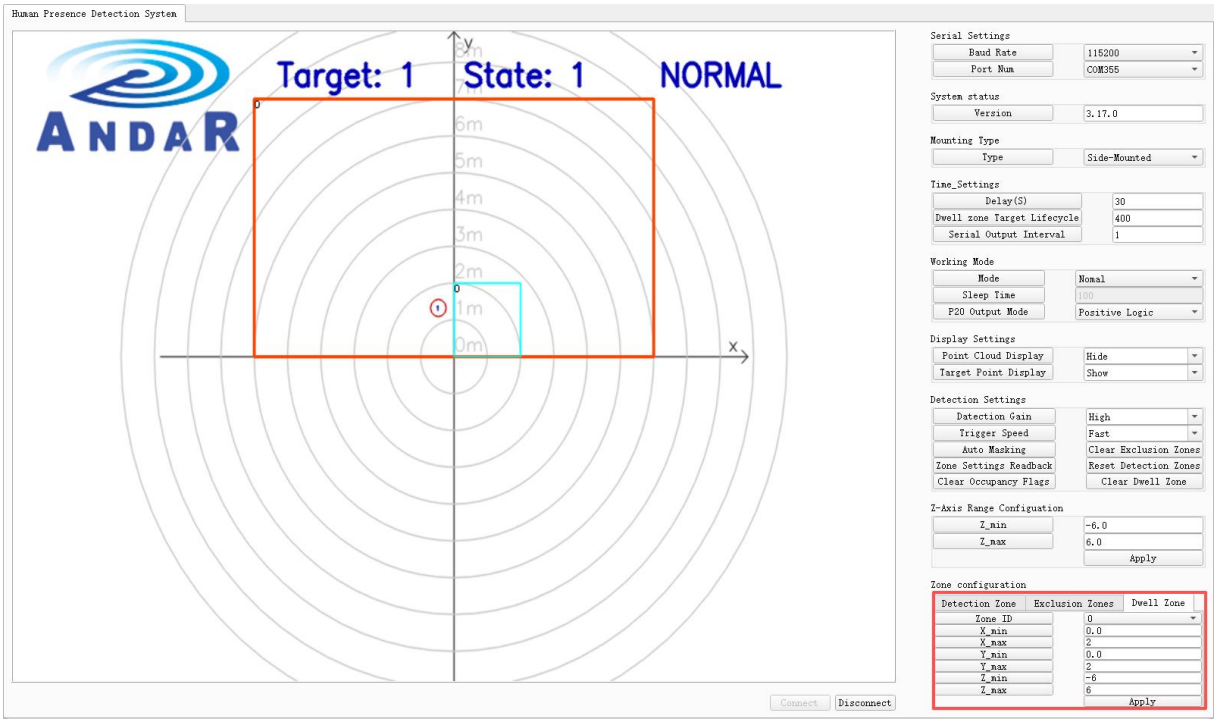
2) Click the [Set Interference Area] button, saved after power-off.




4. Set Stay Area

1) Set the coordinates of the stay area (for some high-demand scenarios, such as deep sleep and toilet glass partition scenarios that require good maintenance of the presence state, and the target should quickly switch to .no one when leaving The delay of the stay area nd the detection area can be set separately.

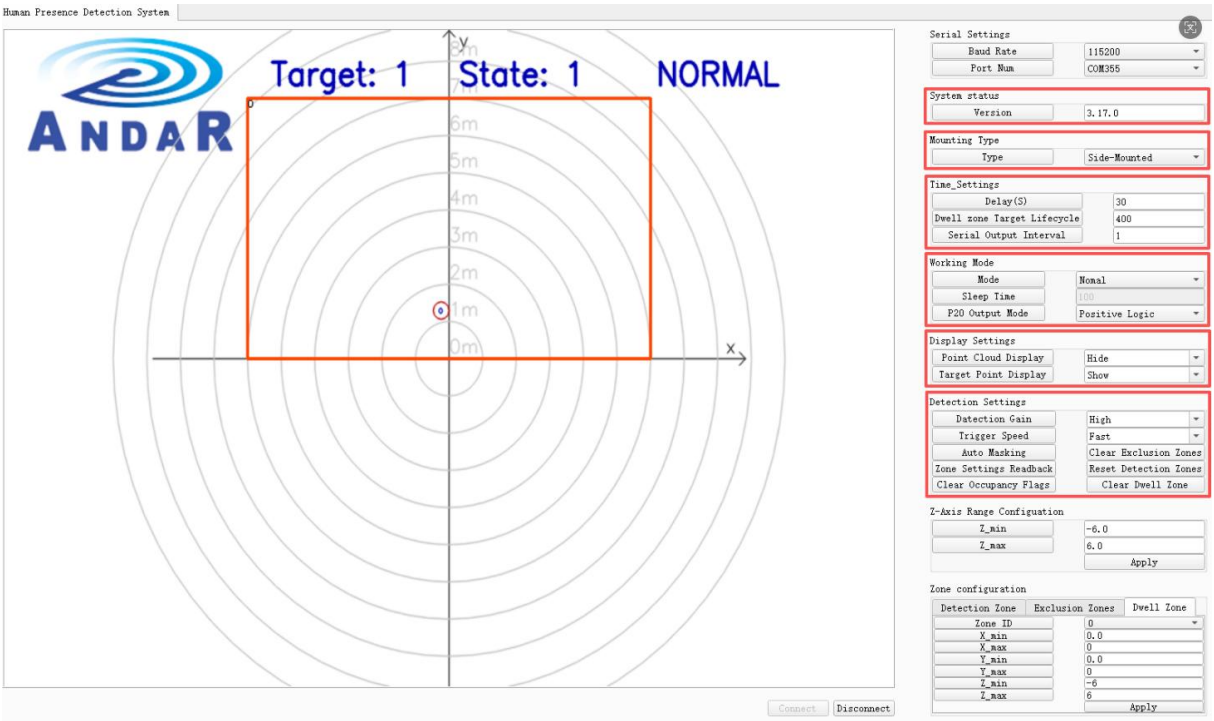
2)Click the [Set Stay Area] button, saved after power-off



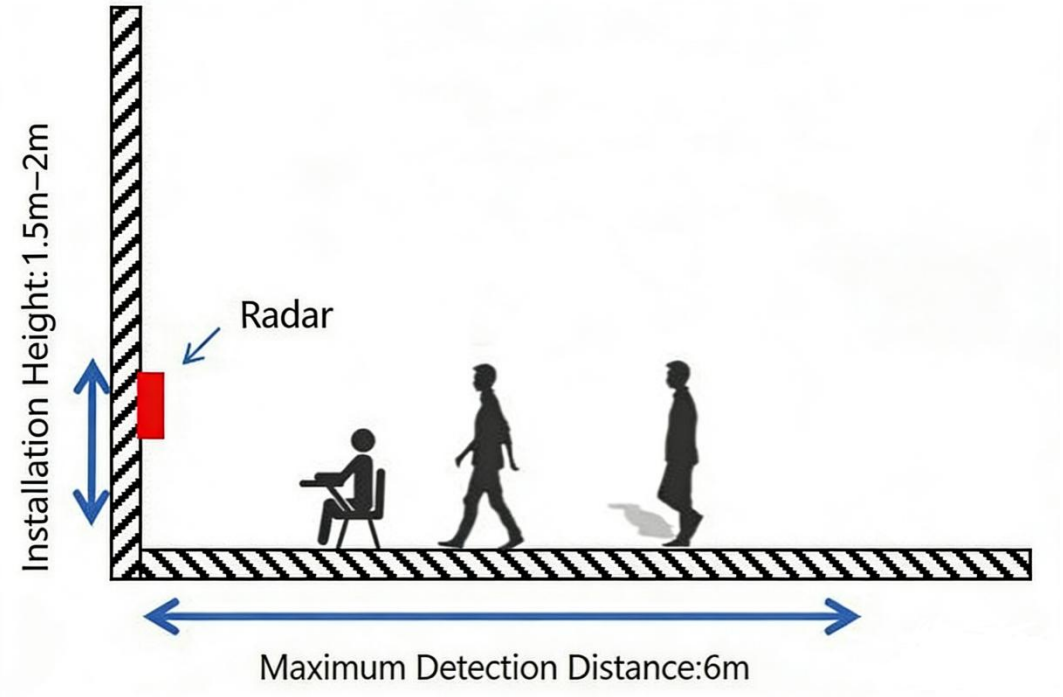

5. Introduction to Other Functions

1) [Firmware Version]: Automatically identifies the software version number when connected to the GUI
2) [Installation Method]: This module supports ceiling and side-mounted installation mode switching
3) [Delay Setting]: The duration for maintaining the presence state when a person is detected
4) [Target Lifecycle of Stay Area]: The delay time of the stay area and the detection area are set independently, mainly for areas with weak signals (toilet glass partitions, beds). Within the set delay time, if the target still generates a certain number of point clouds, the target can be maintained. When the target walks out of the stay area and then out of the detection area, the time for switching from "someone" to "no one" is still based on the set delay time. For example, if the delay setting time is 10s and the delay of the target in the stay area is 30s, the time for switching from "someone" to "no one" after the person walks out of the stay area is 10s. Set Lifecycle = Time x 20
5) [Serial Port Output Interval]: Set the radar reporting interval. The default is one frame every 50ms. If set to 10, it is one frame every 500ms.
6) [Low Power Consumption Mode]: When enabled, it switches to 1T1R mode when there is no one, and switches to 2T2R mode to detect stationary targets after motion trigger is detected. When enabled, the average working current is 2.5mA when there is no one. When disabled, it is always in 2T2R mode, with an average working current of 135mA. When low power consumption mode is enabled, the sleep time can be adjusted, and the sleep time is not recommended to exceed 500ms.
7) [Turn Off Radar P20 Output High Mode]: Turn off the radar, and the TX2 pin continuously outputs high level

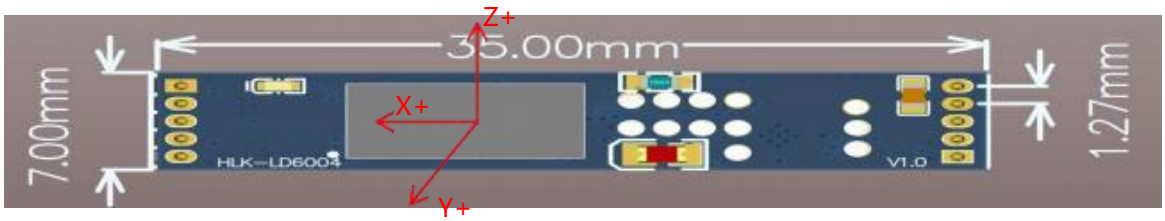
8) [Turn Off Radar P20 Output Low Mode]: Turn off the radar, and the TX2 pin continuously outputs low level
9) [Strong Reflection Mode]: For use in environments with many metals
10) [P20 Output State Switching]: Default is "High when someone, Low when no one" - TX2 outputs high level when someone is present and low level when no one is present; "Low when someone, High when no one" - TX2 outputs low level when someone is present and high level when no one is present; "No Action (High)" - TX2 continuously outputs high level regardless of the presence of people, no switching; "No Action (Low)" - TX2 continuously outputs low level regardless of the presence of people, no switching; "Pulse (500ms Low)" - TX2 outputs low level for 500ms when someone is present; "Pulse (500ms High)" - TX2 outputs high level for 500ms when someone is present;
11) [Point Cloud Display Mode]: Enable or disable the display of original point cloud data
12) [Target Display Mode]: Enable or disable the display of target point data
13) [Detection Sensitivity]: Sensitivity level setting; low sensitivity only detects motion
14) [Trigger Speed]: The time from detecting someone to triggering; fast, medium, and slow are 0.5s, 1s, and 5s respectively
15) [Generate Interference Area]: After installation, when there is no one in the detection environment, turn on the interference sources in the room. When the radar detects interference targets, click [Generate Interference Area] to perform fixed-point shielding of the interference target points
16) [Clear Interference Area]: Clear the manually set interference areas or automatically generated interference areas mentioned above
17) [Get Set Areas]: The set detection areas and interference areas are saved even after power-off. You can click this button to get the areas previously set by the module
18) [Reset Detection Area]: Restore the default 6*4m detection area
19) [Reset No One State]: For test scenarios with long delay times, it is convenient for testing to force reset the detection state to no one
20) [Z-axis Area Setting]: Set the overall Z-axis detection range. The radar is the origin, that is, the minimum value of the Z coordinate is 0



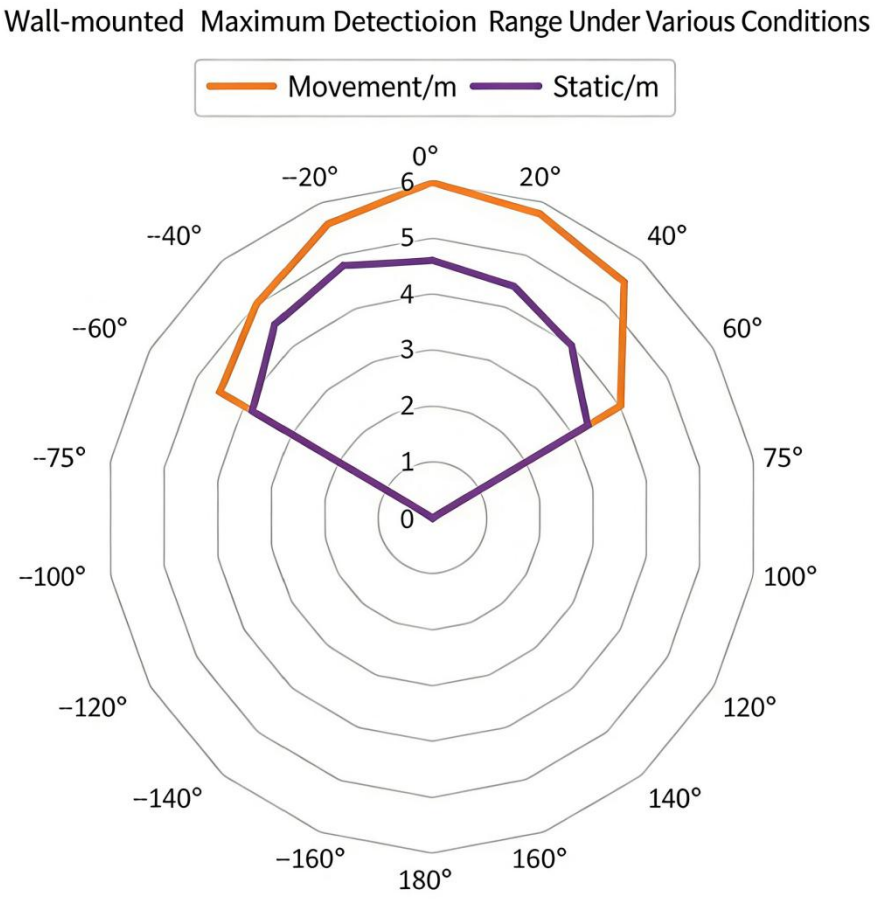

## 4.3 Installation Method and Sensing Range




Side-mounted Schematic Diagram




Direction Mark




Side-mounted Detection Range Schematic Diagram

# V.Precautions

1. The detection distance of the radar module is closely related to the target RCS (Radar Cross Section) and environmental factors. The effective detection distance may change with the environment and targets. Therefore, it is normal for the effective detection distance to fluctuate within a certain range.

2. The radar module has extremely high requirements for the power supply. The input voltage is required to be 3.1~3.5V, the power supply ripple ≤50mV, and the current ≥1A. If a DCDC power supply is used, the switching frequency is required to be no less than 2MHz.

# VI.Radar Radome Design

The radar radome is used to protect the radar antenna from external environmental influences such as rain, sunlight, and wind. However, it has the following impacts on the radar antenna: the dielectric loss and reflection loss caused by the radome will reduce the effective power of the radar; cause distortion of the antenna beam, resulting in changes in the radar's operating area; the reflection of electromagnetic waves by the shell will deteriorate the isolation between the radar transmitting and receiving antennas, and may cause receiver saturation; the phase of electromagnetic waves changes.when passing through the radar radome, affecting angle measurement. Therefore, it is very necessary to design the radar radome to reduce the influence of the shell and improve radar performance.

**Design Requirements:**

1. When selecting the material of the radar radome, on the premise of ensuring firmness and low cost, materials with smaller dielectric constant and loss tangent should be selected to minimize the impact of the radar radome on radar performance. The dielectric constant and dissipation factor of common materials are as follows:

| Material | Dielectric Constant（$\varepsilon_r$） | Dissipation Factor（tan δ) |
|---|---|---|
| Polycarbonate | 2.9 | 0.012 |
| ABS | 2.0-3.5 | 0.0050-0.019 |
| PEEK | 3.2 | 0.0048 |
| PTFE（Teflon®) | 2 | <0.0002 |
| Plexiglass® | 2.6 | 0.009 |
| Glass | 5.75 | 0.003 |
| Ceramic | 9.8 | 0.0005 |
| PE | 2.3 | 0.0003 |
| PBT | 2.9-4.0 | 0.002 |

2. The surface of the radar radome is required to be smooth and the thickness uniform.

3. Requirements for radar radome thickness design

$$T = N \bullet \frac{c}{2f\sqrt{\varepsilon_r}},\ N=1,\ 2,\ 3...$$

**T:** Radar radome thickness

**c:** Speed of light， $3 \times 10^8$ m/s;

**f:** Center frequency

$\varepsilon_r$ **:** Material dielectric constant， DK

4. Requirements for the height design of the radar antenna from the inner surface of the shell

$$d = N \bullet \frac{c}{2f} \quad N=1,\ 2,\ 3...$$

**c:** Speed of light， $3 \times 10$ m/s；

**f:** Center frequencyf=60GHz

c/2f=2.5mm

# VII Maintenance and Support of Products:

## 7.1 Precautions and Maintenance of Products

### 7.1.1 Precautions

- Please do not remove or insert the modules while it is running!
- Please follow all warnings and guidance information marked on the product.
- Please keep this product dry.If it is splashed or soaked by any liquid accidentally, please power off immediately and dry thoroughly.
- Please pay attention to the ventilation and heat dissipation in the environment of running the product to avoid the damage of components by high temperature.
- Please do not use or store the product in dusty or dirty environment.
- Please do not use the product in alternating environment between hot and cold avoid condensation damage to the components of the product.
- Please do not handle the product roughly. Falling, knocking or violent shaking may damage the circuit and components.
- Please do not clean this product with organic solvents or corrosive liquids.
- Please do not repair or disassemble our products by yourself. If the products break down, please contact us for maintenance in time.Unauthorized repair may damage the product,so the resulting damage will not be covered by warranty.

### 7.1.2 Maintenance

Address: Room 9#-211, Building 9, Minhua Technology Information Incubation Base, D-10-2, Information Industry Park, Chaoyang Road, Qixing District, Guilin, Guangxi, China

Department: After-sales Repair Department, Guilin Shengrui Technology Co., Ltd.

Tel: +86-773-2608835

## 7.2 Technical Support

Support hours: 09:30-11:30 and 13:30-17:30 (GMT+8)

Tel: +86-773-2608835 Email: contact@seengreat.com

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If you have creative product ideas, feel free to email us: **contact@seengreat.com**