## Introduction

This high-sensitivity 24GHz human presence sensing radar module utilizes FMCW (frequency-modulated continuous wave) to detect human targets in the set space. Combined with radar signal processing and accurate human sensing algorithm, it can achieve high-sensitivity sensing of human presence status, which can identify human body in motion and stationary state and calculate auxiliary information like the distance to the target.
The sensing effect of the radar module is insusceptible to environmental factors like temperature, brightness, humidity, light fluctuations, etc. Besides, FMCW radars can penetrate materials, which enables this module to work well in a shell without opening holes.
This microwave radar is mainly used in indoor scenarios to sense whether there is a moving or micro-moving human in the detection area and output the detection results in real time. It offers a sensing distance of up to 6 meters and a resolution of 0.75m. Besides, it provides serial communication protocol so users can configure the sensing distance range, sensing sensitivity in different intervals, and delay time for different applications. The module supports UART and GPIO (high and low level) output. When used with Arduino or other controllers, it can be flexibly applied to various projects such as smart light control, human body induction wake-up of advertising screen, UV light control, and home security.

## Features

- 5-12V wide supply voltage
- High sensitivity, wide detection angle of 120°
- Sensing distance up to 6m, capable of outputting distance value
- Long and narrow shape with a width of 7mm, small size, easy to embed
- Support UART & GPIO (high/low level) output

## Specification

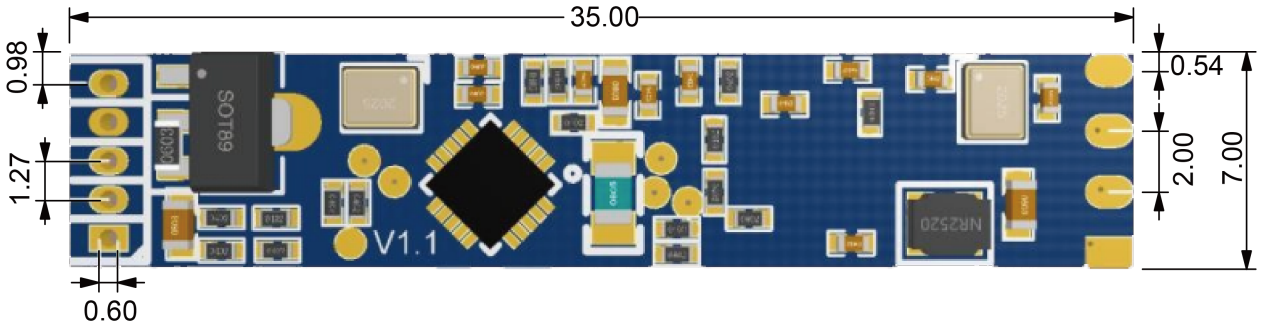
- Nominal Voltage: 5V
- Operating Frequency Range: 24GHz-24.25GHz
- Modulation Mode: FMCW
- Operating Voltage: DC5V-12V

- Average Operating Current: 80mA
- Detection Distance: 0.75m-6m (measured blind zone distance of 30cm)
- Detection Angle: ±60°
- Output Interface: UART & GPIO (3.3V)
- Default Baud Rate: 57600（Best 256000）
- Distance Resolution: 0.75m
- Sweep Bandwidth: 250MHz
- Ambient Temperature: -40 to 85℃
- Dimension: 7mm×35mm/0.28×1.38"
- Connector: SH 1.27mm to DuPont Female 2.54

Note: The operating frequency range and sweep frequency both comply with FCC, CE and SRRC standards.

## Dimensions

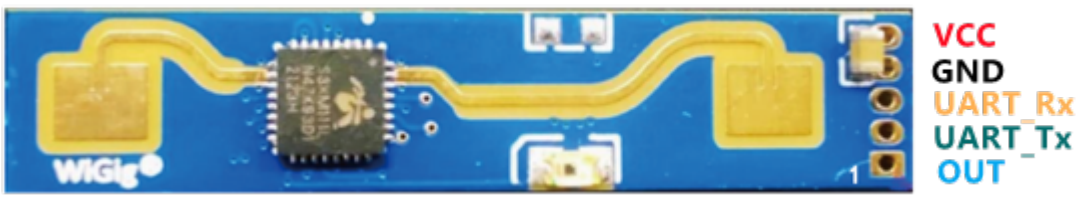
**Back side**




Unit: mm

## Board Overview

**Front side**




| Wire Color | Name | Description |
| --- | --- | --- |

| | | |
|---|---|---|
| Blue | OUT | Object status output, human is detected: output high (3.3V); nobody is detected: output low (0V) |
| Green | UART_Tx | Serial Tx, transmit data |

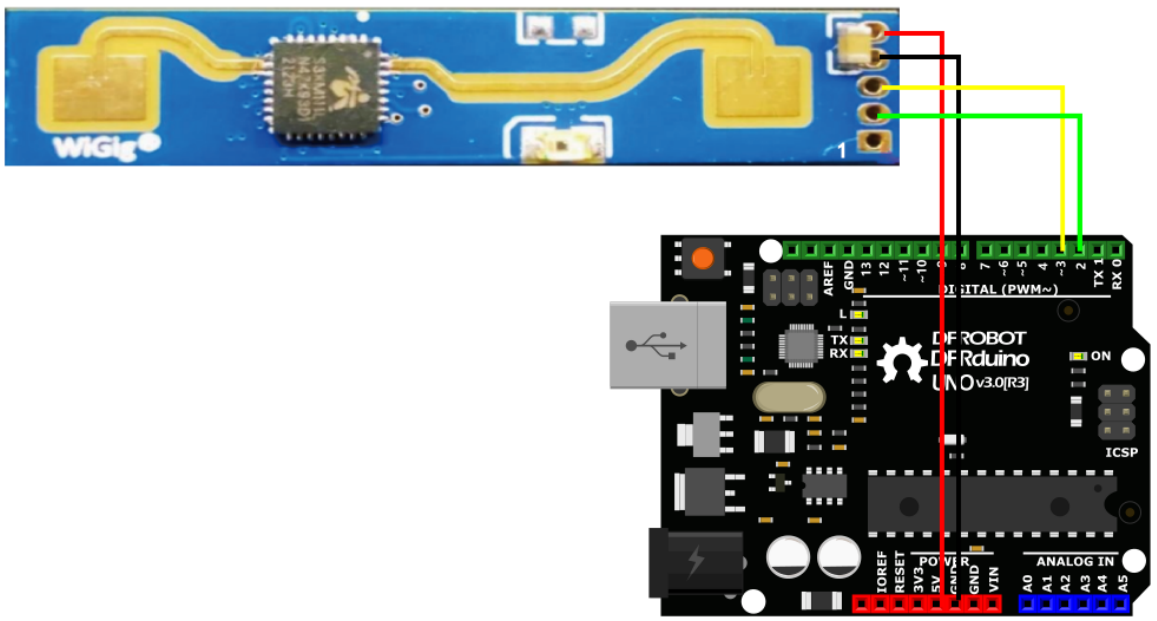
| Wire Color | Name | Description |
|---|---|---|
| Yellow | UART_Rx | Serial Rx, receive data |
| Black | GND | Power ground |
| Red | VCC | Power input |

# Tutorial for Arduino

## Requirements

- **Hardware**
  - DFRduino UNO R3 (https://www.dfrobot.com/product-838.html) (or similar) x 1
  - 24GHz Human Presence Sensing Module × 1
  - Connector × 1
- **Software**
  - Arduino IDE (https://www.arduino.cc/en/Main/Software)

## Connection Diagram




## Read Detection Distance（Demo)

```
#include <SoftwareSerial.h>
SoftwareSerial mySerial(2, 3); //Define soft serial port, define port 3 as TX and p

size_t readN(uint8_t *buf, size_t len);

bool recdData(uint8_t *buf);

uint8_t Cache[23] = {0};    //Cache

void setup()
{
  Serial.begin(115200);
  mySerial.begin(57600); //Soft serial port
  //Serial1.begin(256000);
}

void loop()
{
  recdData(Cache);
}

size_t readN(uint8_t *buf, size_t len)
{
  size_t offset = 0, left = len;
  int16_t Tineout = 1500;
  uint8_t  *buffer = buf;
  long curr = millis();
  while (left) {
    if (Serial1.available()) {
      // buffer[offset] = Serial1.read();
      buffer[offset] = Serial.read();
      offset++;
      left--;
    }
    if (millis() - curr > Tineout) {
      break;
    }
  }
  return offset;
}

bool recdData(uint8_t *buf)
{
  int16_t Tineout = 50000;
  long curr = millis();
  uint8_t ch;
```

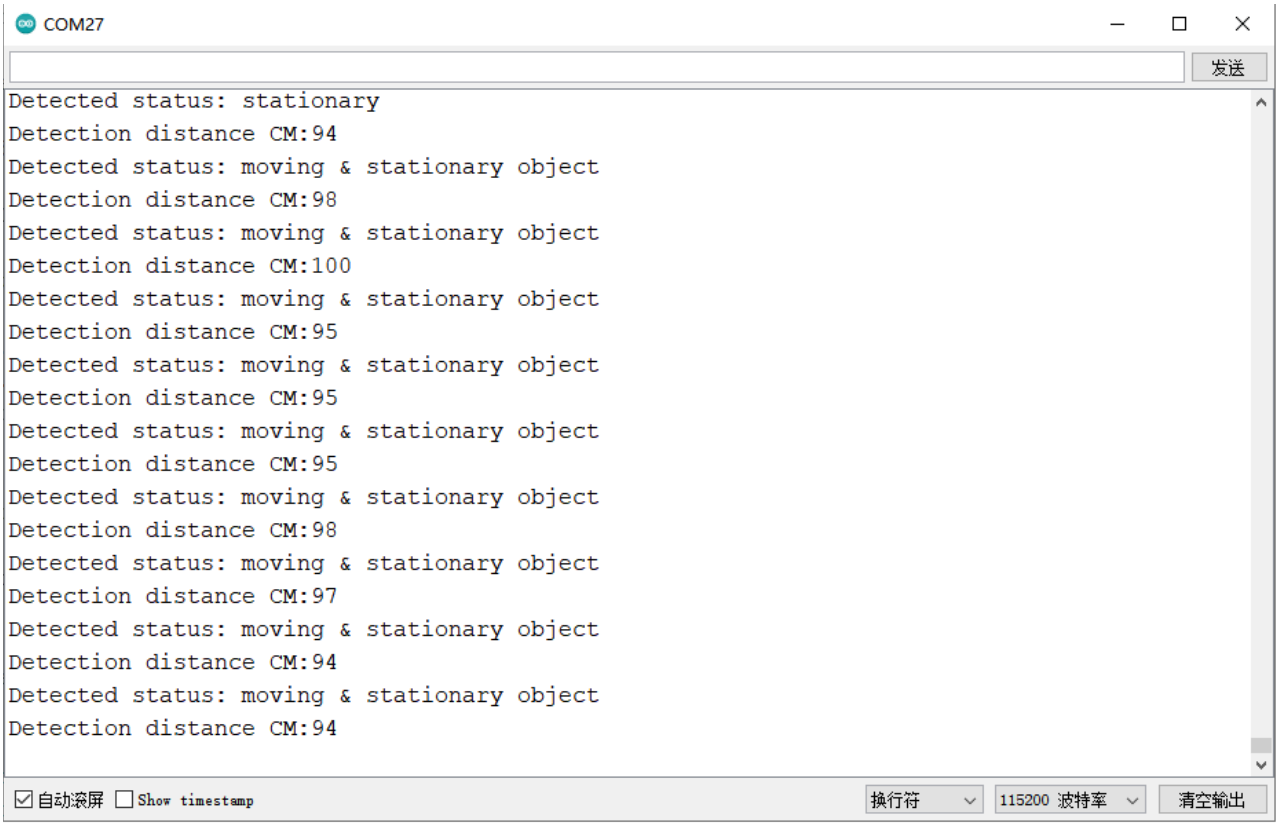
```
  bool ret = false;
  const char *P;
  while (!ret) {
    if (millis() - curr > Tineout) {
      break;
    }
    if (readN(&ch, 1) == 1) {
      if (ch == 0xF4) {
        buf[0] = ch;
        if (readN(&ch, 1) == 1) {
          if (ch == 0xF3) {
            buf[1] = ch;
            if (readN(&ch, 1) == 1) {
              if (ch == 0xF2) {
                buf[2] = ch;
                if (readN(&ch, 1) == 1) {
                  if (ch == 0xF1) {
                    buf[3] = ch;
                      if (readN(&buf[4], 19) == 19) {
//                        printdf(buf, 23); //Print raw data
                        uint16_t Adistance = buf[10] << 8 | buf[9];
                        uint16_t Sdistance = buf[13] << 8 | buf[12];
                        uint16_t Distance = buf[16] << 8 | buf[15];
                        switch (buf[8]) {
                          case 0x00 : Serial.println("Detected status: nobody"); br
                          case 0x01 : Serial.println("Detected status: moving"); br
                          case 0x02 : Serial.println("Detected status: stationary")
                          case 0x03 : Serial.println("Detected status: moving & sta
                        }
//                        Serial.print("Energy value of moving object:");
//                        Serial.println(buf[11]);
//                        Serial.print("Energy value of stationary object:");
//                        Serial.println(buf[14]);
//                        Serial.print("Distance to the moving object in CM:");
//                        Serial.println(Adistance);
//                        Serial.print("Distance to the stationary object in CM:");
//                        Serial.println(Sdistance);
                        Serial.print("Detection distance CM:");
                        Serial.println(Distance);
                        break;
                      }
                  }
                }
              }
            }
          }
        }
      }
    }
  }
  return ret;
}
```

```
void printdf(uint8_t *buf, int len)
{
  for (int i = 0; i < len; i++) {
    if (buf[i] < 0x10) {
      Serial.print("0");
    }

    Serial.print(buf[i], HEX);
    Serial.print(" ");
  }
  Serial.println();
}
```

## Result

**The module only outputs the target distance value of the moving state, and the distance value of the non-moving state is 0.For details, please refer to the serial communication protocol description.**




# Serial Communication Protocol Description

LD2410 Serial Communication Protocol V1.03.pdf (https://dfimg.dfrobot.com/nobody/wiki/3b1c7de28d8343b114c3ab6057f817e2.pdf) //Including the upper computer usage, config description & serial communication protocol commands

24GHz_Tool_EN.rar (https://dfimg.dfrobot.com/nobody/wiki/b92d8ce37b40a8f3d1fd8cf76495dc1d.rar)//Upper computer

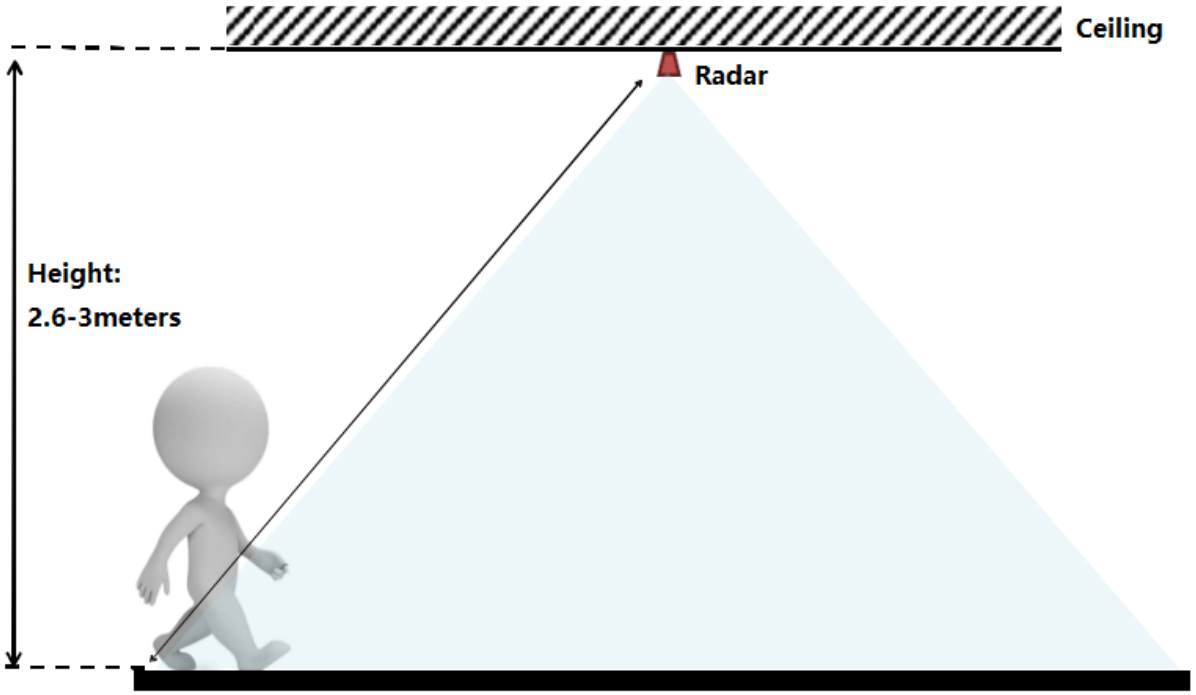
## Application

**This module is able to detect and identify human bodies in moving, micro-moving, standing, sitting and lying-down states. It supports multi-level parameter setting and can be widely used in various AIoT scenarios. The common applications are as follows:**

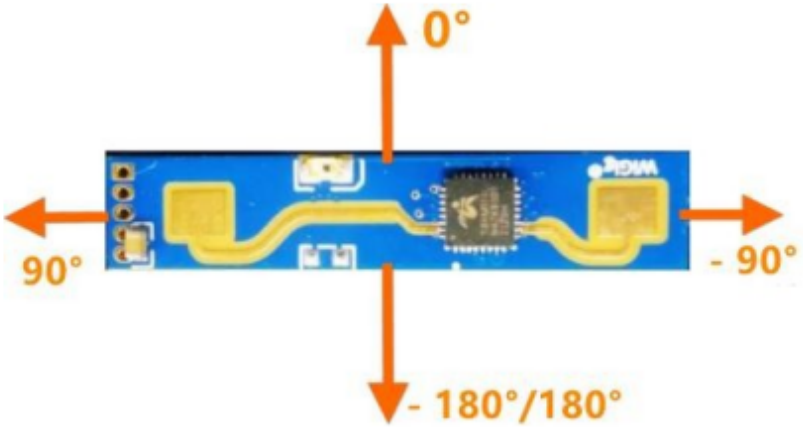
- Human body sensing light control: the device sense whether there is a human body in the space, and automatically control lights, such as lighting equipment in public places, various sensing lights, and LED bulbs.
- Human body induction wake-up of advertising screen and other devices: the device will automatically be on when someone comes nearby and enter sleep mode to save power when there is nobody, ensuring efficient and targeted information delivery.
- Life safety protection: UV lamp operating protection, make UV lamp stay off when there is someone around to avoid personal injury; the device automatically detects and gives an alarm in dangerous places to prevent people from entering specific high-risk spaces, such as the workplace for coal mine blasting.
- Smart home appliances: the TV, air conditioner and other electrical appliances will automatically be off when there is no one in the room for a long time, which is more power-saving and safe.
- Smart security: detection and identification of people intruding in the specified range

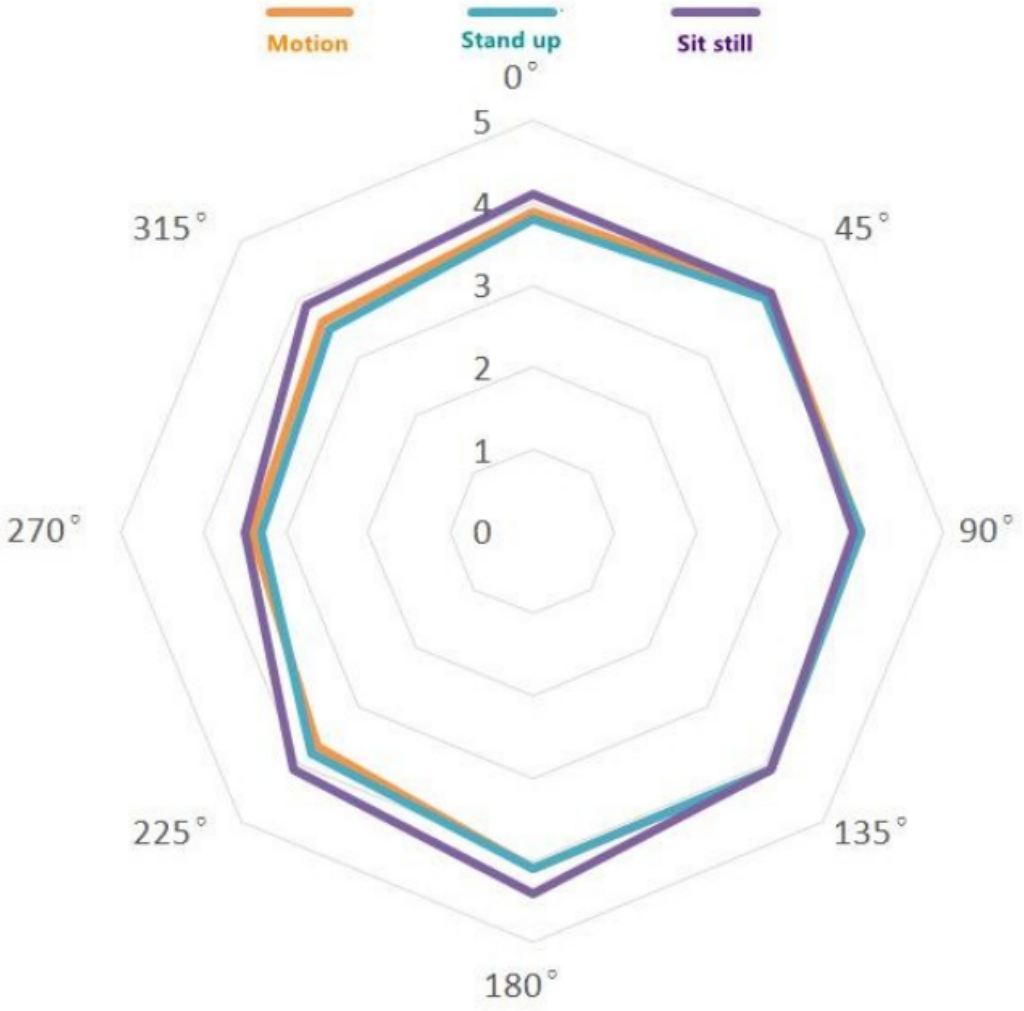

## Installation Method & Sensing Range

### Top Mount



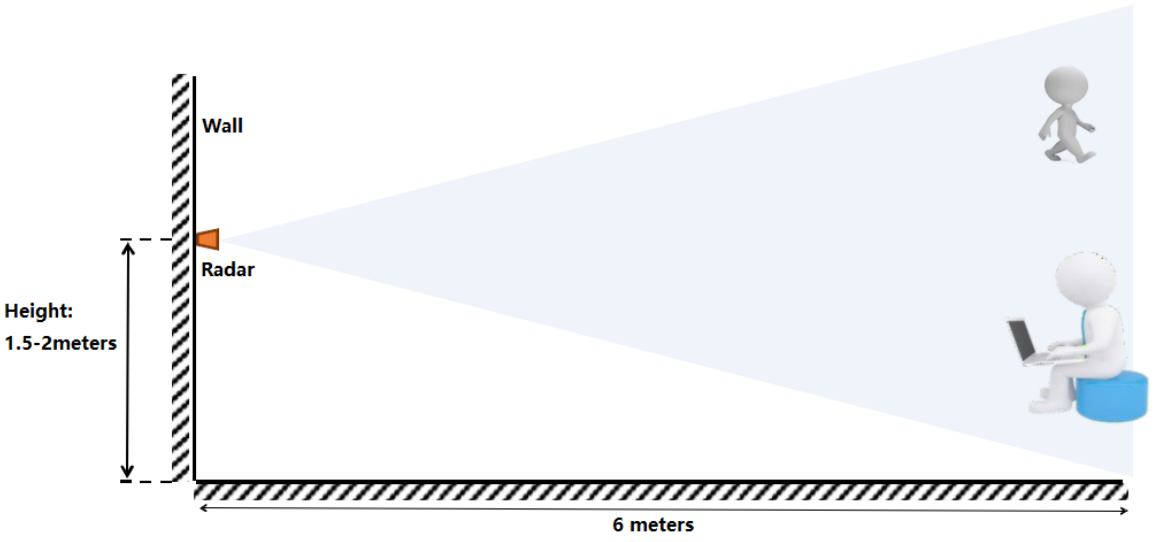

## Detection Range (At height of 3m)





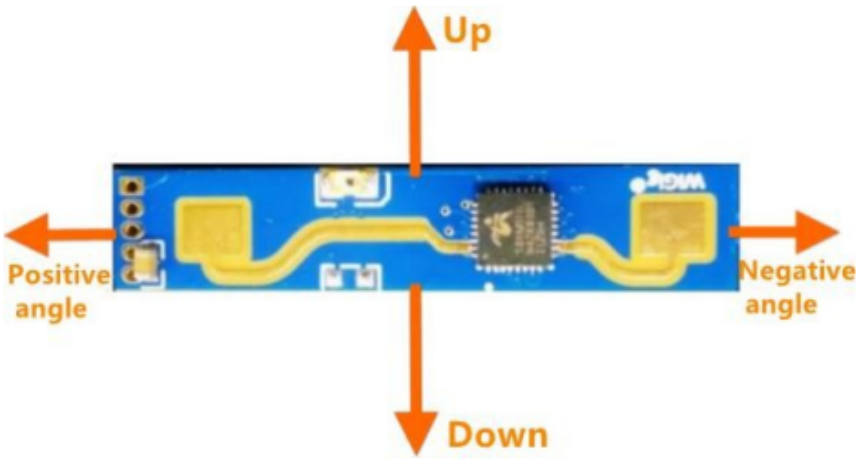

(Distance unit: meters, Angle unit: degrees)

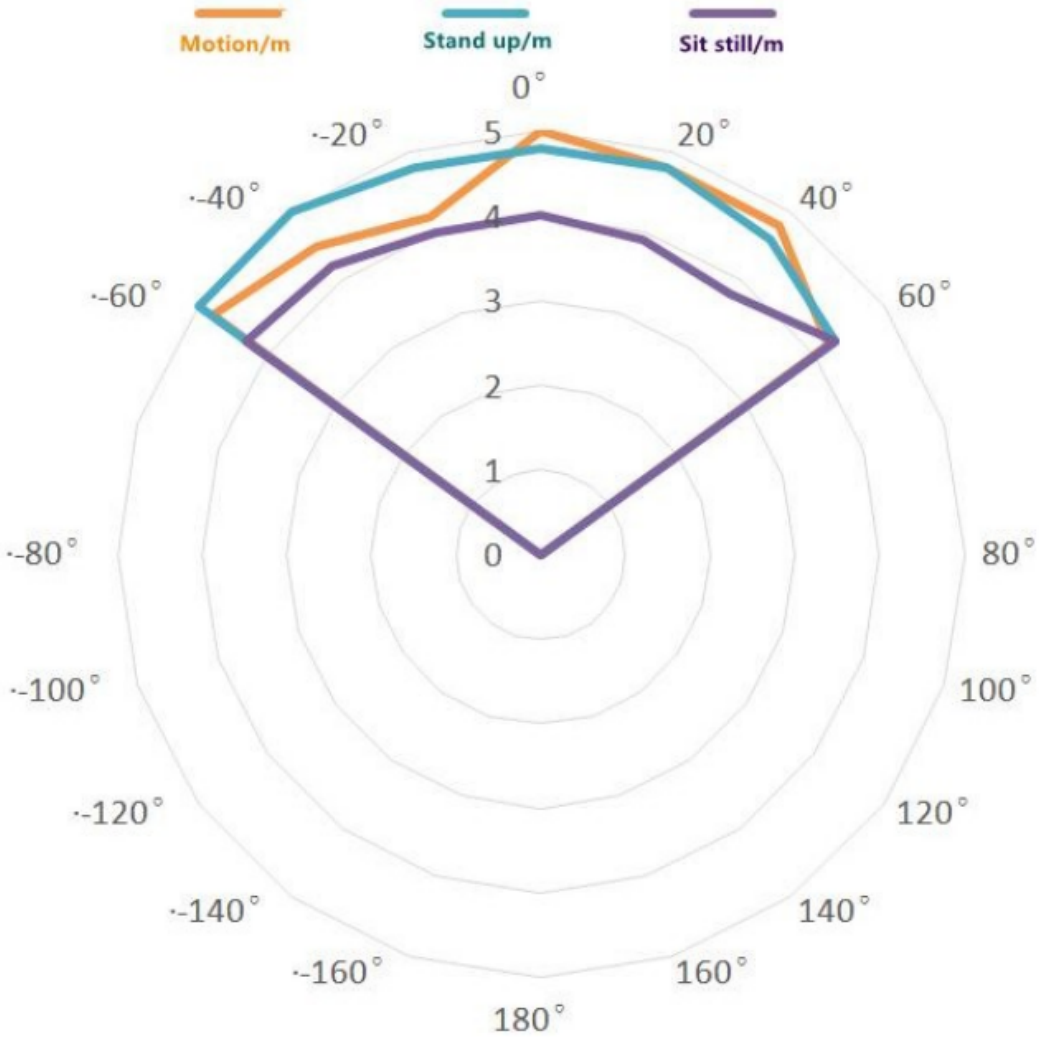
## Wall Mount Diagram




## Detection Range (At height of 1.5m)

Detection Range (At height of 1.5m)




(Distance unit: meters, Angle unit: degrees)

## Installation Conditions

## Confirm the minimum installation clearance

If the radar module needs to be installed in a shell, then the shell must have good wave

permeability at 24 GHz and contain no metal or materials that may block electromagnetic waves.

## Installation Environment Requirements

**This module needs to be installed in a suitable environment. The detection effect will be affected if it's used in the following environments:**

- There are continuously moving non-human objects in the sensing area, such as animals, plants, continuously swinging curtains, etc.
- There are large-area high-reflectivity objects in the sensing area; high-reflectivity objects will interfere with the radar antenna
- When it's installed on the wall, the indoor top-mounted air conditioner, electric fan and other external interference factors should be taken into account.

## Precautions During Installation

- Try to ensure that the radar antenna is facing the detected area, and the surrounding area is open and unobstructed
- Ensure the sensor is installed firmly and stably as the shaking of the radar itself will affect the detection effect
- Ensure that there is no moving or shaking object at the back side of the radar. Due to the penetrability of radar waves, the back lobe of antenna may mistakenly detect the moving object at the back side of radar. So it is recommended to use a metal shield or metal plate to shield the back lobe to reduce the influence caused by the back object.
- The theoretical distance accuracy of the radar is obtained by special algorithm processing based on the distance resolution (0.2m or 0.75m). Due to the differences in the size, state, and RCS of objects, the distance may fluctuate, and so does the farthest detection distance.