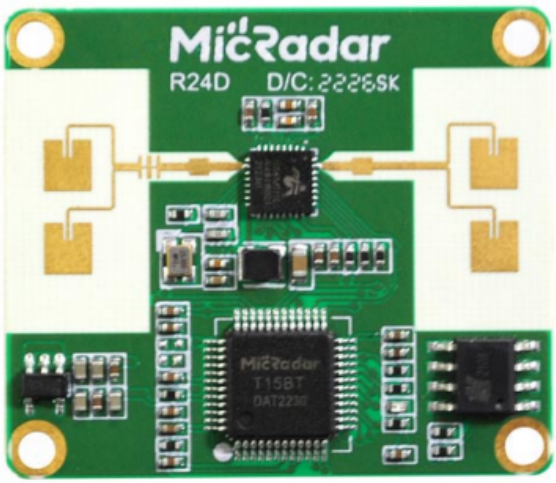
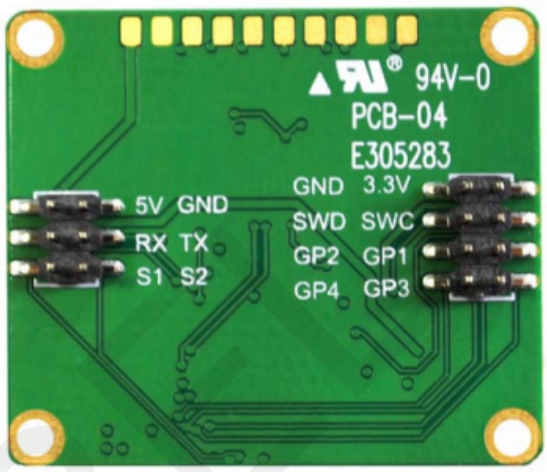
24G Wireless Bio-Radar Sensor for Human Presence IR24DVD1A Manual

Dalian iFlabel Technology Co., LTD.

Specification





Model	**Standard**
Description	**Wireless Bio-Radar Sensor for Human Presence**
Part Number	**IR24DVD1A**
Date	**2023/02/10**
Version	**V1.0**

	Design Team		
	Approval	**Check**	**Edit**
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IR24DVD1A - Human Presence Radar Product Manual

Features

- stationary human detection
- Vital Signs Detection
- 24GHz mmWave radar sensor
- Based on millimeter wave radar technology, realize the function of personnel perception in the radar scanning area;
- Realize the synchronous perception function of moving personnel and stationary personnel;
- Motion sensing maximum distance: 9 meters
- The maximum distance of human static perception: 5 meters
- Antenna beamwidth: horizontal 90°/vertical 60° fan beam
- With scene recognition ability, it can identify people/unmanned people and people's activity status, and output body motion range
- Not affected by temperature, humidity, noise, airflow, dust, light, etc.
- The power of the radar module is less than 0.5 watts and requires long-term power supply work;
- Unmanned to human detection time: within 0.5 seconds
- Time to detect (report) from someone to no one: Automatic detection based on algorithm, typical value is 1 minute

Model Description

✧ IR24DVD1A- Human Precence Radar Sensor, 90°/60° Fan Beam
(High measurement accuracy, it is recommended to use within 6 meters)

Applications

✧ Whole house intelligence
✧ Smart home appliances (TV, Yuba, security, etc.)
✧ Office energy saving (air conditioning, lighting)
✧ Sleep monitoring (sleep curve)
✧ Home security
✧ IPC trigger

Product packaging

✧ Volume: 35mm×31mm×7.5mm
✧ Interface: Pitch 2.0mm double-row pin interface, 2*3 and 2*4 total 2 sets of interfaces

Serial output parameters

✧ Someone/Nobody
✧ Active/Static, Occupied/Idle, Body perception

Configurable parameters

✧ scene setting;
✧ Sensitivity setting;
✧ No time setting;

Output protocol

✧ Standard Serial Protocol
✧ Tuya Standard Protocol

1. Overview

IR24DVD1A radar module is a radar detection module that uses millimeter wave radar technology to realize human motion perception and human biological perception. Based on the frequency modulation continuous wave signal processing mechanism, this module realizes the wireless perception of personnel status in a specific place through the synchronous perception technology of personnel movement intensity and personnel physiological parameters.

The two-array element antenna form of this module: wide-beam radar module, wide-beam radar module is mainly suitable for top-mounted installation mode to realize human respiration detection in a wide angle range; if it is used for horizontal or inclined installation, it is necessary to pay attention to the occlusion of the actual scene to achieve Radar detection function for longer range.

This radar module has the following working characteristics:

- ✧ Realize the synchronous perception function of sports personnel and stationary personnel (sitting, sleeping);
- ✧ It can quickly output the distance and approach status of the target relative to the radar
- ✧ Detect various motion amplitudes and output numerical status in real time
- ✧ Limit the detection object to persons with biological characteristics (moving or stationary), and eliminate the interference of other inanimate objects in the environment;
- ✧ This module can effectively eliminate the interference of non-living objects, and can also realize the detection of non-living moving objects;
- ✧ The product supports secondary development and adapts to various scenarios and applications;
- ✧ Universal UART communication interface, providing common protocols
- ✧ 4 groups of I\O are reserved, which can be input and output according to user definition, or simple interface simulation can be done
- ✧ The output power of this module is small, no harm to human body;
- ✧ This module is not affected by temperature, light, dust and other factors, has high sensitivity, and has a wide range of applications.

2. Electrical Characteristics and Parameters

2.1. Detection angle and distance

Parameter content	minimum	Typical value	maximun value	unit	Installation method
IR24DVD1A (8 -point narrow beam antenna)					
Movement detection distance	-	7	9	Meter	top
Perceived distance of stationary/slightly moving personnel	-	5	6	Meter	top
Sleeper perceived distance	-	3	3.5 _	Meter	top
Radar detection angle (horizontal)	-	90	-	Spend	
Radar detection angle (pitch)	-	60	-	Spend	

2.2. Electrical Characteristics

Working parameters	minimum	Typical value	maximum value	unit
Operating voltage (VCC)	4.5	5.0	6	V
Working current (ICC)	95	110	1 20	mA
Working I\O sink/output current (IIO)	—	8	20	mA
Operating temperature (TOP)	-20	-	+ 85	°C
Storage Temperature (TST)	-40	-	+8 5	°C

2.3. RF performance

Working parameters	minimum	Typical value	maximum value	unit
Operating frequency (fTX)	24.0	-	24.25	GHz
Transmit power (Pout)	-	6	8	dBm
Antenna Gain (GANT)		10		dBi
Horizontal beam (3dB)		100		°
Vertical beam (3dB)		80		°

3. Module size and pin description

3.1. Module size package

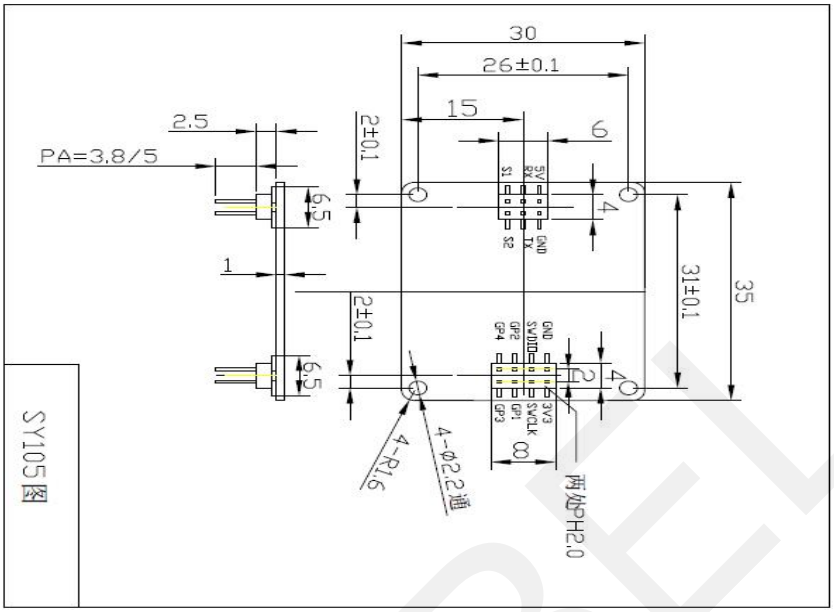

Figure 1 Schematic diagram of the structure of the radar module

3.2. Pin Description

interface	pin	describe	Typical value	illustrate
interface 1	1	5V	5.0V	Power input positive terminal
	2	GND		land
	3	RX	3.3v _	Serial receive
	4	TX	3.3v _	Serial send
	5	GP2	3.3V / 0V	Someone/Nobody
	6	GP1	3.3V / 0V	active/still
interface 2	1	3V3	3.3V	output power
	2	GND		land
	3	SL		reserve
	4	SD		reserve
	5	GP 3		Spare expansion pins
	6	GP 4		Spare expansion pins

	7	GP 5		Spare expansion pins
	8	GP 6		Spare expansion pins

Note: 1)GP 2 output: high level - someone, low level - no one;

2) GP 3 ~ GP 6 are parameter selection control terminals, which can be redefined according to user needs.

3) The output signals of this interface are all 3.3V level.

3.3. Use wiring diagrams

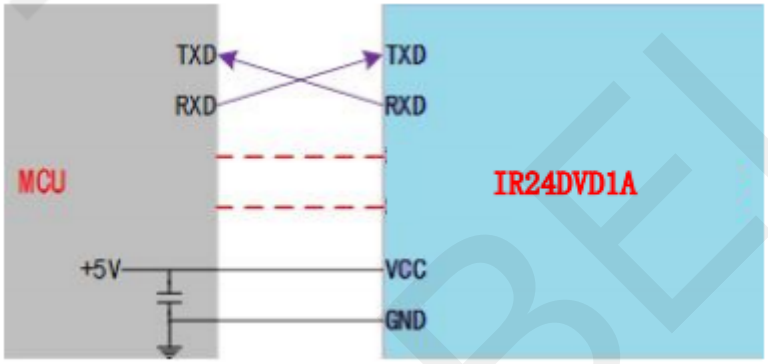

Figure 2

4. Main work function and performance

4.1. Radar module working range

The beam coverage of the IR24DVD1A radar module is shown in Figure 3 . The radar coverage is a three-dimensional sector of 90° horizontally and 60° vertically.

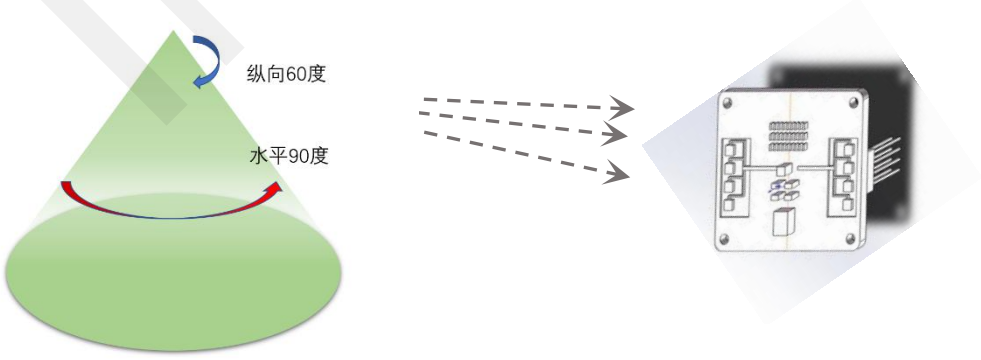

Figure 3 Schematic diagram of IR24DVD1A radar coverage area

Affected by the characteristics of the radar beam, the radar's working distance in the normal direction of the antenna surface is relatively long, but the working distance away from the antenna normal direction will be shorter.

When the radar is installed on the top or inclined, affected by the range of the radar beam and the effective radiation space, the range of the radar will be reduced, so you need to pay attention when using it.

4.2. Main functions and performance

The main functions of this radar module include:

A、Motion detection function (sideways facing the human body)

1）Maximum motion perception distance: 10 meters (normal range of motion for adults);

2）Movement trigger time: ≤0.5s;

B. Static detection function

1)Static human perception distance: 5 meters (human radial radar movement);

2)Detection time of unmanned perception: ≤ 4 0s;

3)Distance resolution ≤ 0.5 meters;

5. Radar work and installation

5.1. Installation method

The recommended installation methods of this radar module include horizontal installation, inclined installation and overhead installation.

5.1.1. Horizontal installation

Figure 4 shows the horizontal installation method. This installation method is mainly for human detection in standing or sitting postures, such as living room and home appliance applications.

Radar installation height is recommended to be 1m to 1.5m, the radar is installed horizontally and forward, the installation inclination angle is≤±5° , and there are no obvious obstructions and coverings in front of the radar.

The normal direction of the radar is aligned with the main detection position to ensure that the main beam of the radar antenna covers the detection area,and the radar beam covers the human activity airspace.

In this installation mode, the maximum distance L3 ≤ 9 meters for moving human detection; the maximum distance L2 ≤ 5 meters for human sitting/ fretting detection, and the maximum distance L1 ≤ 3 meters for human sleep detection;

Limited by the beam range of the radar antenna, and deviating from the normal direction of the radar, the effective range will be reduced.

Millimeter-wave band electromagnetic waves have certain penetrating characteristics for non-metallic substances, and can penetrate common glass, wooden boards, screens and thin partition walls, and can detect moving objects behind obstructions; but for thicker load-bearing walls, metal doors, etc. cannot penetrate.

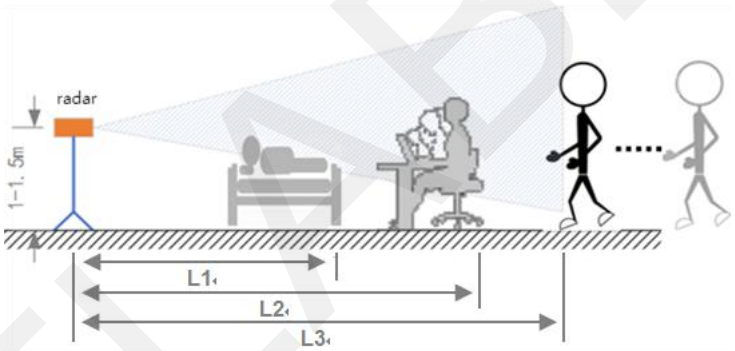

Figure 4 Horizontal installation diagram

5.1.2. Inclined installation

Figure 5, it is inclined installation. This installation method is mainly to detect the movement of people in the room, and is mainly suitable for hotels, halls and other places.

The recommended installation height of the radar is 2-2.75 meters; the range of the radar's downward viewing angle is 10° to 30°, and there are no obvious obstructions and coverings in front of the radar.

The normal direction of the radar is aligned with the main detection position to ensure that the main beam of the radar antenna covers the detection area, and the radar beam covers the human activity airspace.

In this installation mode, the maximum distance for motion detection is L3 ≈ 6 meters; the maximum distance for sitting/fretting detection is L2 ≈ 3.5 meters, and the maximum distance for sleep detection is L1 ≈ 2 meters; In this mode, there may be surveillance blind spots directly under the radar and adjacent areas.

As the downsight angle increases, the static human detection distance will be significantly compressed.

Affected by the radiation characteristics of the radar antenna, if the position deviates from the normal direction of the radar, the effective range of the radar will be reduced.

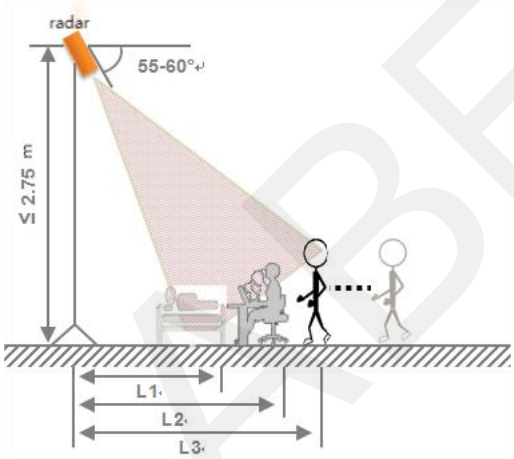

Figure 5 Installation diagram of oblique downward view

5.1.3. Top installation

As shown in Figure 6 for overhead installation. This installation method is mainly aimed at human body monitoring in a lying state, such as bedrooms, retirement places, hospital beds, etc.

The radar is installed vertically, and the horizontal deviation angle is ≤3° to ensure that the main beam of the radar covers the detection area; the radar installation height (from the ground) is recommended to be ≤2.75 meters; there are no obvious obstructions and coverings in front of the radar.

Affected by the installation height of the radar and the range of the radar beam, in this installation mode, the maximum distance of moving human detection is L3 ≈ 4.5 meters; the maximum distance of human sitting/fretting detection is L2 ≈ 2.5 meters, and the maximum distance of human sleep detection is L1 ≈ 1.8 meters.

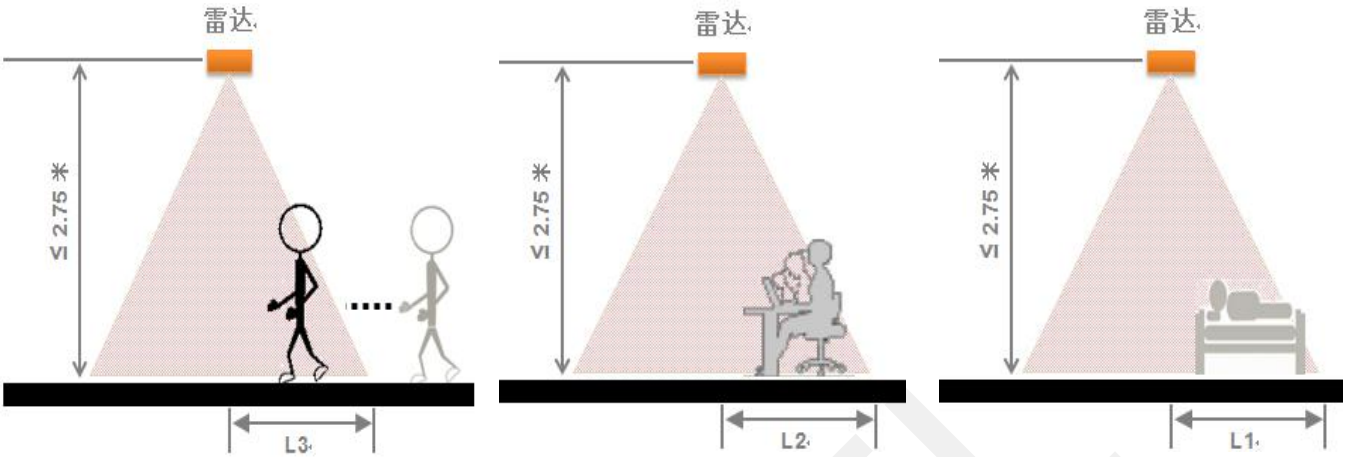

Figure 6 Top installation diagram

Notice:

The different installation methods mentioned above all require the main radar beam to cover the main active area of the human body, and to face the normal direction as much as possible;

When installed obliquely, due to the change of the horizontal projection of the coverage area, the horizontal action distance will be correspondingly reduced;

When the module is working, the surface of the module should not be covered by metal objects;

Affected by the transmission characteristics of electromagnetic waves, the radar operating distance is related to the target RCS, the material and thickness of the target covering, and the effective radar operating distance will change to a certain extent.

Corresponding to the detection of human body in static state, different body positions will affect the range of the radar, and the radar does not guarantee that all states can reach the maximum range.

5.2. Radar module working mode

After the radar module passes through statistical analysis and processing, it comprehensively evaluates the status of personnel in the current detection area, and users can directly use the results.

- **State operating mode**

  In this mode, the radar module periodically gives the presence status and movement status of people in the current radar detection area. The main statuses include:

1) Someone/Nobody;

In the state operation mode, in order to judge the accuracy of the environmental state, the radar module has carried out logic discrimination work. The state output logic of the radar module is as follows:

Only when the radar equipment detects a state change, the radar has the corresponding state output; otherwise, the radar remains silent;

A、The radar switches from unmanned state to manned state (moving, approaching, and moving away), which is a fast switching state, and the switching time is less than or equal to 1s;

B、When the radar switches from a manned state to an unmanned state, it needs to go through multiple state confirmations, and the switching time is ≈40s;

6. Typical Application Mode

This module is mainly used in home, home appliances, energy-saving lamp control and other scenarios. The following describes the application mode of typical scenarios.

6.1. Smart home appliance application

The radar is installed inside the household appliances, and monitors the conditions of the personnel on the working face of the household appliances in real time. The equipment adjusts the working mode of the equipment in real time or in quasi-real time (work, low power consumption, standby, shutdown, etc.) , to realize the intelligentization of home appliances.

In this application scenario, the radar is installed on the equipment radar. According to the normal working nature of the equipment, the radar is installed horizontally or obliquely to ensure that the radar beam can cover the main working area of the equipment.

Conventional home appliances include:

- Smart TV
- Smart speaker
- Smart air conditioner
- Other smart home appliances

6.2. Home application

For places such as homes, hotels, offices, bathrooms, etc., it is necessary to detect whether people enter or whether people move in real time, so as to realize methods such as security, electrical control, and personnel monitoring, and can effectively avoid privacy issues. The radar is installed in the room and can monitor the presence or absence of moving targets, the direction of movement of people, and the presence or absence of people in the room in real time. And through the Internet of Things transmission methods and means, combined with the relevant Internet of Things support platform, to achieve effective application in relevant places.

This radar can be used in the following areas:

Home security
Hotel management and monitoring
Community health care personnel monitoring
Office monitoring

6.3. Bedroom installation and application

For specific applications, real-time bedridden personnel related information, such as someone/no one, and then provide relevant information to implement specific applications. In this mode, the radar needs to be installed on the top. Based on this mode application, the applications that can be implemented include:

Elderly care
Health care
Hotel application
Family health

6.4. Energy saving control application

Based on the moving target detection and biometric detection of this radar, the radar can be well used in energy-saving control. The main application modes are as follows:

Energy saving of home appliances
Energy saving control of office appliances
Street light energy saving control

7. Precautions

7.1. Start Time

Since the module starts to work at the initial power-on, it is necessary to completely reset the internal circuit of the module and fully evaluate the environmental noise to ensure the normal operation of the module. Therefore, when the module is initially powered on, it needs a power-on stabilization time of ≥30s to ensure the validity of subsequent output parameters.

7.2. Effective detection distance

The detection distance of the radar module is closely related to the target RCS and environmental factors. The effective detection distance may change with the change of the environment and the target. This module does not have the ranging function for the time being, so it is normal for the effective detection distance to fluctuate within a certain range.

7.3. Radar Biodetection Performance

Since human biometrics belong to ultra-low frequency and weak reflection characteristic signals, radar processing requires a relatively long time accumulation process. During the accumulation process, many factors may affect the radar parameters, so the occasional detection failure is a normal phenomenon.

7.4. Power supply

Radar modules have higher requirements on power quality than conventional low-frequency circuits. When supplying power to the module, it is required that the power supply has no threshold glitches or ripples, and the power supply noise caused by the accessory equipment is effectively shielded.

The radar module needs to be well grounded. Due to the ground noise brought by other circuits, the performance of the radar module may also be degraded or even work abnormally; the most common cause is to shorten the detection distance or increase the false alarm rate.

In order to ensure the normal operation of the VCO circuit inside the module,the power supply requirement for this module is +5V~+6V power supply,and the voltage ripple is less than or equal to 100mV.

The external power supply must provide sufficient current output capability and transient response capability.

8. Common problem

Interference factors: Radar is an electromagnetic wave detection sensor, and active non-living will cause false alarms. The movement of metals, liquids, can lead to false positives. Usually, electric fans, pets close to the radar, and the shaking of metal curtains can cause false positives. Radar needs to be planned in terms of installation angle.

Non-interfering factors: radar electromagnetic waves will penetrate human clothing, curtains, thin wood, and glass. The installation angle and performance of the radar need to be determined according to the application.

Semi-interference factor: Radar judges the existence of human body and is not suitable for directly facing the air conditioner. The motor inside the air conditioner can cause the radar to misjudge. It is required that the radar product does not directly face the air conditioner. Or in the same direction as the air conditioner.

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