24GMilimeterwave

Bio-sensing radar

R24BBD1-Respiratory sleep module using guide

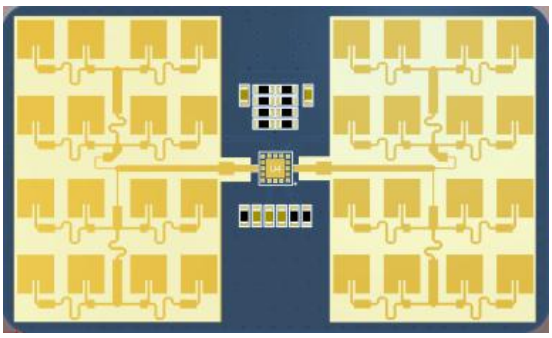
Please read the product instructions carefully before use and keep them properlyV1.0

MicRadar Technology (Shenzhen) Co. ,LTD

1. Product description

Based on the millimeter-wave radar system, the breathing and sleep radar realizes the perception of human biological existence and human motion, continuously records the sleep state of the human body, and judges the sleep state of the person in real time according to the changes in the amplitude of body movement and breathing during sleep, and during a period of sleep. After the process is over, the sleep duration is output, and according to the output of the relevant sleep parameters, it is applied to various services of health and wellness. This product is installed in indoor sleeping situations. Sleep breathing function detection is not affected by factors such as temperature, humidity, noise airflow, dust, light, and complete stillness of the human body.

2. Appearance introduction



(Antenna structure: 32 vibration sources)

3. Main performance description

3.1. Main functions of radar

function points	State change time/function explanation
DP1: Someone/Nobody	No one to someone, report within 0.5s From someone to no one, the unmanned state is output in about 1-2 minutes
DP2: Someone is stationary / Someone is active	Static and dynamic switching, reporting within 0.5 seconds
DP3: Someone approaching the device/someone moving away from the device/someone moving without direction	Output status once every 2 seconds

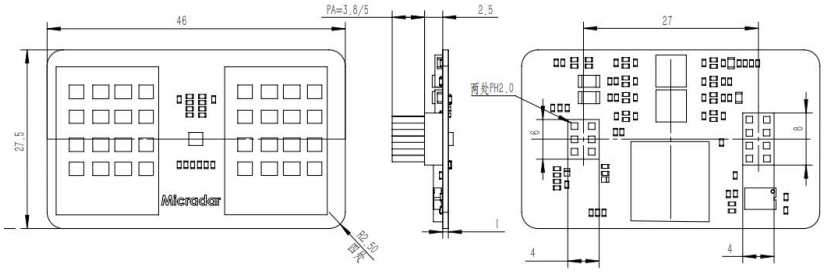
DP4: Body Motion Amplitude Parameter 0 - 100	Output data once every 5 seconds [Reference: Description of Body Motion Amplitude Parameter Output]
DP5: Getting in/Out of bed	From bed to bed, report within 0.5s From getting out of bed to getting in bed, it will output the state of getting out of bed in about 1-2 minutes
DP6: Sleep state (wake/light/deep)	When in bed, judge and report the sleep state once every 10 minutes
DP8: Respiratory rate	Output data once every 3 seconds, the unit is times/minute
DP9: breathing signal (abnormal breath hold/normal signal/no signal/abnormal movement)	Abnormal suffocation reported when breathing returns to zero When breathing is normal, the report signal is normal Report no signal when no one is in the state Report motion abnormality when exercising
DP10: Sleep switch	Control whether the sleep state data is output
DP11: Breathing switch	Controls whether breathing data is output
DP12: Sensitivity settings 1 - 10 steps	The default is sensitivity 4, which can support 10 gear adjustments
DP13: Scene Mode (Area detection, toilet, hotel, bedroom, office, maximum area mode)	Default is area detection scene mode Adapt to different scenarios according to the size of the area

3.2. Body Motion Amplitude Parameter Output Description

Body Motion Parameter		
0%	unmanned	unmanned environment
1%	still (sleep)	Only breathing without limb

2%-30%	micro-motion	Only slight head or limb movement
31%-60%	Ambulation/rapid body	slower body movement
61%-100%	running/close range	rapid body movement

4. Module package size and pin description



接口	引脚	描述	典型值	说明
接口 1	1	5V	5.0V	电源输入正端
	2	GND		地
	3	RX	3.3V	串口接收
	4	TX	3.3V	串口发送
	5	S1	3.3V/0V	有人/无人
	6	S2	3.3V/0V	活跃/静止
接口 2	1	3V3	3.3V	输入电源
	2	GND		地
	3	SL		保留
	4	SD		保留
	5	GP1		备用扩展引脚
	6	GP2		备用扩展引脚
	7	GP3		备用扩展引脚
	8	GP4		备用扩展引脚

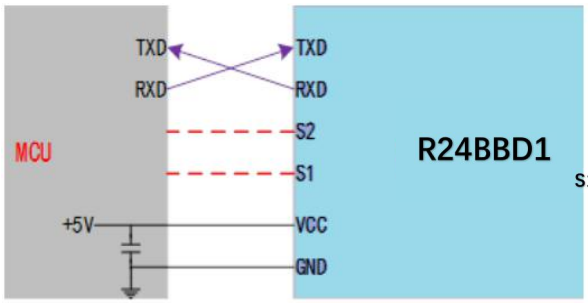
Radar module structure diagram Pin description

Note: 1) S1 output: high level - someone, low level - no one;

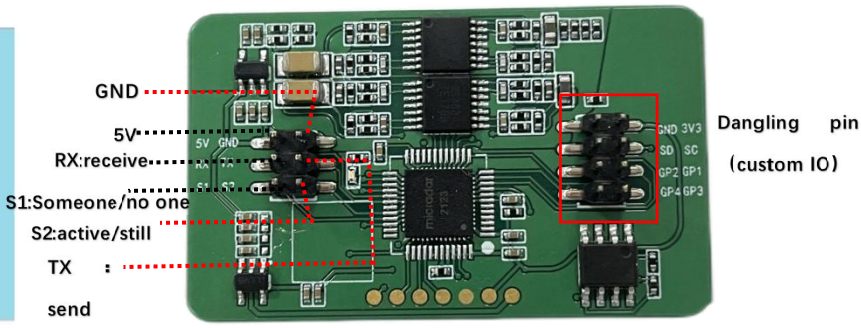
2) S2 output: high level - active, low level - still

3) GP1~GP4 are parameter selection control terminals, which can be redefined according to user needs.

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



Use wiring diagrams



Module wiring diagram

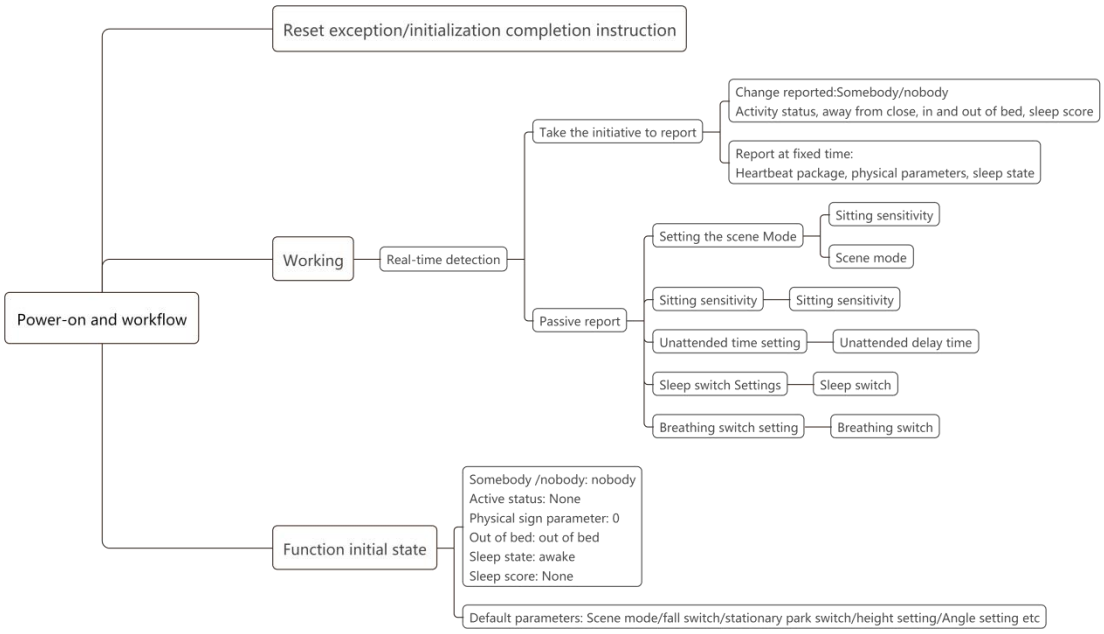
5. Tool preparation

5.1. TTL serial port tool, DuPont line, PC computer, serial port assistant terminal

5.2. Radar-EVB demo board (default Tuya platform, you can freely adapt your own communication module)

5.3. Radar User Manual (Protocol)

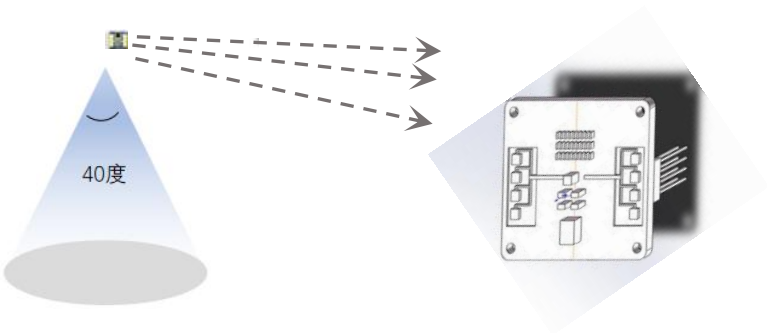
6. Power-up and data rules



7. Radar Installation Instructions

7.1. Working range of radar module

The beam coverage of the R24BBD1 radar module is shown in the figure below. The radar coverage is a three-dimensional sector area of 40° in the horizontal and 40° in the elevation.



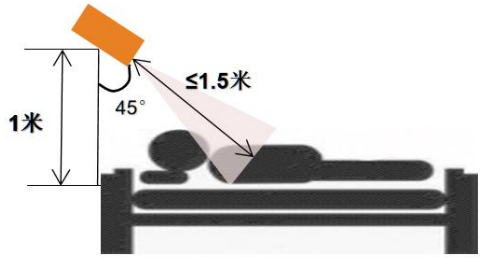
Schematic diagram of R24BBD1 radar coverage area

7.2. Radar installation direction and detection range

This radar module is recommended to be installed obliquely, and the distance parallel to the scanning plane should be ≤1.5 meters.

7.2.1 Inclined installation

If the related detection function of breathing and sleep radar is used in sleep health applications, the radar needs to be installed obliquely above the head of the bed for detection.



The radar is installed as shown in the figure, at a height of 1m directly above, and tilted down 45° to the middle of the bed, to ensure that the distance between the radar and the chest cavity is within 1.5m, and to ensure that the radar detection range can normally cover the sleeping area. (For the specific installation method, please refer to the diagram above)

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 human sleep detection area.

8. Key Functional Testing Guidelines

8.1. Sleep quality state judgment test

- **Sleep Quality Status Test:**

When a sleep test is performed within the radar detection range, the radar will immediately report the relevant status in "awake/light/deep sleep" every 10 minutes

carry out testing Simulate sleep for 10 minutes with immobility within range	When 10 minutes later, the radar sleep state is successfully judged from awake -> light sleep record radar sleep state If the output can be judged normally, it means **"pass"**

Example test table format:

Testing frequency	test location	Whether to report the normal sleep state	pass
the first time	front of the radar	Yes	pass

8.2. Judgment test of entering and leaving bed

- **Bed state judgment test:**

When no one enters the radar detection range, it will respond immediately and report the state of entering bed

Install the radar according to the installation requirements of the sleep scene, Keep approaching the sleeping area at a speed of at least 0.7m/s	When the radar state changes from getting out of bed - "into bed, it stops at the moment Whether the recording and radar can trigger the bed-in state normally If it can be triggered normally, it means **"pass"**

Example test table format:

Testing frequency	Whether entering the detection range normally triggers the bed entry state	pass
the first time	Yes	pass

- **Out-of-bed state judgment test:**

When there is no one in the radar detection range, the radar will detect whether there is no human movement, breathing and other actions within the range for a period of time, and output the state of getting out of bed when it is confirmed that there is no one. (It is normal to enter the unmanned state within 5 minutes in a normal environment)

Stay at least 3m away from the sleep detection area to avoid interference There are no people moving around in the environment and no interference from sources of interference start the timer	When the radar state changes from entering the bed/someone is still -> leaves the bed and stops for a moment Records radar entry and exit times When reporting "Get out of bed" within 5 minutes, it means **"Pass"**

Example test table format:

Testing frequency	Report the time to leave bed	pass
the first time	2min10s	pass

8.3. Respiratory rate test:

- **Breathing rate test:**

When the person sits still in front of the radar detection area and the distance is kept within 1.5m, a 3-minute static calm test and a 40-s breath-holding test are performed, and the radar will output the value change of breathing in real time. When it exists, it will report the breath as 0, and report the abnormal breath hold alarm

Sit still in the specified test position, and breathe calmly for 1 minute, then hold	When the radar breathing rate normally outputs the value 1min before, and the

your breath for 30s~40s after 1 minute Watch the radar status change	breathing value can be reported as 0 times/min after holding the breath for about 30s~40s, and the abnormal breath holding alarm is reported, it means "passed"

Example test table format:

Testing frequency	Confirm that the breathing rate has the correct numerical change	pass
the first time	Yes	pass

9. Guide to the actual installation steps of the radar

Step 1: According to the specific installation requirements of the sleeping scene, install the radar in the correct position to ensure good detection of the sleeping area

Step 2: Confirm whether there is an interference source within the radar detection range

Step 3: When there is an interference source in the radar detection range, reduce the dynamic detection range

(Adjust smaller scene modes)

(Make a trade-off between good triggering effect and anti-jamming stability of radar detection, it is recommended to give priority to ensuring anti-jamming and stability of radar detection)

Step 4: If the overall space of the sleeping scene is relatively small (≤15 ㎡), you can adjust the sensitivity one step smaller

If the overall space of the sleeping scene is relatively large (≥40 ㎡), you can adjust the sensitivity by one step

(Small space will enhance the reflection of the radar, enhance the detection effect of the radar, and adjust the sensitivity to neutralize the reflection interference and ensure the stability of unmanned judgment)

(Large space will reduce the reflection of the radar, weaken the radar detection effect, increase the sensitivity to neutralize and weaken the interference, and ensure the stability of the presence of people)

Step 5: Follow the steps for correct installation and reasonable settings for normal use

Example:

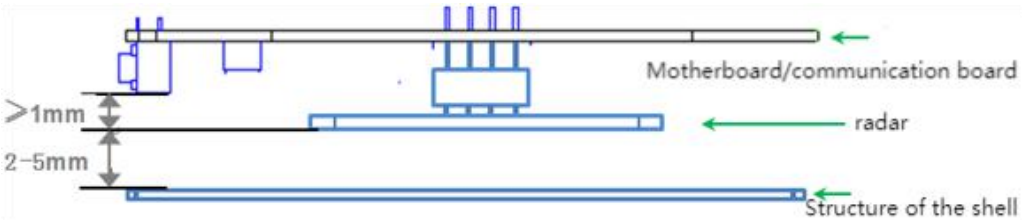
Space size: 10 ㎡ - 20 ㎡
Interference source: air conditioner outdoor unit/blackout curtain/partition wall
Recommended installation sensitivity: 4 (adjust 6 or 8 according to the size of the space)
Scene mode recommendation: area detection (need to evaluate the selected scene mode according to the actual space size)

10. Layout Requirements for Antenna and Housing

PCBA: Need to keep the height of the radar patch ⩾ 1mm than other devices

Shell structure: It is necessary to maintain a distance of 3mm between the radar antenna surface and the shell surface

Shell detection surface: non-metallic shell, need to be straight, avoid curved surface, affect the performance of the entire scanning area.



11. 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.

12.Historical version update instructions

Revision	Release Data	Summary
V1.0_0520	2022/05/20	first draft