

Baby Monitor

model : iBaby I

(Ver. 1.0)

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1. Summary

iBabyI is using 60G millimeter wave radar technology to realize human respiratory heart rate perception and sleep assessment. The module is based on the FMCW radar system, aiming at the output of the respiratory heart rate frequency of personnel in specific occasions, combined with the long-time sleep posture body motion acquisition, and timely reporting the record of personnel's sleep state and history.

Characteristic:

- ✧ Radar detection is realized based on FMCW FM continuous wave signal
- ✧ To achieve the synchronous perception of human respiration and heart rate
- ✧ Realize a historical record of human sleep quality
- ✧ Human sleep quality monitoring to detect the maximum distance: $\leq 2.5\text{m}$
- ✧ Human respiratory heart rate detects the maximum distance: $\leq 2.5\text{m}$
- ✧ Not affected by temperature, humidity, noise, airflow, dust, light and other environments
- ✧ A Universal UART / RS485 communication interface that provides a general protocol;
- ✧ Someone to unmanned detection (report) time: according to the algorithm, the typical value is 30 seconds



(a) front



(b) back

2. Electrical characteristics and parameters

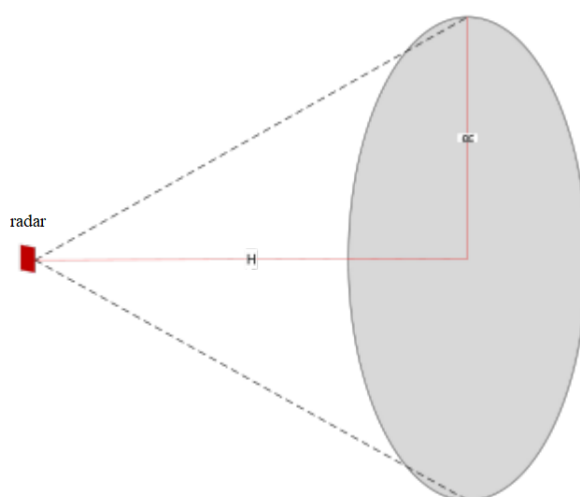
2.1 Detection angle and distance

Parameter	Min	Nomal	Max	unit
Performance				
Sleep detection distance (anocelia)	0.4		2.5	m
Respiratory and heartbeat detection distance (anocelia)	0.4		2.5	m
Respiratory measurement accuracy		90		%
Respiratory measurement range	0	23	54	time/min
Heartbeat accuracy		90		%
Ranges of heartbeat measurement	0	74	120	time/min
Refresh time		0.12		S
Detection establishment time		1.5		S
Operational parameter				
Voltage (VCC)	4.6	5	5.5	V
Current (ICC)	200	350	450	mA
Temperature of operation (TOP)	-20	-	+60	℃
Temperature of storage (TST)	-40	-	+105	℃
Antenna parameters				
Antenna gain (G_{ANT})		5		dBi
Horizontal beam (-3dB)	-60		60	°
Vertical beam (-3dB)	-60		60	°

3. Major function

3.1 Radar operating range

The beam coverage range of the radar module is shown in Figure 3. The radar covers a three-dimensional sector area of horizontal 60 and pitch 60.



Graph 3 Diagram of the radar beam coverage range

Affected by the beam characteristics of radar, the action distance of radar in the normal direction of the antenna surface is relatively far, but the action distance deviated from the antenna normal direction will become shorter. When the radar is tilted, the action scope of the radar will decrease due to the radar beam range and effective radiation space, so attention should be paid to when using.

3.2 Sleep detection function

- a. Detection distance: 2.5m (detection distance between human and radar antenna surface) The
- b. Sleep quality assessment function: awake / light sleep / deep sleep
- c. Sleep time recording function: the data output of the relevant duration of sleep quality
- d. In bed function: in / off bed

3.2.1 Respiratory detection function

- a. Detection distance: $0.4\text{m} \leq x \leq 2.5\text{m}$ (detection distance between chest cavity and radar antenna surface)
- b. precision: $\geq 90\%$

3.2.2 Heart detection function

- a. Distance measurement: $0.4\text{m} \leq x \leq 2.5\text{m}$ (detection distance between chest cavity and radar antenna surface)
- b. precision: $\geq 95\%$

3.2.3 Existence of detection

- a. Detection distance: 2.5m (detection distance between human and radar antenna surface)
- b. precision: $\geq 90\%$

3.2.4 Move detection

- a. Movement trigger
- b. Motion direction and position perception

4. Radar operation and installation method

4.1 Installation

This radar module recommends tilt installation and a distance of 1.5 m parallel to the scanning surface.

4.2 Slant installation

For the demand of sleep breathing and heartbeat detection, the radar should be installed tilted (as shown in Figure 5). The radar should be installed 1m directly above the bed and tilted 45 between the bed. The distance between the radar and the chest cavity is

within 1.5m to ensure that the radar can normally detect breathing, heartbeat and sleep-related parameters. The radar normal direction is aligned with the main detection position to ensure that the main beam of the radar antenna covers the human sleep detection area land within certain boundaries.

The radar normal direction is aligned with the main detection position to ensure that the main beam of the radar antenna covers the human sleep detection area land within certain boundaries.

Limited by the beam range of the radar antenna, the effective action distance of the radar normal direction will be reduced. Millimeter wave frequency band electromagnetic wave has certain penetration properties for non-metallic substances, which can penetrate common glass and wood Plate, screens and thin partition walls can detect moving objects behind the shelter; but for thicker load-bearing walls, Metal doors, etc., do not penetrate.

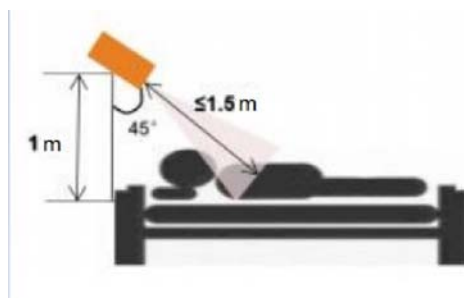


Figure5installation ahead of the bed

4.3 Operating mode of the radar

After the radar module passes the statistical analysis and processing, the personnel status of the current detection area is comprehensively evaluated, and the user can directly use the result.

4.4 Real-time operation mode

In this mode, the radar module periodically gives the existence and movement states of personnel in the current radar detection area. The main states include:

1) Detect there is anyone in the room;

2) Measure people' s Heart rate and respiratory rate;

In this mode, for the accuracy of the environmental state judgment, the state output logic of the radar module is as follows:

A. Only when the radar equipment detects the status change, it has the corresponding status output of the radar; otherwise, the radar remains silent;

B. The radar switch from unmanned to manned (motion, approach, away) is a fast switching state, and the switching time is 1s;

C. If the radar switches from manned to unmanned, it needs to be confirmed many times and the switching time is 1 minute;

D. Radar collects the breathing / heart rate frequency and breathing / heart rate signal state during the dynamic and static human body in real time. The breathing heart rate frequency refresh frequency is 3s, and the signal state changes and output;

4.5 Sleep detection mode

In this mode, the module periodically gives the sleep status and breathing rate of the personnel in the current radar detection area, and the main states include

1) Sleep quality assessment: awake, deep sleep, light sleep;

2) Bed-in / off-the-bed judgment;

3) Statistics of respiratory / heart rate frequency

4) In sleep detection mode, the radar module has a specific

safety for the accuracy of sleep-related state judgment Installation mode and installation height limit;

The radar should be installed at 1m height directly above the head

of the bed, and tilted downward to 45 pairs in the middle of the bed, to ensure that the distance between the radar and the human body is within 1.5m, and to ensure that the radar detection range can normally cover the sleep area.

5. Typical application mode

This module is mainly used in scenarios such as health management or home enabling. The following explains the application mode of typical scenarios.

5.1. Bedroom installation and application

For specific applications, real-time relevant information about bedridden personnel, such as human / unmanned, sleep state, sleep depth, exercise information, etc., and then give relevant information to achieve specific applications. In this mode, the radar needs to be top-mounted. Based on this mode of application, the application can be implemented including.

- a. Elderly care
- b. Health care
- c. Smart home
- d. Family health

5.2. Healthy life application

Based on the detection characteristics of the sleep state and breathing rate of the sleepers, the radar can be better used in a healthy life, including:

- a. Intelligent health single product linkage application
- b. Household electrical appliances

6. Attentions

6.1 Start time

Because the module needs to completely reset the internal circuit of the module, and the environmental noise is fully evaluated, to ensure the normal operation of the module. Therefore, when the module is initially powered up, the startup stabilization time needs 30s to ensure the effectiveness of the subsequent output parameters.

6.2 Respiratory and heartbeat detection scene limitations

Radar is a non-contact device, and the respiratory and heartbeat detection of the target needs to lock the position of the target first. Then, the respiratory and heartbeat intensity and value of the target were collected and calculated. Therefore, the detection target is required to maintain a resting state for detection within a reasonable detection range, so as to avoid the continuous motion affecting the locking of the radar to the target, thus affecting the detection of breathing and heartbeat.

6.3 Effective detection distance

The detection distance of the radar module is closely related to the target RCS and environmental factors, and the effective detection distance may change with the change of the environment and

the target. This module does not have the ranging function temporarily, so it is normal for the effective detection range to fluctuate in a certain range.

6.4 Radar biological detection performance

Because human biometric features are ultra-low frequency and weak reflection characteristic signals, radar processing needs a relatively long time of accumulation processing. In the accumulation process, many factors may affect radar parameters, so the accidental detection failure is a normal phenomenon.

6.5 Power

The radar module has higher power quality requirements than conventional low-frequency circuits. When powering the module, electricity is required. The source has no threshold burr or ripple phenomenon, and effectively shields the power supply noise caused by the accessory equipment. Radar module needs good grounding, and the ground noise caused by other circuits may also cause the radar module performance decline or even abnormal operation; the most common is that the detection distance is approaching or the false alarm rate increases. To ensure the normal operation of the VCO circuit inside the module, the power supply requirement for this module is $+5V \sim +5.5V$ Electric, voltage ripple of 100mV. External power supplies must provide sufficient current output capacity and transient responsiveness.

7. Disclaimer

My company thinks that we should try to describe the documentation accurately during publication. Considering the technical complexity of the product and the difference of the working environment, it is still difficult to exclude some inaccurate or incomplete descriptions, so this document is only for user reference. Our company reserves the right to make changes to

the product without notifying the users, and we will make no promises and guarantees in any legal sense. Encourage customers to comment on recent updates to the product and support tools.

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The components and devices mentioned in this document are references to the information published by the copyright holder company, and the right to modify and publish it belongs to the copyright holder company. Please confirm the update and errata information through appropriate channels during the application. We do not have any rights and obligations to these documents.

9. Contact information

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10. FCC Caution:

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.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

IMPORTANT NOTE:

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.