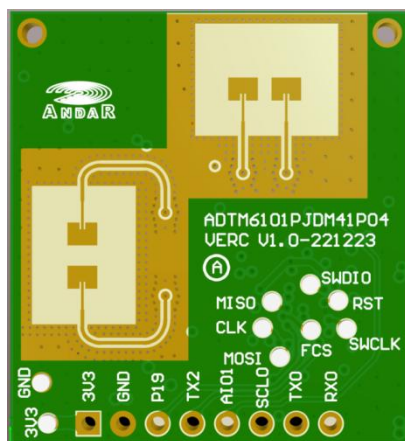




Shenzhen Hi-Link Electronic Co., Ltd

Radar module HLK-LD6002 User Manual



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1. Product profile

HLK-LD6002 is a radar sensor module developed based on ADT6101P chip, single chip integrated 57~64GHz radio frequency transceiver system, 2T2R PCB microstrip antenna, 1MB flash, radar signal processing unit, ARM® Cortex® -M3 kernel. This module is based on the FMCW radar mechanism, to detect the surface reflection radar echo of the human body, combined with the radar signal processing algorithm, to realize the single real-time respiratory heart rate frequency measurement.

2. Product characteristics

- Radar detection based on FMCW signal
- No contact perception of human Breathing and heart rate
- The maximum detection distance of human Breathing heart rate is 1.5m
- Universal UART interface, to provide the communication protocol
- Reserve multiple groups of IO ports and multiple communication interfaces to support customer secondary development, suitable for multiple scenarios
- Small size, only 25*31.5mm, support needle row connection
- Not affected by temperature, humidity, noise, airflow, dust, light and other environment

3. application scenarios

- ✧ **Smart home applications**
According to the respiratory heart rate measurement, to achieve home empowerment
- ✧ **Health control**
Respiratory heart rate data is monitored in real time
- ✧ **Wisdom health**
The elderly breathing heart rate monitoring, abnormal immediately report to the police

4. Electrical characteristics and parameters

4.1 Functional parameters

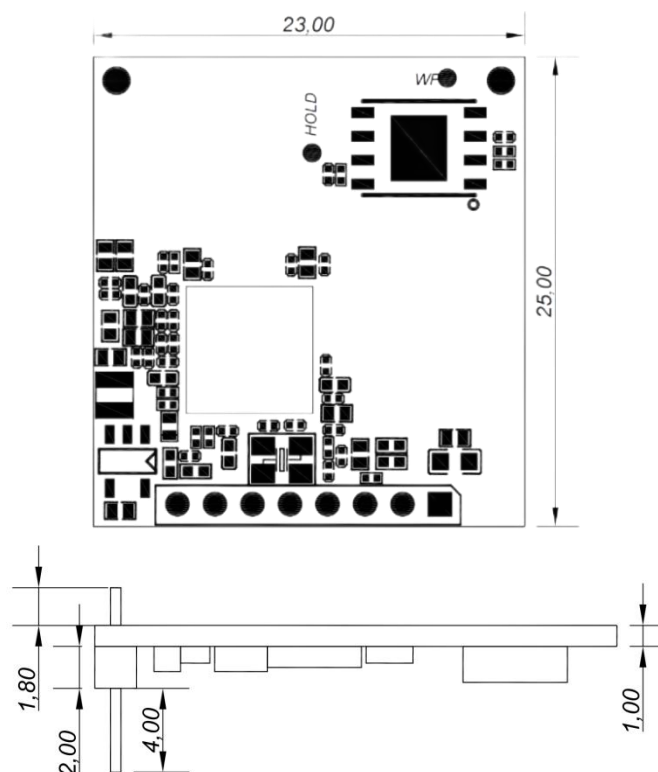
Parameter	Min	Type	Max	Unit
Breathing and heartbeat detection distance (chest cavity)	0.4		1.5	m
Respiratory measurement accuracy		90		%
Range of the number of respiratory measurements	9		48	bpm
Carbeat measurement accuracy		90		%
Range of the number of heartbeat measurements	60		150	bpm
Refresh time		50		ms
Establish detection time		1		Min
Maximum number of tests		1		

4.2 Electrical characteristics

Operational parameter	Min	Type	Max	unit
Operating voltage (VCC)	3.1	3.3	3.5	V
Operating current (ICC)			600	mA
Operating temperature (TOP)	-20		85	°C
Storage temperature (TST)	-40		85	°C

4.3 RF characteristics

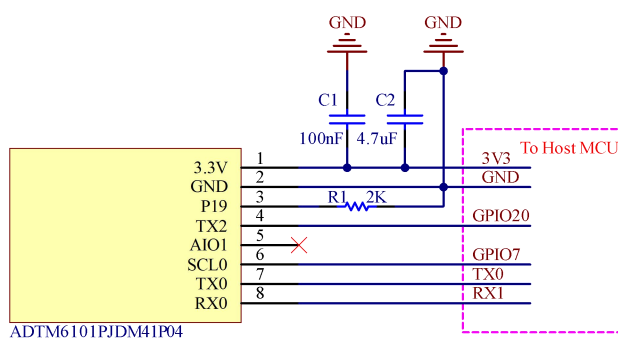
Operational parameter	Min	Type	Max	unit
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5.2 Pin definition

Pin order number	Pin name	Description	Remarks
1	3V3	POWER INPUT 3.3V	
2	GND	GND	
3	P19	GPIO19	Boot1
4	TX2	GPIO20	
5	AIO1	Analog IO	
6	SCL0	GPIO07	
7	TX0	Connected to external serial port T X	
8	RX0	Connected to external serial port RX	

5.3 Module peripheral reference design



5.4 Boot configuration

	BOOT1	BOOT0	Remarks
Configuration level	0	1	Flash starts within the module
Pipe foot position number	Pin8	Pin12	

* BOOT 1, BOOT 0 module internal are pulled up. The BOOT 1 must be connected to a low level before the module starts

6. Guidance for use

6.1 Typical application circuit

HLK-LD6002 The module can directly use UART0 to output the detection results according to the specified protocol, and the serial port data includes the total phase, respiratory phase, heartbeat phase results, rate of breathing, and heartbeat rate results. Users can use it flexibly according to the specific application scenarios.

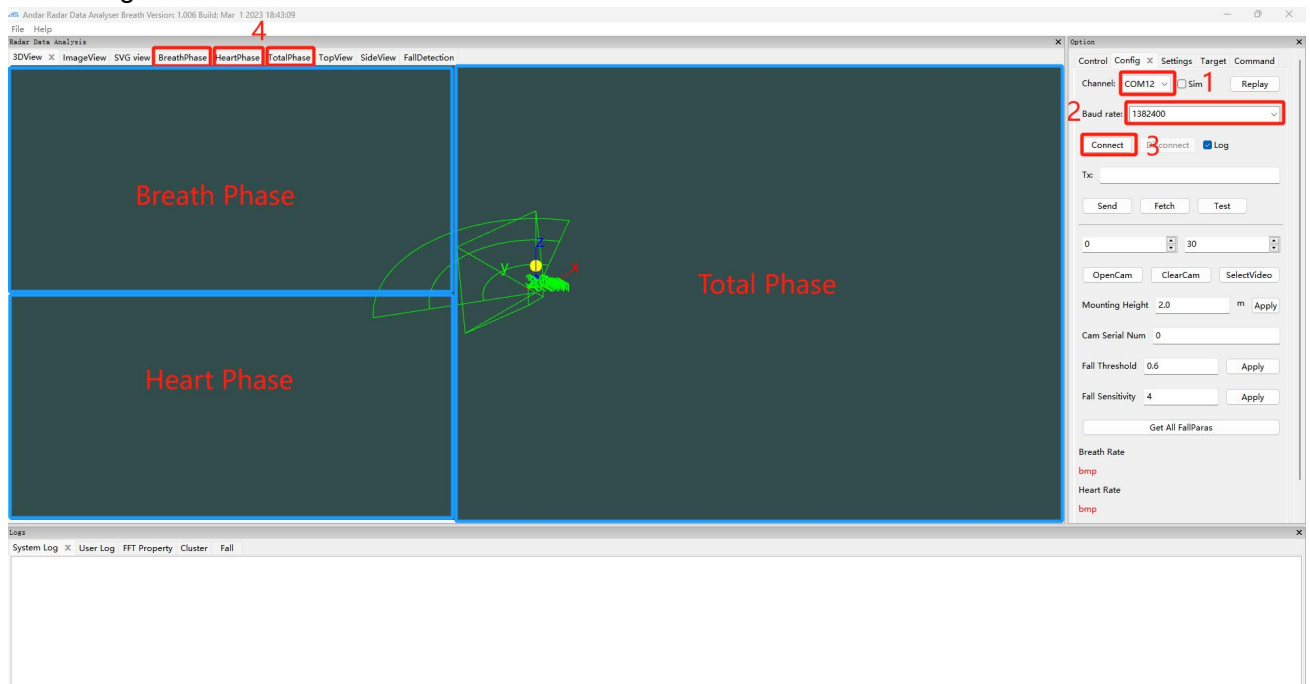
The module power supply is 3.3V, and the input power supply capacity is greater than 1A.

The output voltage of the module IO port is 3.3V. The default port rate of the serial port is 1382400 with no parity.

6.2 GUI visualization tool application

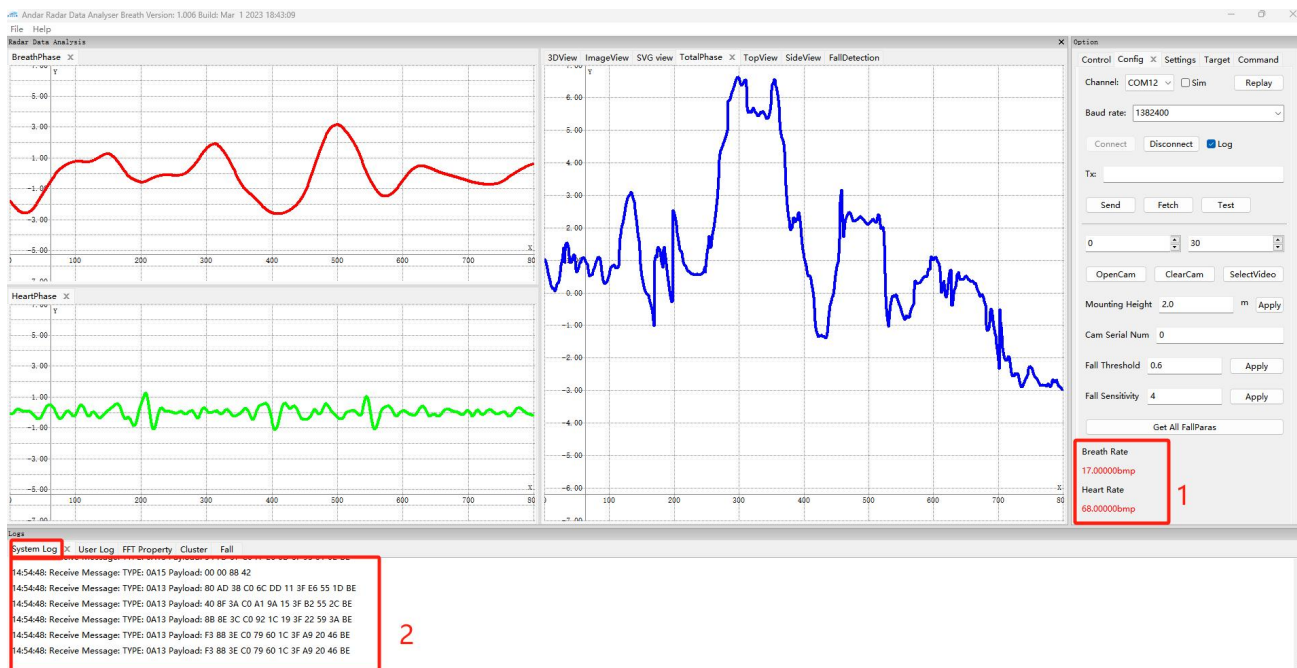
1. Device Connection

- 1) Select the connected serial port in the Config interface in the Option column on the upper right
- 2) Set the Baud rate to 1382400
- 3) Click the [Connect] button to start the measurement
- 4) To view data, Breath Phase, Heart Phase, Total Phase Windows can be dragged and pulled in the following format



2. Data view

- 1) Breathing, heartbeat rate information is shown in the lower right corner.
- 2) The lower left corner [System Log] window shows the message information, including the total phase data, heartbeat phase, respiratory phase, breathing rate, and heartbeat rate information.



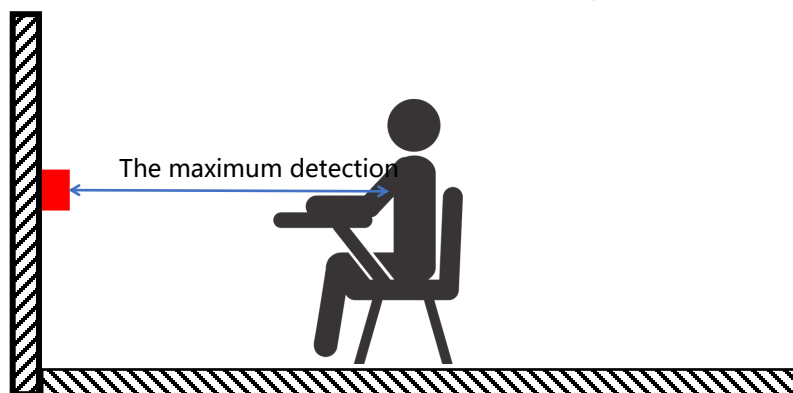
6.3 OTA upgrade

Refer to the 《OTA Upgrade Tool Manual_V1.0》 documentation

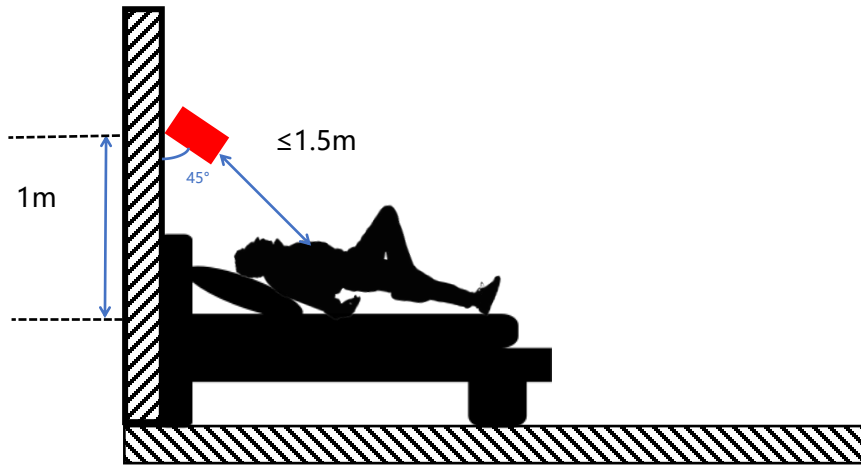
6.4 Installation mode and induction range

1. Side-mounted, it is recommended that the radar installation height is the same as the chest height of the subject, and the module position is 1.5m

Side-mounted schematic diagram



2. Lean installation, for sleep breathing heart rate detection demand, can use tilt installation, radar requirements installed above the head of a bed is 1m height, tilt down 45° in the middle of the implantation, control the distance of radar and chest within 1.5m, radar normal direction at the main detection position, to ensure that the radar can detect breathing heartbeat data.



Schematic diagram of the tilt installation

7. Precautions

1. The detection distance of the radar module is greatly related with the target RCS and environmental factors, and the effective detection distance may change with the change of the environment and the target. Therefore, it is a normal phenomenon for the effective detection range to fluctuate in a certain range.

2. The radar module has high requirements for power supply, requiring input voltage 3.2~3.4V, power ripple 50 mV and current 1A. If DCDC power is used, the switching frequency shall not be no less than 2 MHz.

3. Because the respiratory heart rate is a weak reflected signal, it takes a period of time to accumulate data in the radar signal processing. There are many factors affecting the radar processing results in the cumulative process, so the accidental detection failure is a normal phenomenon.

4. Currently the respiratory heart rate measurement is only a single person, please make sure there is only one person in the detection area.

5. Requito measurement in the resting state, detection of large movements will stop the measurement.

8. Radome design

The radome is used to protect the radar antenna from rain, external environment, and wind. However, it has the following effects on the radar antenna: the dielectric loss and reflection loss caused by the antenna cover will reduce the effective power of the antenna beam; the receiver will change; the electromagnetic wave reflects the electromagnetic wave, which affects the measurement of the Angle. Therefore, it is very necessary to design the radome to reduce the impact of the shell and improve the radar performance.

Design requirement:

1. When selecting the material of radome, under the premise of ensuring firmness and low cost, the material with smaller dielectric constant and loss angle should be selected to reduce the influence of radome on radar performance.

Dielectric constant and dissipation factor of common materials are shown below:

material	dielectric constant (ϵ_r)	Disgution factor ($\tan \delta$)
Merlon	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
pottery and porcelain	9.8	0.0005
PE	2.3	0.0003
PBT	2.9-4.0	0.002

- 2. The radome is required to have a smooth surface and a uniform thickness
- 3. Radome antenna thickness design requirements

$$T = N \cdot \frac{c}{2f \sqrt{\epsilon_r}}, \quad N=1, 2, 3...$$

T: Radome thickness

3×10^8 And c: light speed, m/s;

f: center frequency

ϵ_r : Material permittivity, DK

- 4. Design requirements of radar antenna from the inner surface of the enclosure

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

3×10^8 And c: light speed, m/s;

f: center frequency

f=60GHz

c/2f=2.5mm

Revision History

Revision	Release Date	Description
V1.0	2023/10/10	Initial version

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