

# **3D Presence Radar Module HLK-LD6002B**

## **User Manual**

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## 1. Product profile

HLK-LD6002B is a radar induction module developed by Hi-Link based on the ADT6101P chip, which integrates a 57-64GHz RF transceiver system on a single chip Integrated, 2T2R PCB microstrip antenna, 1MB flash, radar signal processing unit, ARM® Cortex®- M3 kernel. This module is based on the FMCW signal processing mechanism, combined with radar signal processing algorithms, achieves high sensitivity human body state sensing and can recognize motion, micro motion, and stillness stop the human body and calculate auxiliary information such as target distance and speed.

This module is based on a two transmitter and two receiver antenna form, with a wide beam angle, suitable for ceiling installation. Supports GPIO and UART signal output can be flexibly applied to different intelligent scenarios and products.

## 2. Product characteristics

- Radar detection based on FMCW signal
- The detection angle was large with support level  $\pm 60^\circ$  and pitch  $\pm 60^\circ$  detection
- It can realize the movement and static detection of indoor personnel, accurate identification within the interval, support the induction interval division, and shield the interference inside and outside the interval
- Universal UART interface, to provide the communication protocol
- Support UART parameter adjustment to meet the requirements of different scenarios
- Small size, only 25 \* 23mm, support row connection
- Not affected by temperature, humidity, noise, airflow, dust, light and other environmental factors

## 3. Application scenarios

- ✧ Intelligent home appliance application

According to the detection of whether there is personnel in the room, adjust the working mode of home appliances (work, standby, shutdown) in real time to realize intelligent home appliances

- ✧ Human body induction lamp application

Whether there is a human body in the current space, automatically control the lighting switch, such as public scene lighting, office lighting, all kinds of induction lights

- ✧ Smart home scenario application

For home, hotel, office, toilet and other places, it is necessary to conduct real-time detection of whether there is personnel entering or personnel in the place, and then realize security, electrical control, personnel monitoring and other ways, can be combined with the relevant Internet of things support platform, to achieve the effective application of the relevant places.

## 4. Electrical characteristics and parameters

### 4.1 Functional parameters

Parameter content	Min	Typical	Max	unit
Movement personnel detection radius		3		m
Detection radius for stationary/micro		3		m

moving personnel				
Identification accuracy		95		%

### 4.2 Electrical characteristics

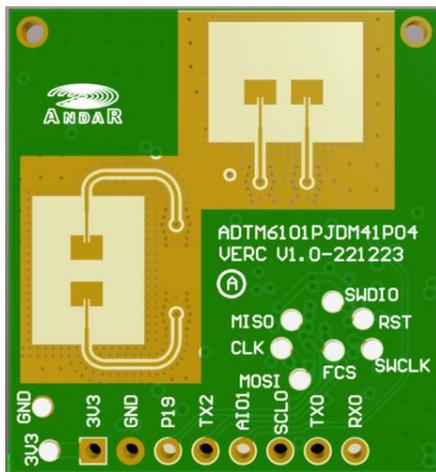
operational parameter	Min	Typical	Max	unit
Operating voltage (VCC)	3.1	3.3	3.5	V
Operating current (ICC)			600	mA
Operating temperature (TOP)	-20		85	°C
Storage temperature (TST)	-40		85	°C

### 4.3 RF characteristics

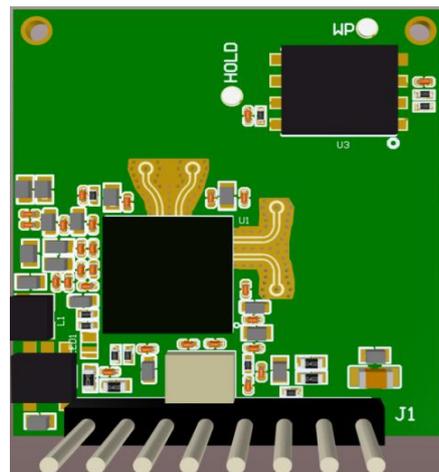
operational parameter	Min	Typical	Max	unit
Operational frequency	58		64	GHz
Emission Power (Pout)		12		dBm
Antenna gain		4		dBi
Horizontal beam (-3dB)	-60		60	°
Vertical beam (-3dB)	-60		60	°

## 5. Hardware description

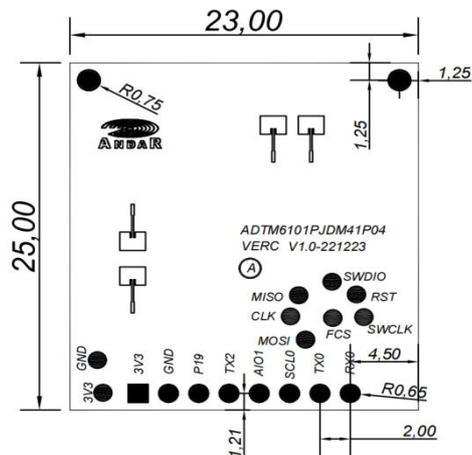
### 5.1 Overall dimensions

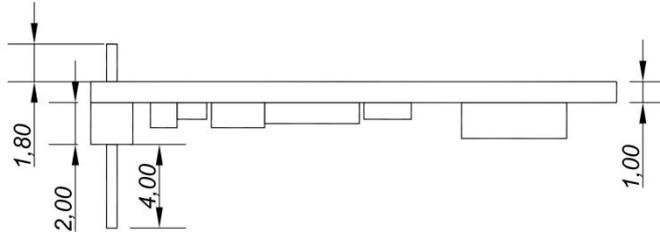


TOP View



Bottom View

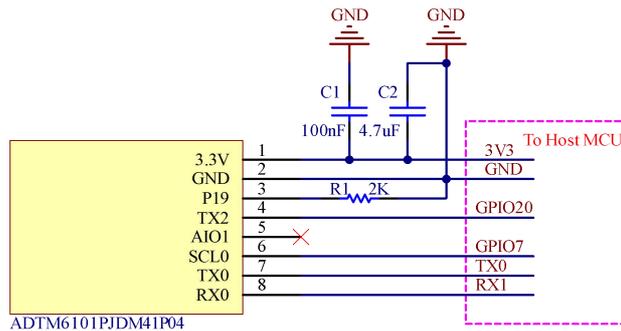




## 5.2 Pin definition

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 TX	
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	Pin3		

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

# 6. Usage and Configuration

## 6.1 Typical application circuit

HLK-LD6002B can directly use the TX 2 pin output detected target information (human high level, unmanned low level). Meanwhile, the UART 0 outputs the detection results according to the specified protocol. The serial port data contains the target position and speed auxiliary information, which users can use 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 115200 with no parity.

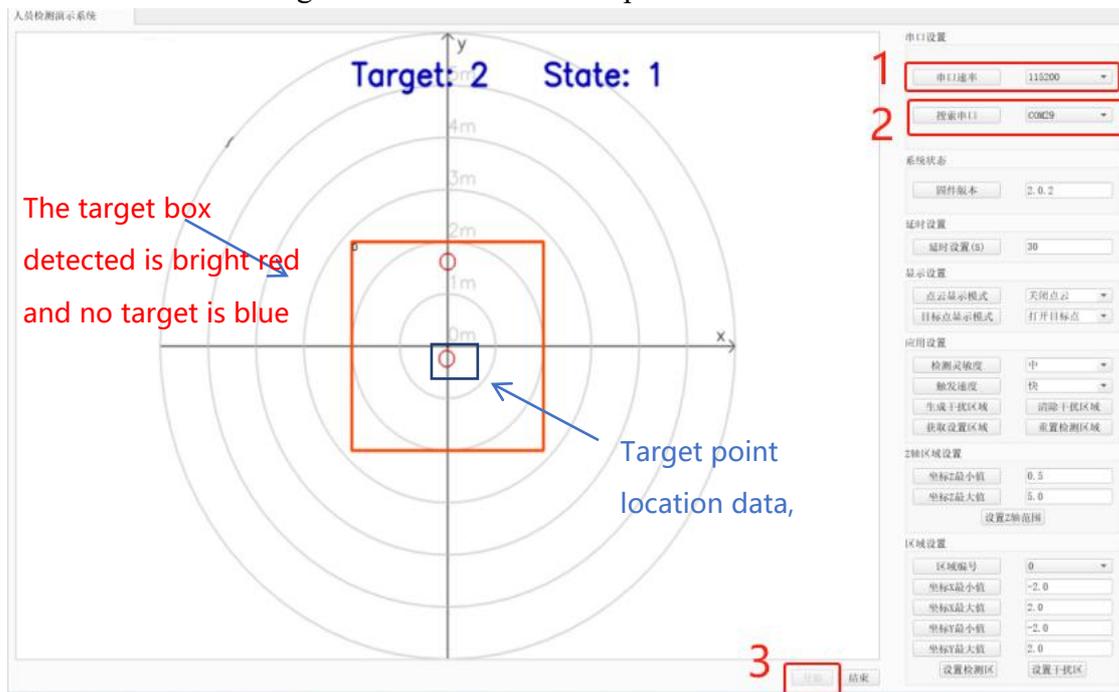
## 6.2 GUI visualization tool application

### 1. device connection

- 1) Set the Baud rate to 1,15,200
- 2) Select the connected serial port
- 3) Click the [Start] button, and the module will start the detection

## 2. Set the detection area

- 1) Set the coordinates of the detection area (with the point at which the module is vertically projected to the floor as the origin), and select different area numbers to set different detection areas. Up to 4 detection areas can be set up.
- 2) Click the [setting detection area] button. After setting the detection area, the module outside the detection area can still be detected, but the TX 2 will output a high level only when triggered within the detection range. Data is not lost when power is lost.



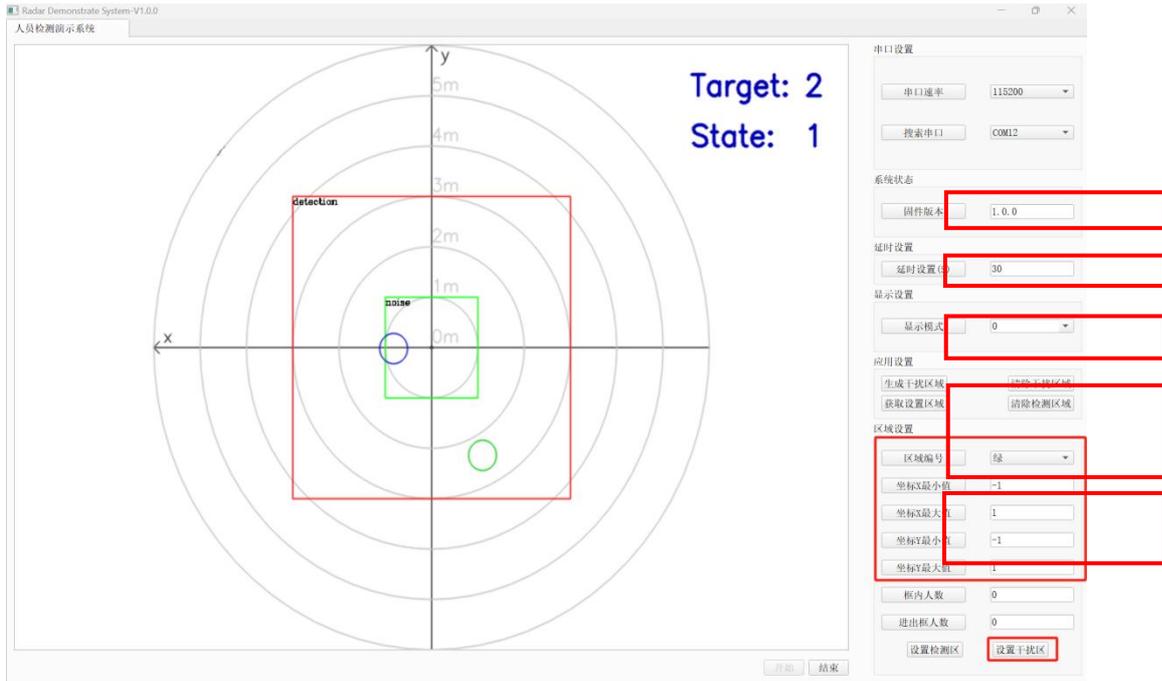
## 3. Set the interference area

- 1) Set the coordinates of the interference area (according to the actual use scenario, to screen some areas that may cause interference to radar sensors such as air conditioning, fan, curtains, etc.) the target in this area does not trigger the sensor, that is, Module TX2 Pin does not output high level. Up to 4 interference areas can be set up
- 2) Click [Setting interference area] button to save the power.



#### 4. Other features

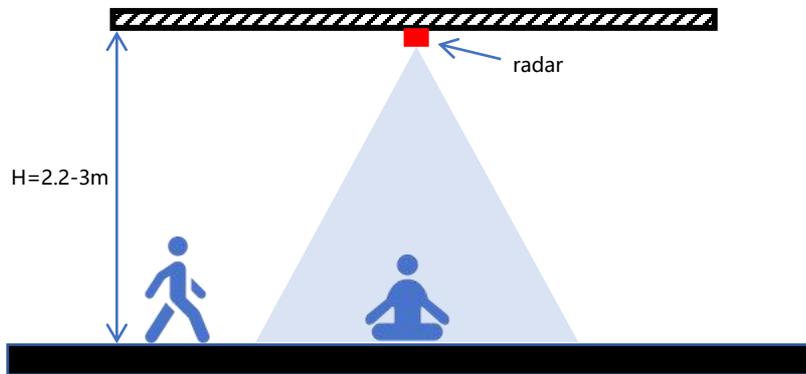
- 1) [Software version]: Connect the GUI to automatically identify the software version number
- 2) [Setting delay time]: Existing status maintenance time when human presence is detected
- 3) [Cloud display mode ]: Original point cloud data display is on or off
- 4) [Target display mode]: Target point data display is on or off
- 5) [Detection sensitivity]: There is a trigger sensitivity gear setting
- 6) [Trigger speed]: No one to someone state switch speed setting
- 7) [Generating interference area]: After the installation, under the condition of unmanned detection environment, open the interference source in the room, click the interference target [Generating interference area], and shield the interference target point at a fixed point
- 8) [Cleaning interference area]: Clear the above manually set interference area or the automatically generated interference area
- 9) [Get settings region]: The set detection area and interference area are dropped and still saved. You can click this button to obtain the previously set area of the module
- 10) [Reset detection area]: Restore the default 4 \* 4m detection area
- 11) [Setting Z-axis region]: Set the Z-axis detection range, the radar is the origin, that is, the minimum value of coordinate Z is 0



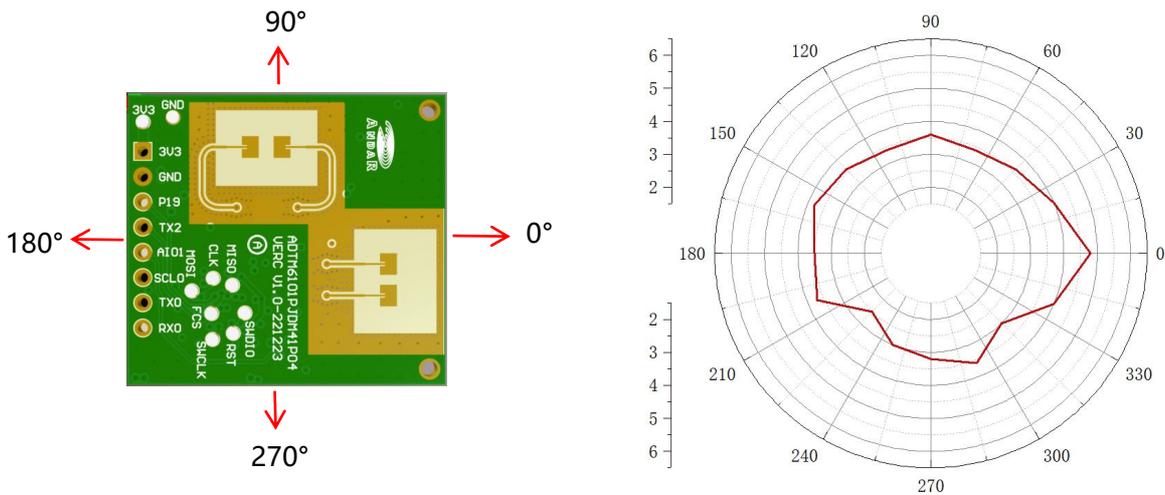
### 6.3 OTA upgrade

Refer to the 《OTA Upgrade Tool Manual\_V1.0》 documentation

### 6.4 Installation mode and induction range



Schematic diagram of top installation



A Schematic representation of the probe range

## 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 3.1~3.5V, power ripple 50 mV and current 1A. If DCDC power is used, the switching frequency shall not be no less than 2 MHz.

## 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; cause the distortion of the antenna beam, 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 ( $\epsilon_r$ )	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
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2. The radome is required to have a smooth surface and a uniform thickness
3. Radome antenna thickness design requirements

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

T: Radome thickness

$3 \times 10^8$  And c: light speed, m/s;

f: center frequency

$\varepsilon_r$  : Material permittivity, DK

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

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

$3 \times 10^8$  And c: light speed, m/s;

f: center frequency

f=60GHz

c/2f=2.5mm

## Revision History

<b>Revision</b>	<b>Release Date</b>	<b>Description</b>
V1.0	2023/09/26	Initial version
V1.1	2023/11/01	Modify the GUI usage instructions



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