

# 60G Millimeter wave Bio-sensing radar

R60APS1—People counting radar

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Datasheet (Ver. 1.0)

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### 1. Overview

The R60APS1 radar module adopts 60G millimeter wave radar technology

to realize the detection function of multiple target state perception and real-time angle/distance information at the same time. Realize the function of counting the number of people and outputting the position of people at periodic time intervals within the detection range of a specific place.

This module is based on the form of one-shot and three-receiver antennas: the wide-beam radar module controls a certain angle range through algorithms, accurately scans the direction and distance changes of multiple targets; outputs specific coordinate data according to the target, and realizes the function of counting the number of people.

**This radar module has the following working characteristics:**

- ✧ Radar detection based on FMCW frequency-modulated continuous wave signal;
- ✧ Realize the number of personnel statistics and personnel location detection functions;
- ✧ The maximum detection distance of personnel movement tracking:  $\leq 10$  meters (horizontal installation);
- ✧ The maximum detection distance of personnel static position locking:  $\leq 6$  meters (horizontal installation);
- ✧ The maximum number of people statistics:  $\leq 7$  people;
- ✧ Minimum angle of people counting and multi-target discrimination:  $\geq 20^\circ$  ;
- ✧ Minimum distance for people counting and multi-target discrimination:  $\geq 0.5$  meters;
- ✧ The maximum angle of horizontal detection of people counting radar:  $\leq 100^\circ$  ;
- ✧ 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 the radar module is less than 0.5 watts and requires long-term power supply work;
- ✧ This module is not affected by temperature, light, dust and other factors, has high sensitivity, and has a wide range of applications.

### Model Description

- ✧ R60APS1 – (Horizontal Mount) People Counting Radar Sensor, 100° /100° Fan Beam

## Applications

### Home appliance linkage application:

- ✧ Intelligent fresh air system (fresh air adjustment according to the number of people)

### Security management application:

- ✧ Hotel Check-in Management Application

## Product packaging

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

## Serial output parameters

- ✧ Statistics on the number of people
- ✧ Personnel location data output

## Output protocol

- ✧ Standard Serial Protocol

## 2. Electrical Characteristics and Parameters

### 2.1. Detection angle and distance

Parameter content	minimum	Typical value	maximum value	unit	Installation method
R60APS1					
Radar installation height	1.0	1.4	1.5	Meter	Horizontal installation
Athlete's position perception distance	-	-	10	Meter	Horizontal installation
Stationary Person	-	-	6	Meter	Horizontal

Position Perception Distance					installation
Statistics	-	5	7	people	Horizontal installation
Radar detection angle (horizontal)	-	100	-	Spend	
Radar detection angle (pitch)	-	100	-	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)	90	93	100	mA
Operating temperature (TOP)	-20	-	+60	° C
Storage Temperature (TST)	-40	-	+105	° C

## 2.3. RF performance

launch parameters				
Operating frequency (fTX)	61	-	61.5	GHz
Transmit power (Pout)	-	-	6	dBm

## 3. Module size and pin description

### 3.1. Module size package

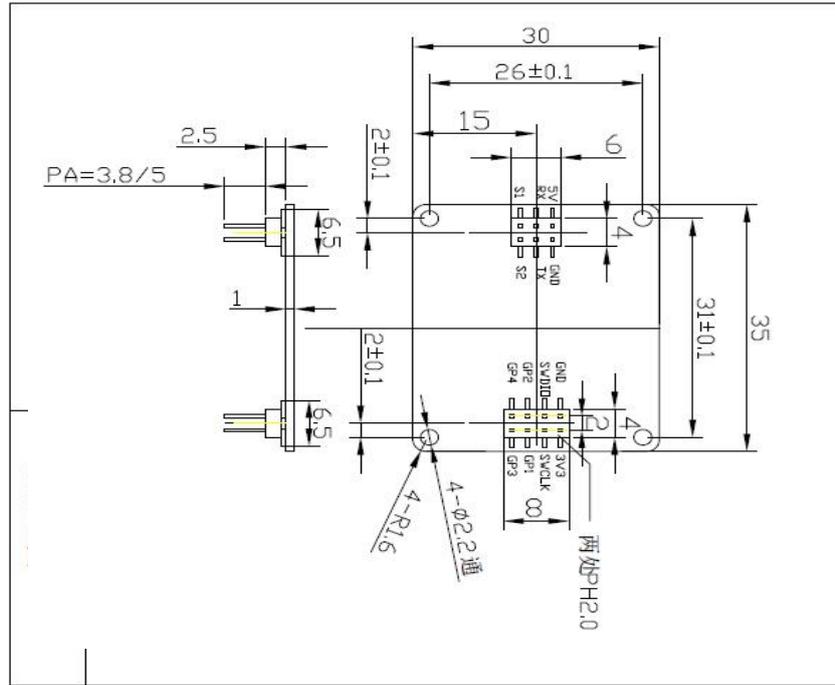


Figure 1 Schematic diagram of the structure of the radar module

### 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	GP1	3.3V/0V	
	6	GP2	3.3V/0V	
interface 2	1	3V3	3.3V	input power
	2	GND		land
	3	SL		reserve
	4	SD		reserve
	5	GP3		Spare expansion pins
	6	GP4		Spare expansion pins
	7	GP5		Spare expansion pins
	8	GP6		Spare expansion pins

### 3.3. Use wiring diagrams

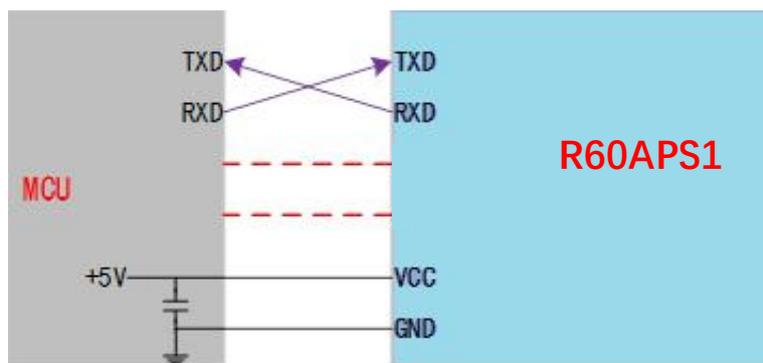


Figure 2 Schematic diagram of the connection between the radar module and the peripherals

## 4. Main work performance

### 4.1. Radar module working range

The radar module beam coverage is shown in Figure 3. The radar coverage is a three-dimensional sector area of  $100^\circ$  horizontally and  $100^\circ$  vertically.

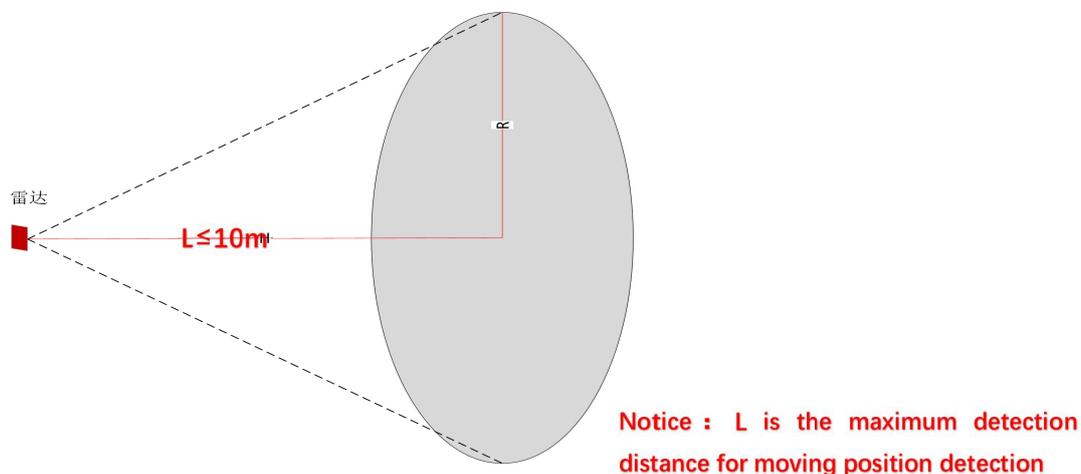


Figure 3 Schematic diagram of radar wave speed coverage

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 horizontally, due to the influence of the radar beam range and the effective radiation space, the radar's range of action will be reduced, which needs to be paid attention to when using it.

## 4.2. Main functions and performance

### 4.2.1. The main function

- 1) Personnel location detection;
- 2) People counting function;

### 4.2.2. Main performance parameters

- 1) Maximum motion position detection distance:  $\leq 10$  meters; (horizontal installation)
- 2) Maximum static position detection distance:  $\leq 6$  meters; (horizontal installation)
- 3) Ranging accuracy:  $\leq 0.3$  meters;
- 4) Angle measurement accuracy:  $\leq 5^\circ$  ; (target  $\geq 2$  meters)
- 5) Motion detection refresh rate:  $\geq 10$ Hz;
- 6) Maximum statistic number:  $\leq 7$  people;
- 7) Minimum angle for people counting and multi-target discrimination:  $\geq 20^\circ$  ; (horizontal installation)
- 8) Minimum distance for people counting and multi-target discrimination:  $\geq 0.5$  meters; (horizontal installation)

## 5. Radar work and installation

### 5.1. Installation method

The recommended installation method of this radar module is horizontal installation.

Figure 4 ,the horizontal installation method is used. This installation method is mainly aimed at detecting the target position in the walking or static sitting state, such as living room, home appliance

application and other occasions.

The radar installation height is recommended to be 1m to 1.5m, the radar is installed horizontally and forward, and the installation inclination is  $\leq \pm 5^\circ$ .

There are no obvious obstructions and coverings directly 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 of moving target position detection is  $L1 \leq 10$  meters; the maximum distance of stationary target position detection is  $L2 \leq 6$  meters; and the minimum distinguishing angle of multi-target simultaneous detection is  $20^\circ$  and the minimum distinguishing distance is 0.5m.

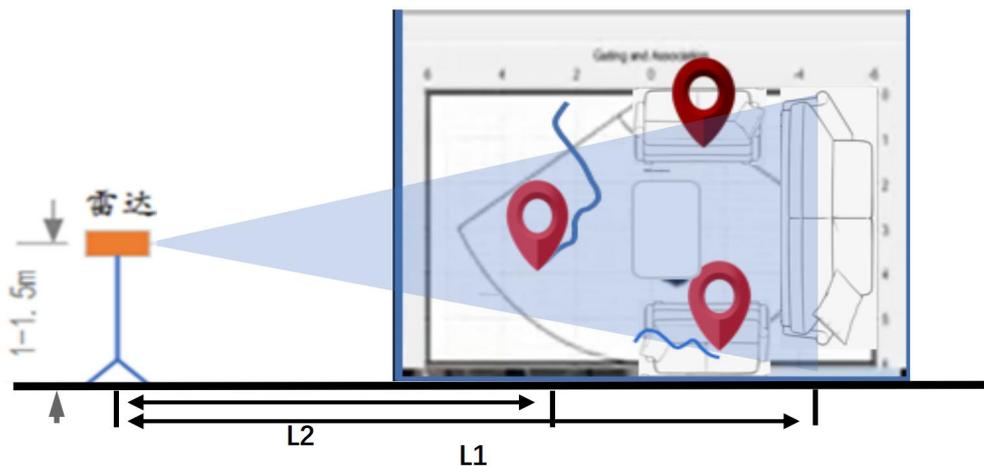


Figure 4 shows the horizontal installation

## 5.2. How the radar works

After the radar module passes through statistical analysis and processing, it comprehensively evaluates the real-time position status of personnel in the current detection area and the statistical data of the number of people, and users can directly use the results.

### 5.2.1. People counting mode

In this mode, the radar module periodically gives the number of people in the current radar detection area and the position information of each target person. The main states include:

- 1) Periodic statistics of people;
- 2) Periodic angle change information;
- 3) Periodic distance change information;

## 6. Typical Application Mode

This module is mainly used in scenarios such as home appliance empowerment and security management. The following describes the application modes of typical scenarios.

### 6.1. Home appliance enabling installation application

For specific applications, it periodically outputs personnel location information and population statistics, and implements specific applications through relevant information. In this mode, the radar needs to be installed horizontally. Based on this mode application, the applications that can be implemented include

- ◆ Intelligent fresh air system

### 6.2. Security management application

For a specific application, the statistics information of the people is periodically output, and the specific application is realized through the relevant information. In this mode, the radar needs to be installed horizontally. Based on this mode application, the applications that can be implemented include

- ◆ Hotel Check-in Management Application
- ◆ Homestay apartment application

## 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  $\geq 30$ s 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. Disclaimer

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## 11. Historical version update instructions

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