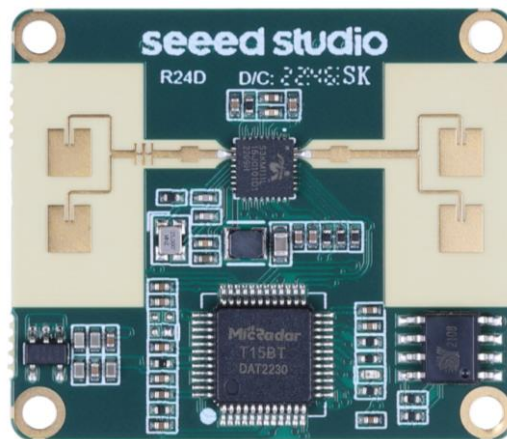


24GHz mmWave Sensor - Human Static Presence Module Lite Datasheet

Product Overview



Statement

This document is the datasheet for the 24GHz mmWave Sensor - Human Static Presence Module Lite and covers its hardware design and specification.

Description

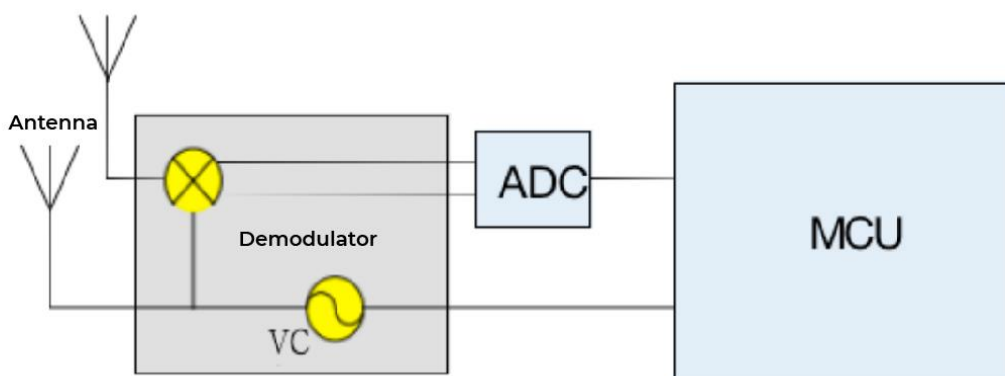
24GHz mmWave Sensor - Human Static Presence Module Lite is an antenna-integrated, health-friendly mmwave radar sensor that applies FMCW ranging technology, with operation in 24GHz, for implementation of human presence, independently of environmental influences. This is also a personalized radar that users can configure underlying parameters of it to determine detected functions.

Feature

- 24GHz millimeter wave radar sensor - detect human presence and absence, the motion and the direction of motion, object speed and detected distance
- Highly configurable - adjust detection range, sensing sensitivity, trigger threshold, valid time for states changing, and installation environment.
- Two output modes - standard function and underlying open function

- Human motion perception maximum range: 5 meters
- Human static perception maximum range: 4 meters
- Antenna beam width: 90° horizontal / 60° vertical sector beam
- With scene recognition ability, identify human presence/absence and human activity state, output body motion amplitude
- High immunity against interferences: Output data independently of environmental influences like temperature, humidity, noise, airflow, dust, light
- Long power supply, the radar module power is less than 0.5 watts

Operating Principle



The radar transmits 24G band millimeter wave signal to the detected object and the object reflects back the electromagnetic wave signal to the radar. Inside the radar, the transmitted signal is firstly decomposed, then amplified, going through filtering, ADC, and other signal processing, to be converted into echo demodulation signal data and finally be transmitted to the MCU unit. In the MCU unit, the amplitude, frequency and phase of these echo signal are calculated to measure target parameters (respiration, movement, fretting, etc.) or evaluate the scenes.

Application

- Automatically outdoor lighting
- Automaed door opening
- Whole house monitor
- Intelligent home appliances (TV, bath bully, security, etc.)
- Office energy (air conditioning, lighting)
- Sleep monitoring curve
- Home security
- IPC trigger

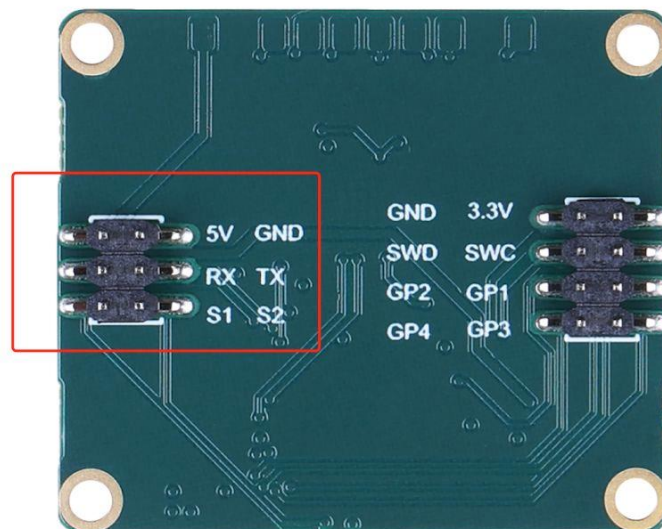
Debugging Tools

- Upper Computer Software
- Arduino

Hardware Overview

Interfaces Diagram

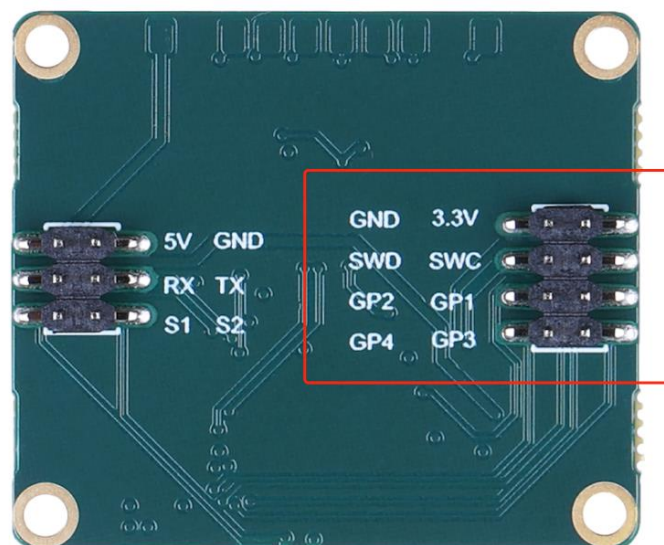
Interface 1	1	5V	5.0V	Input
	2	GND		Ground
	3	RX	3.3v	Receive
	4	TX	3.3v	Transmit
	5	GP2	3.3V/0V	Presence/Absence
	6	GP1	3.3V/0V	Active/Stationary



Note

GP2 output: high level - human presence, low level - human absence

Interface 2	Pin	Description	Typical	Detail
	1	3V3	3.3V	Input
	2	GND		Ground
	3	SL		
	4	SD		
	5	GP3	IO	Spare expansion pin
	6	GP4	IO	Spare expansion pin
	7	GP5	IO	Spare expansion pin
	8	GP6	IO	Spare expansion pin

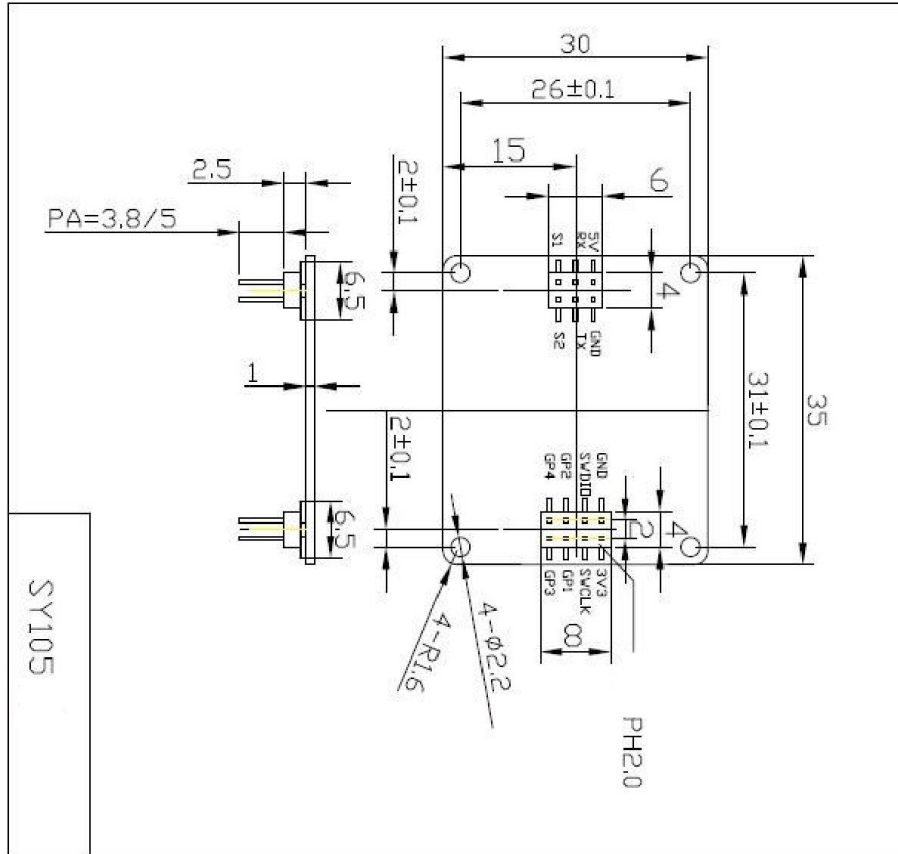


Note

GP3 to GP6 are the parameter selection control terminals, which can be redefined based on user requirements.

The output signals of this interface are 3.3V.

Dimensions Schematic Diagram



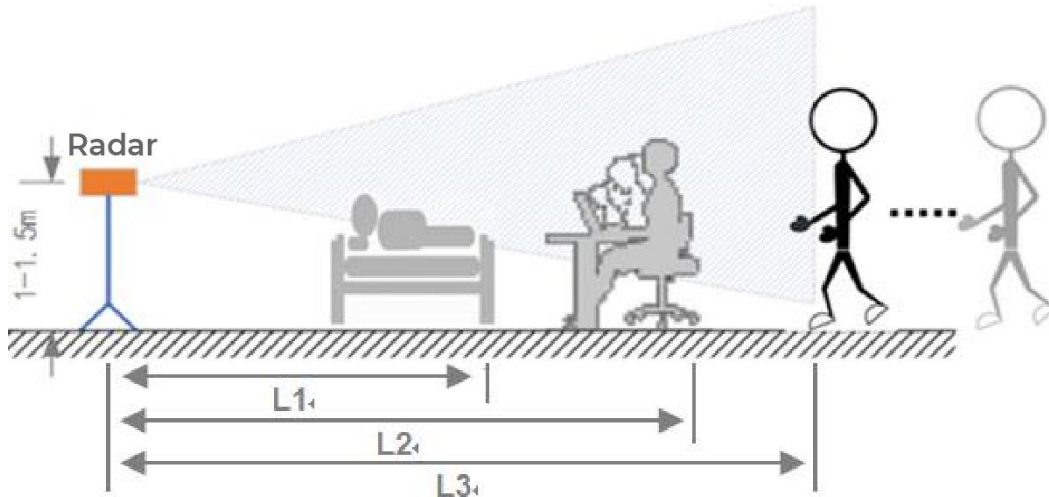
Installation Method

The recommended installation methods are showing below:

- Horizontal Installation
- Diagonal Installation
- Top Mounting

Horizontal Installation

The figure below shows the horizontal installation mode. This installation method is mainly used for human body detection in standing or sitting state, such as in the living room, household appliance application and other occasions.



- The recommended installation height is 1 m ~1.5 m
- The radar should be installed horizontally and forward, where installation angle should be $\leq \pm 5^\circ$.
- In this installation method:
 - The detection range of moving human body(L3) is ≤ 5 m
 - The detection range of human sitting/fretting(L2) is ≤ 4 m
 - The presence detection range of human sleep(L1) is ≤ 3 m
- There should be no obvious shielding or covering in front of the radar.

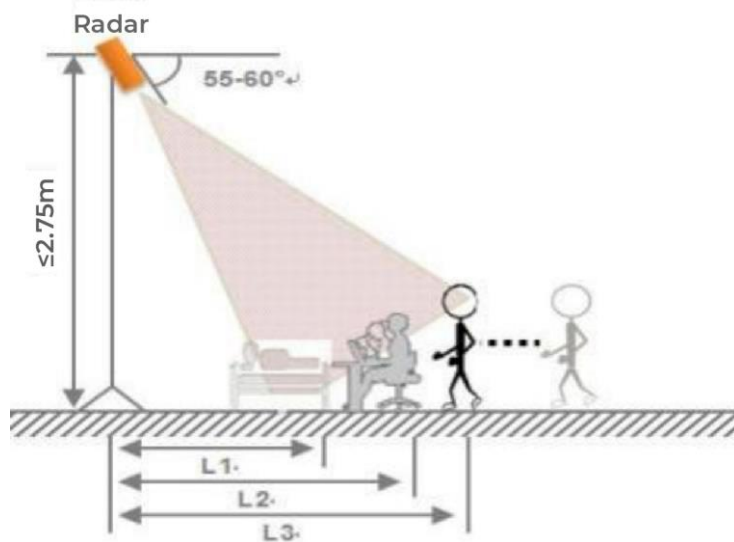
Note

- Due to the limitation of radar antenna beam range, the effective range will be reduced if the radar deviates from the normal direction.
- Millimeter wave frequency wave has certain penetration characteristics for non-metallic materials, that it can penetrate common glass, wood, screen and thin partition wall, also detect the moving object behind the block. But for thicker load-bearing walls such as metal doors it can not penetrate.

Diagonal Installation

The figure below shows the diagonal installation mode. This installation method is mainly

used to detect human movement in the room, mainly suitable for hotels, halls and other places.



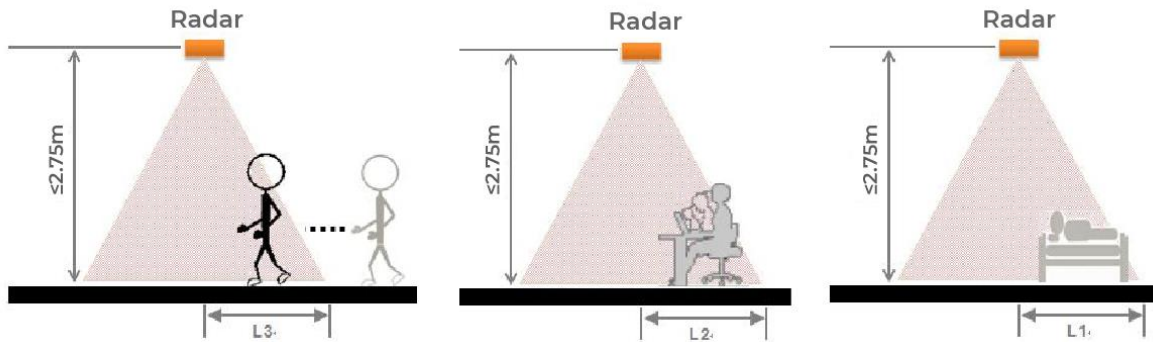
- The recommended installation height is 2 m ~ 2.75 m
- The down tilt angle range should be 10°~30°
- In this installation method:
 - The detection range of moving human body(L3) is ≤ 4.5 m
 - The detection range of human sitting/fretting(L2) is ≤ 2.5 m
 - The presence detection range of human sleep(L1) is ≤ 1.8 m
- There should be no obvious shielding or covering in front of the radar.

Note

- Due to the limitation of radar antenna beam range, the effective range will be reduced if the radar deviates from the normal direction.
- Millimeter wave frequency wave has certain penetration characteristics for non-metallic materials, that it can penetrate common glass, wood, screen and thin partition wall, also detect the moving object behind the block. But for thicker load-bearing walls such as metal doors it can not penetrate.

Top Mounting

The figure below shows the top mounting mode. This installation method is mainly used for the human body monitoring under the lying state, such as bedroom, nursing home, hospital bed, etc.



- The recommended installation height is ≤ 2.75 m
- The horizontal deviation angle should be $\leq 3^\circ$
- In this installation method:
 - The detection range of moving human body(L3) is ≤ 4.3 m
 - The detection range of human sitting/fretting(L2) is ≤ 4 m
 - The presence detection range of human sleep(L1) is ≤ 1.8 m
- There should be no obvious shielding or covering in front of the radar.

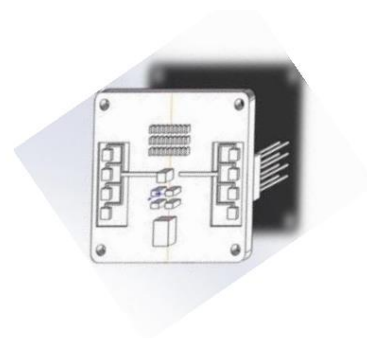
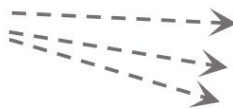
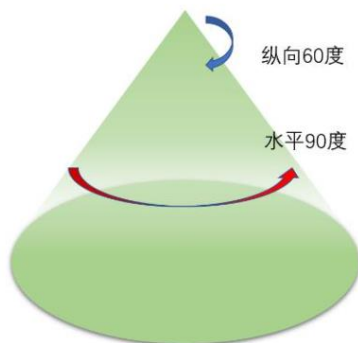
Note

- Due to the limitation of radar antenna beam range, the effective range will be reduced if the radar deviates from the normal direction.
- Millimeter wave frequency wave has certain penetration characteristics for non-metallic materials, that it can penetrate common glass, wood, screen and thin partition wall, also detect the moving object behind the block. But for thicker load-bearing walls such as metal doors it can not penetrate.

Installation Instructions

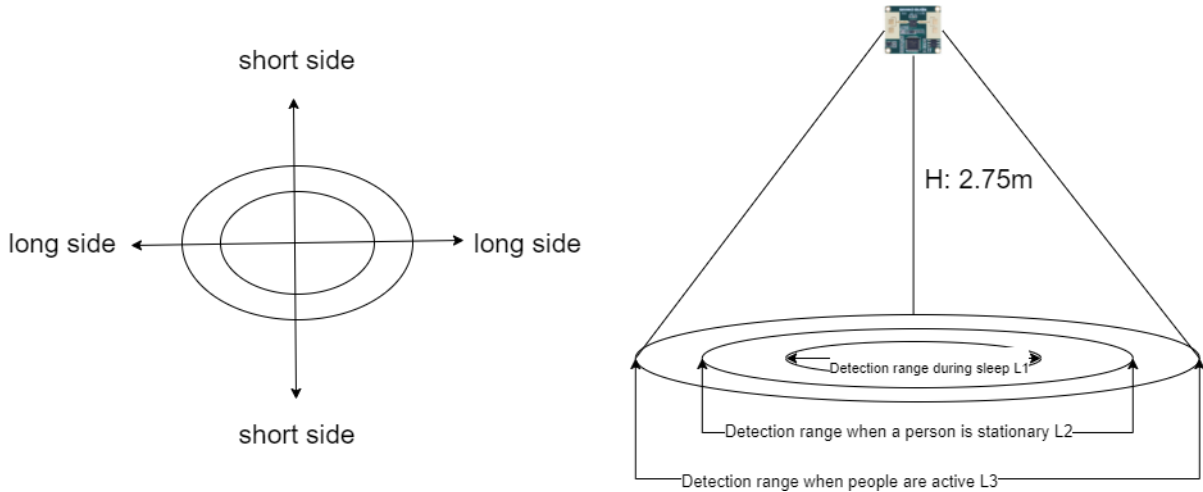
Radar installation method recommendation and detection range

The radar coverage is a three-dimensional sector of 90° horizontally and 60° tilted.



Note: To ensure radar detection accuracy, please install it on top!

The range of the overhead radar is about 6m*9m when detecting human activity, 4m*5m when detecting human motionlessness, and 3m*2m when scanning sleep. The range is 4m*5m, and the range when scanning sleep is about 3m*2m.



Scene setting (sensing range setting)

	Detection distance for trigger conditions (Diameter)	Stationary detection distance (diameter)	Sensitivity
Maximum area mode	Wide angle 9m / narrow angle 6m	Wide angle 6m / narrow angle 5m	3
Area detection mode (default)	Wide angle 7m / narrow angle 5m	Wide angle 5m / narrow angle 4m	2
Small-area detection	Wide angle 5.5m / narrow angle 4m	Wide angle 2.5m / narrow angle 2m	1

Radar installation step-by-step guide

1. Initialize a scene pattern by comparing the approximate area of the space.
2. Confirm the main area of human activity, the middle of the location is the radar installation location.
3. Determine the entrance and exit of the space, the long side of the radar to the entrance and exit, to ensure that people enter the trigger effect.

4. Confirm the presence of interference sources within the radar detection range.
5. Reducing the dynamic detection range in case of interference sources within the radar detection range (adjusting the scene mode to a smaller size).

In the "doorway entry trigger motion detection" and "radar detection of anti-interference stability" to make trade-offs, it is recommended to give priority to ensure the anti-interference and stability of radar detection.

6. Confirm the real use of radar scene is home scene or office scene, recommended initial sensitivity.

Small space will enhance the reflection of the radar, enhance the radar detection effect, reduce the sensitivity to neutralize the reflection interference, to ensure the stability of unmanned judgment. Ensure the stability of unmanned judgment.

Large space will reduce the reflection of radar, weakening the radar detection effect, and increase the sensitivity to neutralize the weakening interference. Ensure manned presence stability.

7. Follow the steps to confirm the final scene mode and sensitivity for normal use.

Example:



Hotel space size: 10 m² - 20 m²

Interference source: Air conditioner outdoor unit / blackout curtain / partition wall

Recommended installation sensitivity: 3 (according to the space to adjust the small)

Scene mode recommendation: area detection mode (need to assess the actual space size selected scene mode)

Installation orientation: long side to the door

Specification

Basic Information

Contents	Minimum	Typical	Maximum	Unit
Operating voltage (VCC)	4.5	5.0	6	V
Operating current (ICC)	95	110	120	mA
Operating I/O Input/output current(I/O)	-	8	20	mA
Operating temperature	-20	-	+85	°C
Storage temperature	-40	-	+85	°C
Buad rate	-	115200	-	
Power cost	-	≤ 5	-	watt
Dimension	-		-	mm
Weight	-		-	g

Detect Angle and Range

Contents	Minimum	Typical	Maximun	unit	Installation
Motion detection range	-	5	5	meter	slide mount
Stationary/micro movements detection	-	4	4	meter	slide mount

range					
Detection range in the case of sleep	-	3	3.5	meter	slide mount
Radar detection angle (horizontal)	-	90		degree	
Radar detection angle (pitch)	-	60		degree	

RF Performace

Contents	Minimum	Typical	Maximum	unit
Operating frequency	24.0	-	24.25	GHz
Transmitted power	-	6	8	dBm
Antenna gain		10		dBi
horizontal beam (3dB)		100		degree
vertical beam (3dB)		80		degree

FAQ

Are there the interfering factors around? What are the interfering factors?

Interference factors: Radar belongs to electromagnetic wave detection sensor, so active inanimate experience will lead to false positives. The movement of the metal, the liquid body, can cause misjudgments. For example, electric fans, pets close to the radar, and the shaking of metal curtains can cause misjudgments. Radar needs to be considered the installation carefully.

Non-interfering factor: Radar electromagnetic waves will penetrate human clothing, curtains, thin boards, glass. The installation Angle and performance of radar should be determined according to its application.

Semi-interfering factor: Radar determines the existence of human body, which is not suitable for directly facing air conditioner. The electric generator inside the air conditioner can cause the radar to misjudge. Requires radar products that do not directly face air conditioning, nor should in the same direction as the air conditioner.

Can this radar range?

The detection range of the radar module is closely related to the target RCS and environmental factors, and the effective detection range may change with the change of the environment and target. This module does not have the ranging function for the moment, so it is normal for the effective detection range to fluctuate in a certain range.

What should I pay attention to about the power supply?

The requirement of radar module on power quality is higher than that of conventional low frequency circuit. When supplying power to modules, it should ensure that the power source has no gate limit burr or ripple phenomenon, and effectively shield the power noise caused by the accessory devices.

The radar module needs to be well grounded. Due to the ground noise brought by other circuits, the performance of the radar module may be degraded or even work abnormally. The most common result is a closer detection range or an increased false alarm rate.

In order to ensure the normal operation of the VCO circuit inside the module, the power supply of the module is required to be +5V~+6V, 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.