E54-10LD06 Series User Manual

10.525 GHz low-power motion sensing radar module



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Chapter 1 Product Overview

The E54-10LD06 series is a motion-sensing radar module designed by Chengdu Ebyte Electronic Technology Co., Ltd. based on an X-band radar chip with a center frequency of 10.525 GHz . This module utilizes a fixed-frequency, directional transmit and receive antenna (integrated transceiver), integrating intermediate frequency demodulation, signal amplification, and digital processing. It also features delay setting, adjustable sensing range, and light intensity detection.

The E54-10LD06 series also offers advantages such as long range, anti-interference, compact size, excellent noise and harmonic suppression, high stability, and consistency. The module's pulse power supply duty cycle is adjustable, with different duty cycles resulting in different power consumption.

1.1 Features

- Following the Doppler radar principle, it has high-precision speed measurement capability and strong anti-interference ability ;
- Ultra-small size: 15 mm × 15 mm ;
- Capable of light-sensitive detection (users can choose as needed);
- Center frequency: 10.525 GHz;
- 3.3V power supply , supports 2.6V~12V wide voltage range ;
- Average operating current 60uA ;
- Ceiling installation, 3dB Beam width: 110°±10°;
- Sensing distance (hanging height 3m) : 3-4m (radius); radial: 12m, 1-3m (micro motion) .

1.2 Application Scenarios

The E54-10LD06 series is also suitable for concealed embedded installation and is unaffected by temperature/humidity, oil smoke, water mist, etc. It can be widely used in various types of lamps, such as fluorescent lamps, bulbs, downlights, ceiling lamps, etc., covering the following types:

- Smart Home

Sense the presence and distance of human body and report the detection results for the main control module to intelligently control the operation of home appliances.

- Smart Security

Induction access control, building intercom, electronic cat's eye, etc.

- Smart Lighting

Identify and sense the human body , accurately detect the location , and can be used for lighting equipment in public places (induction lamps, bulbs, etc.).

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- Smart Business

Identify when a person approaches or moves away within the set distance range; light up the screen promptly and keep the device on when a person is present.

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Chapter 2 Product Specifications

2.1 Specifications

Specifications	Unit	Model		Remark
		E54-10LD06A	E54-10LD06AL	
Operating voltage	V	2.6～12	2.6～12	DC power supply
Working current	uA	60	60	VCC=3.3V 1kHz 0.1% duty cycle
Microwave frequency	GHz	10.525	10.525	VCC=5 ～ 12V
Output voltage	V	3.3	3.3	-
Power-on stabilization time	S	5~7	5~7	-
Contact discharge	KV	2	2	ESD protection features
Air discharge	KV	2	2	
Operating temperature	℃	-40～+85	-40～+85	-
Storage temperature	℃	-40～+85	-40～+85	Industrial-grade design
Operating humidity	%RH	10～95	10～95	-
Storage humidity	%RH	10～95	10～95	-

2.2 Perception range

Specifications	Unit	Model		Remark
		E54-10LD06A	E54-10LD06AL	
Sensing distance	m	3～4 (radius)	3～4 (radius)	Hanging height 3m
		10-12	10-12	wall-mounted
Delay time	S	5	5	-
Blocking time	S	2	2	-
Photosensitivity detection	-	/	have	-

Note: • Delay time is the time to maintain the state after triggering, the default value is 5s;

• Blocking time refers to the time that the output state does not respond after being triggered again after being flipped. The default value is 2s;

• Power-on initialization: When the module is powered on, the O port outputs a high level for 1 second and then changes to a low level. After another 3 seconds, it enters the normal detection mode;

• Radar threshold default is 100;

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Chapter 3 Hardware Description

3.1 Dimensions

Figure 3-1 shows the mechanical dimensions of the E54-10LD06 series hardware . All units are in mm. The hardware board thickness is 1.2 mm , with a tolerance of ± 0.2 mm .

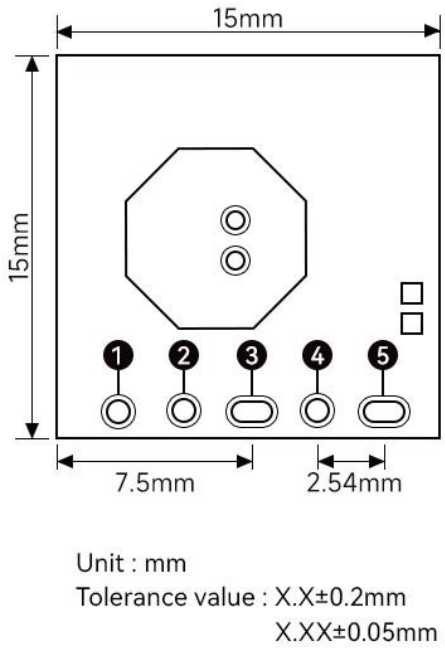


Figure 3-1 Mechanical dimensions

3.2 Pin Definition

Pin Number	Definition	Function	Remarks
1	RX	TTL serial RX input connected to external TXD output pin	The serial port uses default fixed values for configuration and reading module parameters: 9600bps, 8N1
2	TX	TTL serial TX output connected to external RXD input pin	
3	V	Power input: DC 2.6～12V	Electrical source
4	O	The high-level state indicates a trigger.	Level voltage: 3.3±0.2V
5	GND	Electrical grounding	Power supply ground

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Chapter 4 Software Description

This chapter introduces how to use configuration software of the E54-10LD06 series products .

The E54-10LD06 series has the system firmware burned in at the factory . Ebyte provides the corresponding configuration tool software to facilitate developers to configure the parameters of the E54-10LD06 series according to the usage scenario and optimize the sensing effect.

4.1 Preparation

The E54-10LD06 series product via the USB to TTL serial port adapter board . The pin connection method is shown in the figure below :

The corresponding relationship between the pins when connecting the sensor to the USB serial port adapter board	
Motion radar sensor module	**Serial port adapter board**
RX	TX
TX	RX
GND	GND
V	VCC (3.3V/5V)
O	AUX

Note: O port is a level output interface. By default, when the O port is at a low level, AUX is on. When there is motion detection , the output is high and AUX is off .

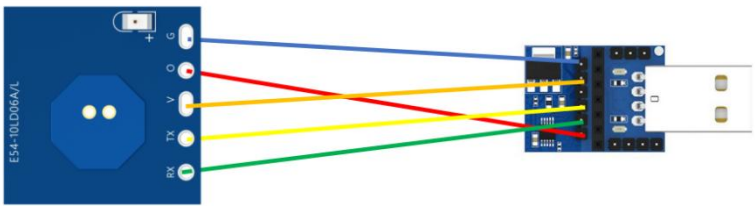


Figure 4-1 Connection between the E54-10LD06 series and the USB to serial port adapter board

Step 2: Open the device manager on the configuration software and check the serial port number of the motion sensing radar module .

Step 3. Open a third-party serial port tool , select the serial port number of the motion sensing radar module , set the serial port baud rate to 115200 , and then click the " Open Serial Port " (or equivalent) button to view the current millimeter wave sensor detection results on the output end of the tool interface .

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4.2 Configuration software description

4.2.1 Interactive Interface

The interactive interface (as shown below) provides users with basic operations, including serial port configuration, configuration status, and module configuration .



Figure 4-2 Interactive interface

The functions opened by the interactive interface are as follows:

1. Serial port configuration:

    1) Port number: Automatically detect the port number of the serial device currently connected to the computer. You can select the port number to be connected through the drop-down box;

    2) Baud rate: Select the baud rate of the corresponding module (9600bps) from the drop-down box according to the hardware module;

    3) Open the serial port: connect to the port selected in "Port Number";

2. Configuration status:

    The initial state is yellow. When setting the mode, reading parameters, or configuring parameters, if no response data is received from the module within 2 seconds after the button is pressed, the light turns red to indicate communication failure. Otherwise, the light turns green to indicate communication success, and the corresponding parameters in the module configuration begin to display.

3. Module configuration (currently only supports the configuration of the above common parameters) :

    1) Set mode: You can select a working mode according to the mode drop-down box ("Move");

    2) Read parameters: read the parameters in the selected working mode;

    3) Configuration parameters: configure the relevant parameters of the selected working mode;

    4) Motion sensing parameters:

        a. Radar Threshold: The radar threshold of the motion sensing module. The smaller the threshold, the longer the detection distance. The larger the threshold, the closer the detection distance. The specific threshold needs to be adjusted according to the actual usage scenario. The value range is [16, 65534]. The default value is 200, and the maximum diameter distance is 5m .

        b. Light threshold: The light threshold is set to respond during the day or at night. When the light

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threshold is lower than the light threshold , the radar detection is activated . The larger the threshold value, the brighter the ambient light. The value range is [1,254], and the default value is 254 (light sensitivity is always on) .

c. Output delay: The output delay of the module response . When motion is detected, the output of the O port is kept high for a certain period of time. If motion is continuously detected during this period, the hold time will be reset. The value range is [1,18000], unit: 100ms, and the default is 1s .

5) General parameters:

a. Module ID: The ID set internally in the module . However, reading the module ID is currently unavailable. The ID area on the configuration software is grayed out .

b. Version number: The version number of the firmware burned into the module.

4.2.2 Parameter View/Set

This section introduces the use of the configuration software tool that comes with the E54-10LD06 series motion sensing radar module to help users understand the meaning of related parameters and how to obtain them .

Note: The cconfiguration softwaretool and the third-party serial port tool cannot be used at the same time!

Before using the functions , users should first connect the E54-10LD06 series to the configuration software. The steps are as follows:

Step 1: Get the E54-10LD06 series supporting configuration software tool "E54_SettingV1.0 " from the Ebyte official website ;

Step 2: Use the serial port adapter board to connect the motion sensing radar module and the configuration software as shown in Figure 4-1 .

Step 3. Select the correct port number from the port number list in "Serial Port Configuration", select the correct baud rate from the baud rate list, and then click the "Open Serial Port" button. The "Open Serial Port" button will change to "Close Serial Port". Clicking it again will disconnect the serial port. After opening the serial port, you need to set the module operating mode before you can read and write parameters normally.

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Before connecting the device	After the device is connected
	

4.2.3 Parameter View/Set

The steps to start module configuration are as follows:

Step 1: After the module is connected to the computer, the serial port must be successfully opened first. This is a must .

Step 2: Set the working mode ("Mobile"). After setting the working mode, the corresponding parameter interface will become configurable. The current module can only select the "Mobile" mode.

Step 3. Click "Read Parameters" to read all the parameters of the module in the corresponding working mode and display them in the corresponding position.

Step 4. After reading the module parameters, you can modify the parameter values according to actual needs. Click "Configure Parameters" to write the parameters to the module;

Note: After the module is powered on, you need to wait for 4 seconds for the module to initialize before setting the working mode and reading and writing parameters(The MCU recommended for use with the user synchronously delays the waiting time).

4.2.4 HEX instruct

Serial number	Order format	Detailed explanation
1	Setting instructions	The baud rate is fixed at 9600. The following instructions can be sent through TTL port to configure the module, which is consistent with the upper computer. ●Protocol frame header：0x3C 0x3A ●Protocol frame tail：0x3A 0x3E The overall instruction configuration is: **Protocol Header + Instruction Length + Function Code + Parameters + Protocol Frame Tail**

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2	Read the configuration parameters	Read the configuration parameters： **3C 3A 07 FA 01 3A 3E** **Note：** ●Protocol frame header: 0x3C 3A ●Instruction length: 0x07 ●Read configuration function code: 0xFA ●Read configuration parameters: 0x01 ●Protocol frame tail: 0x3A 0x3E Return message parsing: **3C 3A 19 FA 01 10 00 03 E8 FA 00 0A 00 00 00 00 00 00 00 00 00 00 00 3A 3E** **Note：** ●Protocol frame header:0x3C 0x3A ●Instruction length: 0x19 ●Function code: 0xFA ●Read return: 0x01 ●Radar threshold: 0x03 0xE8 ●Light sensitivity threshold: 0xFA ●Output delay time: 0x0A ●Firmware version code: Bytes 13-21 ●Reserved bytes (fixed): 0x00 0x00(Bytes 22-23) ●Protocol frame tail: 0x3A 0x3E
3	Set up parameters	Set up parameters: **3C 3A 13 FD 01 00 03 E8 FA 00 0A 00 00 00 00 00 00 3A 3E** **Note：** ●Protocol frame header: 0x3C 0x3A ●Instruction length: 0x13 ●Function code: 0xFD ●Setting parameters: 0x01 0x00 ●Radar threshold: 0x03 0xE8 ●Light sensitivity threshold: 0xFA ●Output delay time: 0x0A ●Reserved bytes (fixed): 0x00 0x00 0x00 0x00 0x00 0x00(Bytes 12-17) ●Protocol frame tail: 0x3A 0x3E Return message parsing: ●The return parameter matches the configuration parameter instruction.
4	Format error	Format error response: FF FF FF

Note：

a.Radar threshold: Radar threshold of mobile sensing module. The smaller the threshold, the farther the detection distance; the larger the threshold, the closer the detection distance. The specific threshold should be adjusted according to the actual application scenario. The value range is [16,65534], the default value is 200, and the maximum diameter distance is 5m；

b.Photoelectric threshold: Photoelectric threshold, set to respond during day or night. The radar detection is activated below the photoelectric threshold value. The larger the threshold value, the brighter the ambient light. The value range is [1,254], and the default value is 254 (photoelectric normally on)；

c.Output delay: Output delay of module response. Detection of high level output time of moving O port. During this period, continuous detection of movement will reset the holding time. The value range is [1,18000], unit: 100ms, default 1s；

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Chapter 5 Installation and Detection Range

The E54-10LD06 series motion sensing radar module supports both ceiling-mounted and wall-mounted installation . Ceiling-mounted installation is recommended.

5.1 Ceiling installation

The recommended ceiling mounting height is 2.7-3.0m. The maximum motion sensing range of the ceiling-mounted E54-10LD06 series in the default configuration is a 5m radius from the bottom .

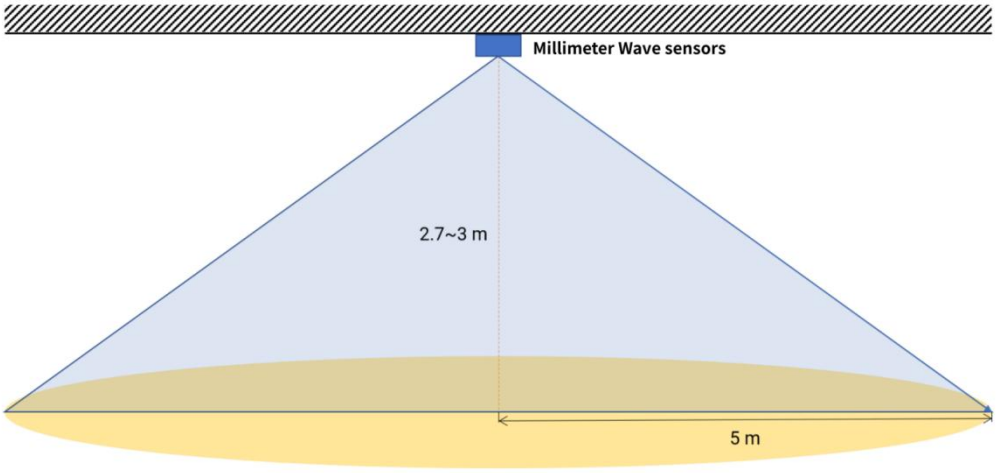
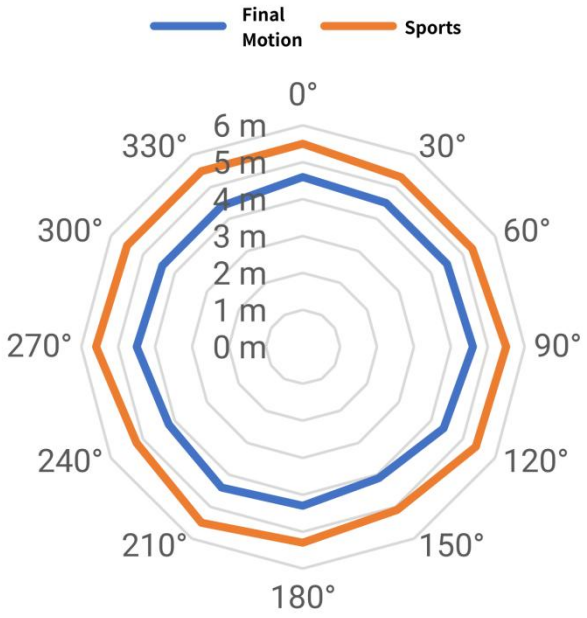


Figure 5-2 Schematic diagram of the detection range of the E54-10LD06 series ceiling-mounted installation

Figure 6-3 shows the motion and micro-motion detection range of this reference solution when the ceiling installation height is 2.7m .



5-3 E54-10LD06 series ceiling mount sensing range

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5.2 Wall mounting

The recommended wall-mounting height is 1.5-2 meters. When wall-mounted , the millimeter-wave sensor's X-axis (reference) points horizontally , the Z-axis points upward , and the Y-axis points toward the detection area. In the default configuration, the maximum motion sensing range of the E54-10LD06 series when wall-mounted is 10 meters normal to the sensor, within a conical space within ±60° of horizontal and pitch angles , as shown in Figure 5-4 .

The detection range diagram of this reference solution when the wall-mounted installation height is 1.5m is shown in Figure 5-5 .

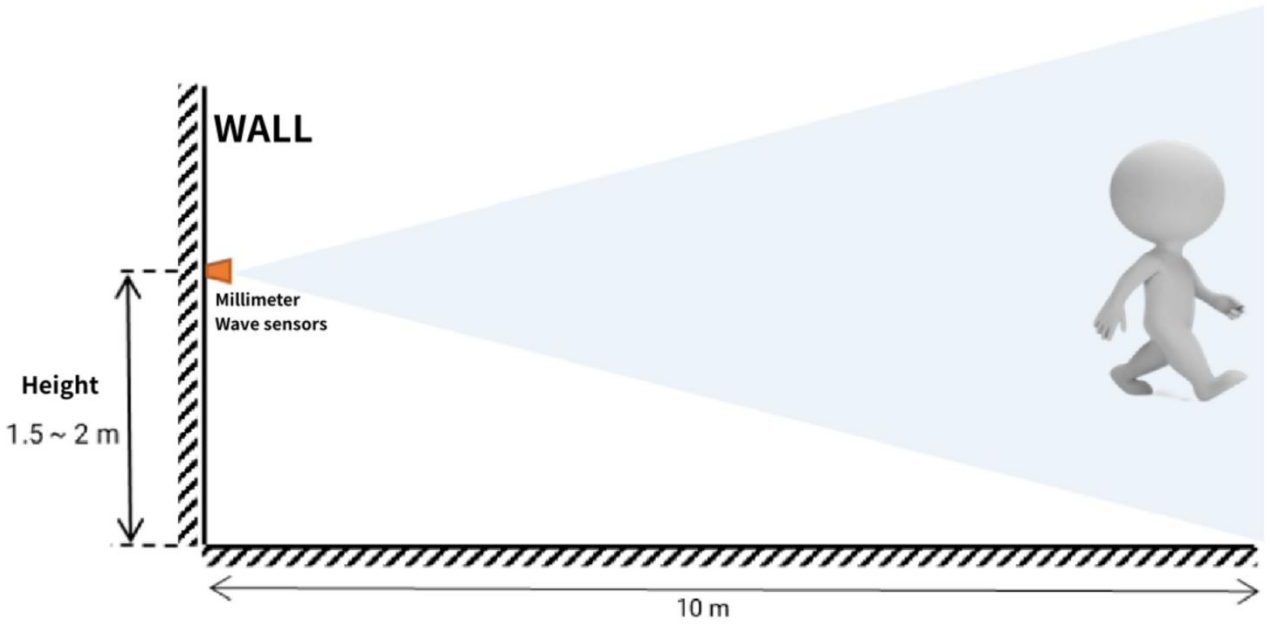


Figure 5-4 Schematic diagram of detection range for wall-mounted installation

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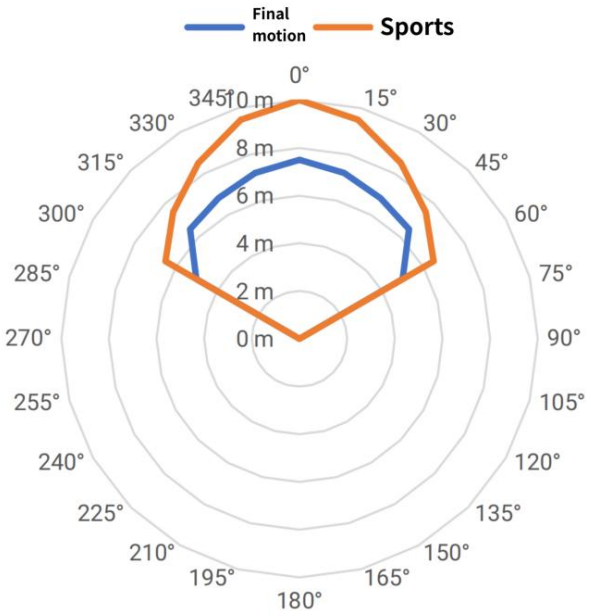


Figure 5 -5 Wall-mounted sensing range

Chapter 6 Installation Instructions

6.1 Considerations for designing the supporting driver power supply

- Be sure to use a driver power supply that meets the standards for output voltage, current, and ripple factor. An unstable driver power supply or strong electromagnetic radiation may cause false alarms, no perception, or self- restarting of the radar module .
- The matching drive power supply should be between 2.6V and 12V, with a peak-to-peak drive current of no less than 5mA. The power supply ripple amplitude should be controlled within 100mV, and the power frequency fluctuation amplitude should be small. If power consumption allows, it is recommended to configure the module in full power supply mode for better anti-interference.
- When assembling the driver power supply and radar module, avoid placing the bottom or antenna surface of the radar module directly opposite the driver power supply module. Also, avoid placing them as far away as possible from components with high power frequency interference, such as the rectifier bridge and switching transformer inside the driver power supply module, to prevent interference with microwave signals.

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6.2 Radar module testing and usage precautions

- When there are walls or obstacles around that reflect microwaves, the sensing distance and angle will be increased; when there is an open space around, the sensing distance and angle will be attenuated.
- Since even small changes to the microwave antenna can affect detection, please protect the antenna and avoid any metal objects (such as solder wire) on the surface to avoid affecting the sensing distance.
- Handle the radar module with care, avoid violent vibration, and keep it flat and free of deformation. Ensure that the optical sensor is not blocked or covered, especially around the photosensitive element D1 on the radar module. Avoid any opaque obstructions.
- The radar module maintains an independent use space, with a free space of more than 2mm around it;
- After power-on, there is approximately 3 seconds of initial noise analysis time, during which the sensor is not working normally.
- If the radar module's light-sensing device is obstructed (e.g., by a housing), retesting is required to determine the light-sensing threshold.
- During production line testing and burn-in operations, if a large number of radar modules are stacked together while powered on, self-excitation may occur. Please ensure that there is a safe distance of more than 50 cm between powered radar modules.

6.3 Precautions for installing and using devices with built-in radar modules

- Devices equipped with radar modules should be installed away from ventilation ducts, fire protection pipes, drainage pipes, mechanical vibrations, or areas with strong vibrations such as large metal equipment, as these may affect radar reflection waves and detection perception.
- It is strictly forbidden to work with electricity, so as to avoid mistakes, wrong connection, burning of circuits or electric shock;
- Avoid installing in places exposed to the sun and rain to prevent damage and shorten service life;
- The device must be installed away from electromagnetic fields to avoid malfunction caused by electromagnetic interference. It must also be installed away from objects that rotate or swing (such as electric fans, swaying leaves, clothes drying in the wind, etc.) to avoid malfunction.
- When multiple devices with built-in radar modules are fixedly installed, the distance between each device should be ≥0.5m;

- It is recommended that the antenna surface of the radar microwave module be 3-5 mm away from the product casing, otherwise the sensing distance will be affected;

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Figure 6 - 3 Distance between the antenna surface and the product housing

- After the device has a built-in radar module, it is recommended to place it horizontally or vertically. Within the effective sensing range, try to avoid installing two or more devices with built-in radar modules face to face.
- Avoid placing other light sources (such as emergency lights, guide lights, and other interfering light sources) near devices with built-in radar modules (such as lamps). This may cause the device's (lamp's) built-in light sensor to fail, causing the device (lamp) to malfunction (constantly off, misjudged as daytime).
- If a device with a built-in radar module (such as a lamp) remains on (constantly illuminated) and does not turn on or off based on moving target detection, the radar module may be experiencing intermediate frequency interference, causing it to continuously detect moving targets within its detection range. In this case, turn off the power supply and check the power supply board for proper operation and whether the module's spatial distance has changed.
- If the above problem still cannot be solved, please turn off the power and observe the surrounding conditions of the installation location to eliminate the influence of surrounding interference factors. If the problem persists after restarting the power, consider replacing the device's driver power board or radar module and verify again.

6.4 Power Supply Considerations

- The power input voltage range is 2.6 V to 12 V , and the power ripple has no obvious spectrum peak within 100 kHz . This solution is a reference design , and users need to consider the corresponding electromagnetic compatibility design such as ESD and lightning surge.

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Chapter 7 Related Models

Product Model	Chip Solutions	Package	Product size mm	Communication interface
E54-24LD12 A	-	plugins	20.0*20.0mm	UART/GPIO
E54-24LD12B	-	plugins	18.0*15.0mm	UART/GPIO
E54-24LD12C	-	plugins	19.0*16.0mm	UART/GPIO
E54-24LD12D	-	plugins	44.0*15.0mm	UART/GPIO
E54-05LD06A	-	plugins	18.0*18.0mm	UART/GPIO
E54-05LD06AL	-	plugins	18.0*18.0mm	UART/GPIO

Revision History

Version	Revision Date	Revision Notes	Maintainer
V1.0	2025-7-31	first edition	Hao
V1.1	2025-9-17	Add instruction notes	Hao
V1.2	2026-2-28	Optimize Pin Description and Instruction Description	Ning

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