



Shenzhen Hi-Link Electronic Co., Ltd.

Radar Sensor Module
HLK-LD1040C
Datasheet

Product Introduction

HLK-LD1040C is a motion sensing module designed based on X-band radar chip with a center frequency of 10.525GHz. The module is designed with fixed frequency, directional transmitting and receiving antennas (1T1R), integrated with intermediate frequency demodulation, signal amplification and digital processing, and has the ability to set delay, adjustable sensing range and light intensity detection. This product has the advantages of not penetrating walls, anti-interference, small size, good suppression of clutter and high-order harmonics, high stability and consistency. The module has a short initialization time and a quick test mode. It is easy to install in the lamp and the test operation is simple, which can effectively accelerate production testing. This module is mainly aimed at low-cost applications.

This product is suitable for embedded concealed installation, is not affected by temperature/humidity, oil smoke, water mist, etc., and can be widely used in various lamps, such as bulbs, down-lights, ceiling lamps, etc.;

Features

- ◆ Based on the principle of Doppler radar
- ◆ Ceiling installation, 3dB beam width: $110^{\circ}\pm 10^{\circ}$
- ◆ This product is positioned for motion sensing scene applications
- ◆ With quick detection mode
- ◆ Sensing distance: hanging height 3-4m (sensing radius), wall hanging 8-10 meters (radial)
- ◆ With the ability of light detection (optional)

Application

Smart lighting: home, office, lighting, pet supplies, etc.

Specification

TA=25°C

Table 1 Input parameters

No	Parameters	Testing condition	Min	Typ	Max	Unit
VCC	Working voltage	Dc power supply	5		12	V
I	Working current	VCC=5~12V	48	50	53	uA

Table 2 Output parameters

No	Parameter	Test condition	Min	Typ	Max	Unit
fOSC	Microwave frequency	VCC=5~12V		10.525		GHz
Vout	Output voltage		3.2	3.3	3.4	V
Tw	Power-on stabilization time			7	9	s

Table 3 Temperature and humidity range

No	Parameter	Testing condition	Min	Typ	Max	Unit
TA	Operating temperature		-20		+70	°C
TB	Storage temperature		-40		+85	°C
HA	Operating humidity		10		95	%
HB	Storage humidity		0		95	%

Table 4 Perception range

No	Parameter	Testing condition	Min	Typ	Max	Unit
	Distance	Height 3m	2	3	4	m
Td	Delay time			5		s
Ts	Block time			2		s

Table 5 ESD feature

No	Parameter	Testing condition	Min	Typ	Max	Unit
	Contact discharge			2		kV
	Air discharge			2		kV

- The delay time is the time to maintain the state after triggering, and the default value is 5s;
- The blocking time refers to the time without response after the output state is flipped and triggered again, and the default value is 2s;
- There are two kinds of startup initialization with different software configurations:
 1. No quick detection mode initialization state description: After the module is turned on, the O port output is high for 1s, and then it is low all the time, and the normal detection mode starts after 7s

2. Description of the initialization status of the quick detection mode: When the module is turned on, the O port outputs high (1s) and low (0.5s) levels for 3 times, and then enters the sensing mode after 5s. The first sensing is the quick detection mode test (the sensing delay is fixed at 3s), and then enters the normal detection mode.

Sensing range area



Figure 2 Perception diagram

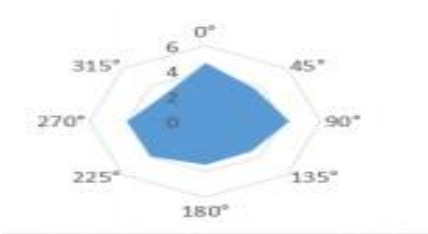


Figure 3 Sensing range diagram

- Test results may vary in different test environments or moving targets;
- Metal casings can shield radar electromagnetic waves, affecting the sensing distance;
- The above test results are obtained in a standard test site. For specific test environments and conditions, please consult relevant technicians.

Pin Configuration and Function Description

Table 6 Pin Configuration and Function Description

Part	Port	Description	Picture
P1	VCC	DC 5-12V; Customizable 3.3V	
	GND	Power Ground	
	TX	Serial port sending	
	RX	Rxd	
	OUT	TTL high and low level output	
P2	Program download port	Test point, burned for testing purposes, not for external use	

Considerations for Designing the Matching Drive Power Supply

- Be sure to use a drive power supply that meets the standards for output voltage, current and ripple coefficient. An unstable drive power supply and strong electromagnetic radiation will cause false alarms, no perception, and self-starting of the radar module;
- The matching drive power supply should be 5~12V, the drive current should not be less than 5mA, the power supply ripple amplitude should be controlled within 100mV, and the power frequency fluctuation amplitude should be small;
- When assembling the drive power supply and radar module, avoid the bottom of the radar module or the antenna surface facing the drive power module, and try to stay away from the rectifier bridge, switch transformer and other devices with large power frequency interference in the drive power module to prevent interference with microwave signals;

Radar Module Testing and Usage Precautions

- When there are walls or obstacles around to reflect microwaves, the sensing distance and sensing angle will be increased; when there is a relatively open space around, the sensing distance and angle will be attenuated;
- Since the microwave antenna can change detection even with a small change, please protect the antenna and avoid metal objects (such as solder wire) on the surface to avoid affecting the sensing distance;
- Handle with care to avoid violent vibrations, and keep the radar module flat and not deformed; the photosensitive device is not blocked or covered, especially around the photosensitive element D1 on the radar module, opaque shielding should be avoided;
- The radar module maintains an independent use space, and the surrounding space maintains a free space interval of more than 2mm;
- After power-on, there is about 7s initialization noise analysis time, during which it is considered abnormal sensing work;
- If the photosensitive device of the radar module is blocked (such as the outer shell, etc.), it is necessary to retest to determine the light threshold value;
- During production line testing and aging operations, if a large number of radar modules are stacked together when powered on, self-excitation may occur. Please ensure that the powered radar modules are kept 50cm apart Above safe distance.

Precautions for Installing and Using Built-in Radar Module

- Devices equipped with radar modules should be installed away from ventilation ducts, fire ducts, drainage ducts, mechanical vibrations or places with strong vibration objects such as large metal equipment, because they will affect the radar reflection wave and detection perception effect;
- Live work is strictly prohibited to avoid misoperation, wrong connection, circuit burnout 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 false operation caused by electromagnetic interference; it should also be installed away from places where objects are fixed, rotating or swinging (such as electric fans, swaying leaves, clothes drying in the wind, etc.) to avoid false operation;
- When several devices with built-in radar modules are fixedly installed, the distance between each device should be $\geq 0.5\text{m}$;
- The antenna surface of the radar microwave module is recommended to be 3~5mm away from the product casing, otherwise it will affect the sensing distance;



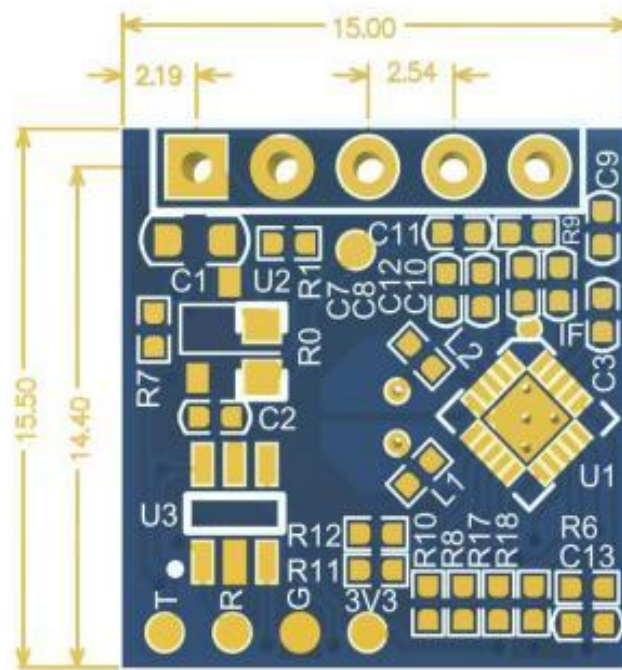
Figure 4 Distance between antenna surface and product housing

- 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 other lighting objects (such as emergency lights, guide lights and other interfering light sources) near the device (such as lamps) with built-in radar modules, so as to avoid the built-in light-sensing judgment of the device (lamp) failing to work properly (often off, misjudged as daytime);
- If a device (such as a lamp) with a built-in radar module is always working (always on) and cannot be turned on or off according to the moving target detection, it may be that the radar module is interfered by the intermediate frequency, causing the module to always judge that there is a moving target in the sensing range. At this time, the power supply should be turned off, and

the power supply status of the power board should be checked to see if it is normal and whether the module space distance has changed;

- If the above problems cannot be solved, please turn off the power and observe the surrounding conditions of the installation location to eliminate the influence of the surrounding environmental interference factors; if there is still a problem after restarting the power supply, consider replacing the device's driver power board or re-verifying the radar module.

Dimension



The dimension unit is mm. The module size is 15.5mm * 15mm * 3mm, the P1 hole spacing is 2.54mm, the aperture is 0.9mm, and there are 2.54 * 5 single row pins.

Mobile and Hand Scan Inductive Communication Protocol

field	Byte length	describe	notes
Frame header	2	Set it to 0x3C 3A	
Total data length (LEN)	1		Mobile hand scan protocol public part
Command word	1		
work pattern	1		
Version number (VERSION)	1	Report only when data is read	
Mobile radar threshold (TH)	3		
Mobile light threshold (LIGHT_TH)	1	The default setting is 0xFF	
Mobile output delay time (DELAY_NUM)	2	The delay time of the light is n* 100ms	
Module number (ID)	4	Initial setting 0xFF FF FF FF	
Mobile output mode	1	You can temporarily select "O port output" or "PWM output"	
Motion sensitive AD value (light_ad)	1	Sensitivity AD value	Use of commissioning parameters for the project
Mobile Mid-Frequency (average)	1	The AD value (V) of the medium frequency DC voltage in the radar is higher for objects and lower for no objects	
Mobile noise value (SUM0)	2	SUM0/ 64, reported only when reading data	
Mobile signal value (SUM2)	2	SUM2/ 64, reported only when reading data	
Tap to respond	1	Two effects are tentatively available. Please refer to the manual for the use of the host computer	
The door threshold is hand-swept	2	Adjust the hand sweep distance	
Hand sweep the lockdown time	2	Adjust the invalid time period of the adjustment	
The hand sweep frequency is high	1	Adjust the hand sweep speed	These two parameters are used together, with the high frequency parameter <the low frequency parameter
The hand sweep frequency is low	1	Adjust the hand sweep speed	
Hand sweep output mode	1	You can temporarily select "O port output" or "PWM output"	
Frame end	2	Fixed as 0x3A 3E	

Note: All data larger than 1 byte is transmitted in big-endian mode.

- Version: Program version number
- TH1 TH2 TH3 A 16-bit data is formed in the big-end mode, which is the radar threshold set
- L1 is the set light threshold
- T1 T2 A 16-bit data is formed according to the big-end mode, and the data *100ms is the set delay time
- L_AD is the photosensitive AD value
- Mobile MF: Radar IF signal output, DC voltage AD value /4, byte 8/ 128 is the DC voltage value (V)
- SUM0 is two bytes, which are composed into a hexadecimal data in big-endian mode and combined into the noise value SUM0/64
- SUM2 is two bytes, which are composed into a hexadecimal data in big-endian mode and combined into the noise value SUM2/64
- The output mode is a byte bit7--output mode: 1-O port output; 0-PWM output

bit6--Gradually brightening and extinguishing mode: 1-gradually brightening and extinguishing mode on, 0-gradually brightening and extinguishing mode off

Bit5-bit0: The range is 0~40 (bit5~0 is meaningful when bit6 =0)

Mobile, hand scan, mobile + hand scan parameter setting, parameter query example is as follows:

Describe: work pattern: = 1 means moving =2 means hand sweeping =3 means moving +hand sweeping

M indicates the output mode

instance:

Function name	data
The power supply started successfully	MCU appear in the newspapers 3C 3A 06 FC 3A 3E

The PC queries the MCU to save parameters	PC transmit by radio	3C 3A 07 FA mode 3A 3E (mode=1,2,3)
PC set up parameters	MCU reply	3C 3A 07 FD mode 3A 3E (mode=1,2,3)

PC setting work mode	PC sending	3C 3A 07 FB mode 3A 3E (mode=1,2,3)
MCU receives response	MCU response	3C 3A 07 FB mode 3A 3E (mode=1,2,3)
PC Set Mobile Parameters	PC sending	3C 3A 13 FD 01 00 88 80 FF 00 0E FF FF FF FF M 00 3A 3E
PC Set Hand Scan Parameters	PC sending	3C 3A 14 FD 02 01 99 90 01 33 03 F0 FF FF FF FF M 00 3A 3E
PC settings for mobile and manual scanning parameters	PC sending	3C 3A 1B FD 03 00 88 80 FF 00 0E FF FF FF FF M 01 99 90 01 33 03 F0 M 00 3A 3E
PC queries mobile parameters	MCU response	3C 3A 19 FA 01 DE 00 88 80 FF 00 0E FF FF FF FF M 01 54 01 12 02 D4 3A 3E
PC queries hand scan parameters	MCU response	3C 3A 14 FA 02 DE 01 99 90 01 33 03 F0 FF FF FF FF M 3A 3E
PC query hand scan+mobile parameters	MCU response	3C 3A 21 FA 03 DE 00 88 80 FF 00 0E FF FF FF FF M 01 54 01 12 02 D4 01 99 90 01 33 03 F0 M 3A 3E

Mobile, Hand Scan, Mobile+Hand Scan 1 Test Related Functions Engineering Debugging and Testing Settings (Modify Output Mode 1) Parameter Examples are as follows:

1. Set the mobile work mode:

PC sent: 3C 3A 07 FB 01 3A 3E

MCU response: 3C 3A 07 FB 01 3A 3E

2. Query parameters related to mobile mode

PC sent: 3C 3A 07 FA 01 3A 3E

MCU response: 3C 3A 19 FA 01 01 01 5F 90 D1 00 14 FF FF FF FF M 00 37 00 5A 00 7C 3A 3E

3C 3A 19 FA 01 11 01 5F 90 D1 00 14 FF FF FF FF 80 00 44 01 FB 00 02 3A 3E //I/O

3C 3A 19 FA 01 11 01 5F 90 D1 00 14 FF FF FF FF 40 00 44 01 FB 00 02 3A 3E //Gradually turning on and off mode

3C 3A 19 FA 01 11 01 5F 90 D1 00 14 FF FF FF FF 08 00 44 01 FB 00 02 3A 3E //Gradually turning on and off mode off

3. Set the mobile mode

PC sent: 3C 3A 13 FD 01 00 88 80 FF 00 0E FF FF FF FF M 00 3A 3E

3C 3A 13 FD 01 00 88 80 FF 00 0E FF FF FF FF 80 00 3A 3E //IO
 3C 3A 13 FD 01 00 88 80 FF 00 0E FF FF FF FF 40 00 3A 3E //Gradually turning on and off mode
 3C 3A 13 FD 01 00 88 80 FF 00 0E FF FF FF FF 08 00 3A 3E //Gradually turning on and off mode off

MCU response: 3C 3A 07 FD 01 3A 3E

4. Set the manual scanning working mode:

PC sent: 3C 3A 07 FB 02 3A 3E
 MCU response: 3C 3A 07 FB 02 3A 3E

5. Query parameters related to hand scanning mode:

PC sent: 3C 3A 07 FA 02 3A 3E

MCU response: 3C 3A 14 FA 02 01 01 08 02 FF FF FF FF FF FF FF FF M 3A 3E

3C 3A 14 FA 02 01 01 08 02 FF FF FF FF FF FF FF FF 80 3A 3E //IO
 3C 3A 14 FA 02 01 01 08 02 FF FF FF FF FF FF FF FF 40 3A 3E //Gradually turning on and off mode
 3C 3A 14 FA 02 01 01 08 02 FF FF FF FF FF FF FF FF 0F 3A 3E //Gradually turning on and off mode off

6. Set parameters related to manual scanning mode

PC sent: 3C 3A 14 FD 02 01 99 90 01 33 03 F0 FF FF FF FF M 00 3A 3E

3C 3A 14 FD 02 01 99 90 01 33 03 F0 FF FF FF FF 80 00 3A 3E //IO
 3C 3A 14 FD 02 01 08 CA 00 05 03 32 FF FF FF FF 40 00 3A 3E //Gradually turning on and off mode
 3C 3A 14 FD 02 01 08 CA 00 05 03 32 FF FF FF FF 0F 00 3A 3E //Gradually turning on and off mode off

MCU response: 3C 3A 07 FD 02 3A 3E

7. Set the mobile+hand scan working mode:

PC sent: 3C 3A 07 FB 03 3A 3E
 MCU response: 3C 3A 07 FB 03 3A 3E

8. Query parameters related to mobile+hand scan mode

PC sent: 3C 3A 07 FA 03 3A 3E

MCU response: 3C 3A 21 FA 03 01 01 5F 90 D1 00 14 FF FF FF FF M 00 E3 00 5F 09 88 01 08 02 FF FF FF FF M 3A 3E

3C 3A 21 FA 03 01 01 5F 90 D1 00 14 FF FF FF FF 80 00 E3 00 5F 09 88 01 08 02 FF FF FF FF 80 3A 3E //YD IO, Hand sweeping IO
 3C 3A 21 FA 03 01 01 5F 90 D1 00 14 FF FF FF FF 40 00 E3 00 5F 09 88 01 08 02 FF FF FF FF 40 3A 3E //YD Gradually turning on and off mode, Hand sweeping IO
 3C 3A 21 FA 03 01 01 5F 90 D1 00 14 FF FF FF FF 08 00 E3 00 5F 09 88 01 08 02 FF FF FF FF 08 3A 3E //YD Gradually turning on and off mode off, Hand sweeping IO

9. Set parameters related to the mobile+hand scan mode

PC sent: 3C 3A 1B FD 03 00 88 80 FF 00 0E FF FF FF FF M 01 99 90 01 33 03 F0 M 00 3A 3E

3C 3A 1B FD 03 00 88 80 FF 00 0E FF FF FF FF 80 01 99 90 01 33 03 F0 80 00 3A 3E //YD IO, Hand sweeping IO
3C 3A 1B FD 03 00 88 80 FF 00 0E FF FF FF FF 40 01 99 90 01 33 03 F0 80 00 3A 3E //YD Gradually turning on and off mode, Hand sweeping IO
3C 3A 1B FD 03 00 88 80 FF 00 0E FF FF FF FF 08 01 99 90 01 33 03 F0 80 00 3A 3E //YD Gradually turning on and off mode off, Hand sweeping IO

MCU response: 3C 3A 07 FD 03 3A 3E

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