

# 说明书

## User manual

(24 款感知模块)

(Sensor System)

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## 一、功能说明

### I. Introduction

The sensing module is applied to the perception of agricultural operation environment, detecting the distance, speed and orientation of people, trees, wires, poles and other targets in the environment, and output 3D position point cloud information and speed information. The back-end processor uses the point cloud output by the radar for target detection and identification, and establishes a real-time map to provide agricultural UAVs with route planning and obstacle avoidance. The millimeter-wave radar has a head motor inside, which can realize the function of rocking scanning or maintaining a fixed Angle. The visual function produces images.

**产品型号: FRD2488**

**Model: FRD2488**

**主要特性:**

**Main Features:**

- Ranging range 0.3m~80m@ Swing Radar 0.3m~100m Ground Simulating Radar
- Bluetooth communication distance 0m~10m
- Visual distance 0m~100m
- point cloud refresh rate: 50Hz
- CAN-FD port
- LAN port
- CAN-FD Interface
- IP67 Waterproof
- Operating Temperature: -40°C~+85°C

**典型应用：**

**Applications:**

- 无人机

Unmanned Aerial Vehicles

- 无人车

Unmanned Ground Vehicles

- 农机自驾仪

Autopilot Consoles



## 二、关键性能

### II. Specifications

表 1 主要性能

Table 1. Main Specifications

参数 Parameter	测试条件 Testing Condition	最小值 Min	典型值 Typical Value	最大值 Max	单位 Unit
<b>频率特性</b>					
<b>System</b>					
<b>4D Imaaina Radar</b>					
发射频率 Transmit Frequency		24.15		24.15	GHz
调制方式 Modulation	FMCW				
刷新率 Refresh Rate			50		Hz
<b>Terrain Radar</b>					
发射频率 Transmit Frequency		24.15		24.15	GHz
调制方式 Modulation	FMCW				
<b>BLE</b>					
频率范围 Frequency	BLE:<2MHz	2402		2480	Mhz
调制方式	BLE:GFSK				
<b>Performance characteristic of 4D Imaaina Radar</b>					
测距范围 Distance Range	@FOV: 方位±40°, 俯仰+90° ~-45°	0.3		80	M

	@FOV: Azimuth: $\pm 40^\circ$ ; Pitch Angle: $+90^\circ \sim -45^\circ$				
测距精度 Distance Accuracy	非跟踪点目标 Non-tracking Point Target		$\pm 0.1$		M
测速范围 Velocity Range	远离目标为“-”，靠近目标为“+” Away from Target: “-” ; Toward Target: “+”	-13		+13	m/s
测速精度 Velocity Accuracy	点目标 Point Target		$\pm 0.1$		m/s
测角范围 Angle Range	方位角 Azimuth	-40		+40	$^\circ$
	俯仰角 Pitch Angle	-45		+90	$^\circ$
测角精度 Angle Accuracy	非跟踪点目标@方位角 $\pm 50^\circ$ Non-tracking Point Target @Azimuth: $\pm 50^\circ$		$\pm 1$		$^\circ$
	非跟踪点目标@俯仰角 $\pm 30^\circ$ Non-tracking Point Target @Pitch Angle: $\pm 30^\circ$		$\pm 1$		$^\circ$
同时检测目标 Targets Tested Simultaneously				64	个
距离分辨率 Distance Resolution	非跟踪点目标，满足 1.5 到 2 倍分辨率的条件下可以区分两个物体 For Non-tracking Point Targets, two objects are distinguishable at 1.5x to 2x zoom		0.75		M
速度分辨率 Velocity			1		m/s

Resolution					
角度分辨率 Angle Resolution	非跟踪点目标@方位角±40° Non-tracking Point Target @Azimuth: ±40°		9.5		°
天线波束宽度 Beamwidth	方位角 (-3dB) Azimuth (-3dB)		120		°
	俯仰角 (-3dB) Pitch Angle (-3dB)		23		°
天线增益 Antenna Gain			10		dBi
<b>Performance characteristics of Terrain Radar</b>					
测距范围 Distance Range		0.3		100	M
测距精度 Distance Accuracy			±0.3		M
天线波束宽度 Beamwidth	方位角 (-3dB) Azimuth (-3dB)		40		°
	俯仰角 (-3dB) Pitch Angle (-3dB)		30		°
天线增益 Antenna Gain			10		dBi
<b>performance characteristics of BLE</b>					
Communication distance		0		10	m
Antenna polarization	Circular polarization				
Antenna gain Antenna Gain			2.13		dBi
<b>接口特性 Interface</b>					
CAN-FD	通信速率 Communication Speed		4		Mbps

LAN	通信速率 Communication Speed		100		Mbps
供电	电源接口	12	24	26	V
<b>结构特性</b> <b>Structure</b>					
尺寸 Dimensions	宽*长*高 W*L*H	-			mm
材料 Material	雷达罩 Radar Housing	PA66+30%GF			
	后壳 Rear Cover	铸铝 Cast Aluminum			
重量 Weight		1200			g



### 三、接口

#### III. Interfaces

感知模块与外部通信接口为 CAN-FD，LAN 口，接口定义 12PIN 接头、具体定义如下：

表 2 接口信号定义

Table 2. Interface Signal Definition

引脚 Pin	信号 Signal	类型 Type	定义 Definition	连接器 Connector
1	CAN_L	I/O	CAN-bus 低位线 CAN-bus (Low Level)	1# Green 2# Green and white 3# blue 4# Blue and white 5# yellow 6# yellow and white 7# brown 8# black 9# brown and white 10# black and white 11# red 12# red and white X2026WVS-2x06D1- 46SN
2	CAN_H	I/O	CAN-bus 高位线 CAN-bus (High Level)	
3	DATA1_N	I/O	LAN CAN Data1	
4	DATA1_P	I/O	LAN CAN Data 1	
5	DATA2_N	I/O	LAN CAN Data 2	
6	DATA2_P	I/O	LAN CAN Data 2	
7	DATA3_N	I/O	LAN CAN Data 3	
8	DATA3_P	I/O	LAN CAN Data 3	
9	DATA4_N	I/O	LAN CAN Data 4	
10	DATA4_P	I/O	LAN CAN Data 4	
11	24V		Power supply positive	
12	GND		Negative terminal	

#### 四、工作条件

#### IV. Operating Conditions

Normal use of the sensing module requires certain working conditions and working environment, beyond the range of working conditions may lead to abnormal work, burn, etc. Specific requirements are as follows:

表 3 工作条件

Table 3. Operating Conditions

参数 Parameter	测试条件 Testing Condition	最小值 Min	典型值 Typical Value	最大值 Max	单位 Unit
工作电压 Operating Voltage	电池供电 Battery Powered	12	24	26	VDC
功耗 Power Consumption	@24VDC			10	W
静态功耗 Static Power Consumption	@24VDC		100		mW
工作温度 Operating Temperature		-20		+85	°C
存储温度 Storage Temperature		-40		+85	°C
冲击 Shock	500m/s <sup>2</sup> @6 ms half-sine(10 x shock each in +/-X/Y/Z dir.)				
振动 Vibration	20m/s <sup>2</sup> peak at 10Hz/0.14m/s <sup>2</sup> peak at 1000Hz				
防护等级 Protection Rating	IP67 (水下 10cm) IP67 (10cm below the surface of water)				

## 五、规范要求

### V. Standards & Requirements

表 4 测试规范标准

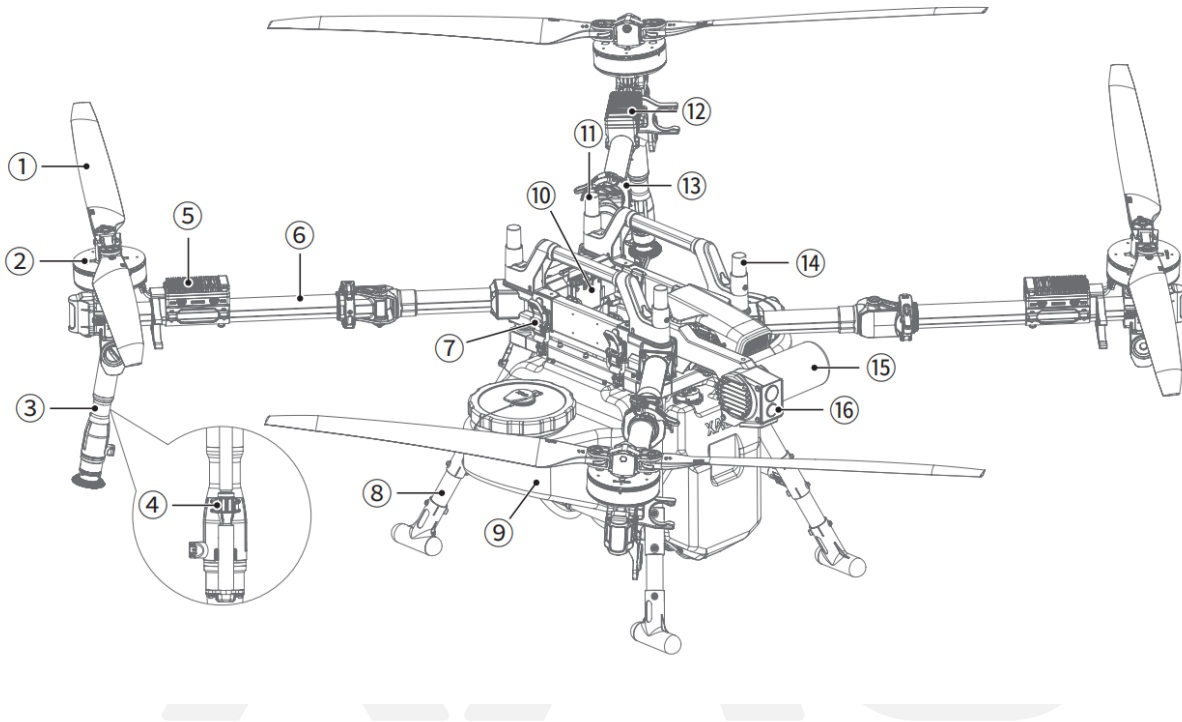
Table 4. Testing Requirements and Standards

规范 Requirement	测试项 Test Item	执行标准 Standard
EMC	ESD	IEC61000-4-2 Level 3 Class B
	传导与辐射 Conduction & Radiation	EN55032:2015/AC:2016-07 Class B
环境适应性 Environmental Adaptability	高低温循环 Temperature Cycling	ISO 16750-1 -20°C~+85°C
	振动测试 Vibration Testing	IEC 60068-2-64/无人机振动试验标准 IEC 60068-2-64/Random Vibration Testing
	防水 Waterproof	IP67
出口认证 Export Certification	24G 雷达 24GHz Radar 蓝牙 2.4Ghz	CE/FCC/KCC

## 六、安装位置

### VII. Installation position

FRD2488 installed in the nose position of the UAV, is only allowed to be placed horizontally as shown in FIG. 15 and 16. As shown in the following picture.



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转到“设置”以

## 七、版本更新

### VII. Version History

表 5 版本说明  
Table 5. Version History

版本 Version	说明 Description
V1_1	新建文档 Document Created

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Caution: The user is cautioned that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC RF Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator and any part of your body.

### **FCC Supplier's Declaration of Conformity**

*Brand name / model number: FDR2488*

*This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.*

*Suppliers Name(FCC): Pegasus Spray LLC*

*Suppliers Address (FCC): 2235 79th Ave NE, Medina, WA 98039, USA*

*Suppliers phone number and / or internet contact information: +1 (503) 866-1228*