



MicroBrain Intelligent

UAV-R21-1 (CAN)

**Obstacle Avoidance Drone Radar
User Manual**

**(Compatible with Open Source
Flight Controller)**

Microbrain Intelligent Technology Co., Ltd.

Disclaimer

Welcome to purchase this product.

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<https://www.microbrain.com.cn>

Please read this statement carefully before using this product. Once used, it is deemed to be recognition and acceptance of the contents of this statement.

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Historic Version

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1. UAV-R21-1 Introduction

UAV-R21-1 Obstacle Avoidance Radar is a tiny & light millimeter wave obstacle avoidance radar sensor, which is self-designed and manufactured by MicroBrain Intelligent. It has advantages of high precision, small body, high sensitive, light weight, easy for integration and stable performance. This product can distinguish whether there's obstacle ahead or not by forward sending fan-shaped 79GHz electromagnetic wave and dealing with the returned signals. It will send back the relative distance, speed and angle data between obstacles and radar to make the drone keep away from obstacles and ensure its safe working.

Microbrain Intelligent UAV-R21-1 middle distance radar has performance as below:

1.1 Antenna applies 2 send 4 receive MIMO array. Angle scope area to 30 degree with high resolution and precision.

1.2 Working frequency 77GHz~81GHz. Sensitive for motion and precise for distance detection.

1.3 Effective detection distance to 27m.

1.4 Support CAN port. Default 500k baud rate.

1.5 Apply DSP + ARM dual core structure for signal process and control unit.

Execute radar data process, target detection and tracking arithmetic on inside high speed digital signal processor.

2. Product Feature

Type: Obstacle Avoidance Radar

Model: UAV-R21-1

Dimensions: 76*71.5*19.6mm

Weight: 87g (Including cables)

Protection: IP67

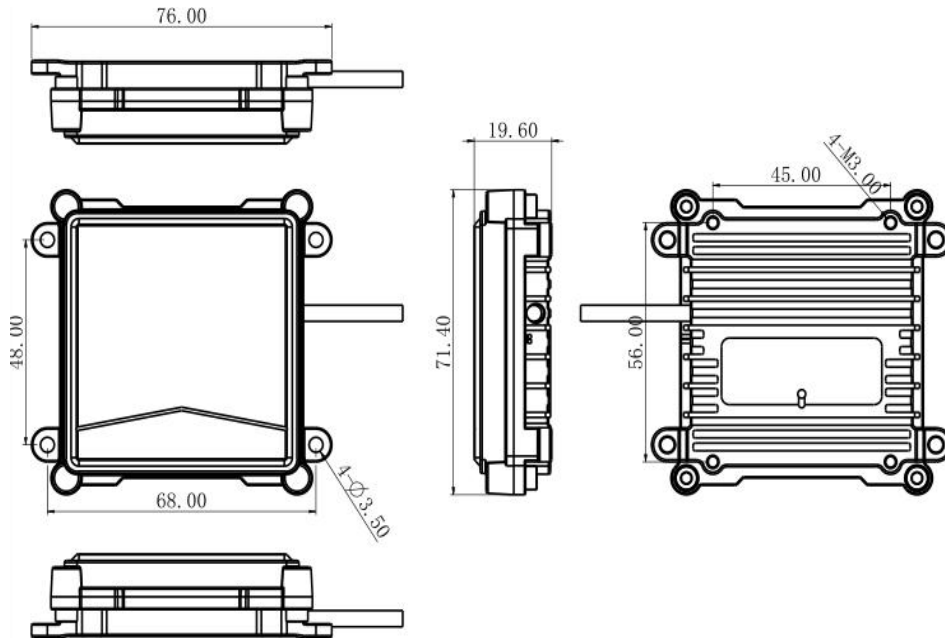


Figure 1 UAV-R21-1 Dimensions

3. Product Parameters

Name	Parameter	Data
Antenna Performance	Azimuth Width	±15°
	Elevation Width	-5°~ +3°
	Max EIRP(dBm)	30
Radar Detection	Detect Range (m)	1.5~27
	Detect Accuracy (m)	±0.1
	Distance Resolution(m)	0.12
Radar Performance	Frequency Band (GHz)	79
	Refresh Rate (Hz)	20
	Bandwidth (GHz)	1.4
System	Working Voltage (V)	5-24
	Working Temperature	-40°C~85°C
	Power Consumption(W)	3W
	Waterproof Level	IP67
	Connect Port	CAN
	PCB Size (mm)	55*52*1.6

4. Product Photo

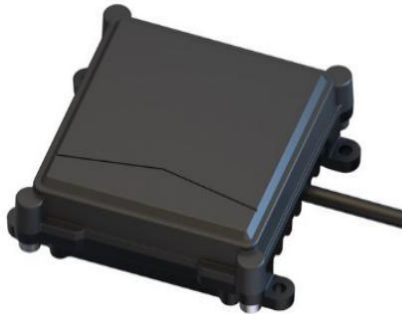


Figure 2 UAV-R21-1 Product Photo

5. Installation

Installation steps for UAV-R21-1 radar:

5.1 Install place: There shouldn't have any obstacles in the area of beam azimuth width $\pm 15^\circ$ or elevation width $-5^\circ \sim +3^\circ$.

5.2 Install direction: The antenna is on the back of radar where there's an arrow. While installing, the direction of arrow on radar's back should be upward, cables of radar be right towards, and the front side of radar towards the flying direction of drone.

5.3 Install angle: While installing, the antenna side (radar front side) points to the front direction of drone. The radar installed inclined upwards according to the largest inclination angle during drone flying. The best install angle is relative to the biggest flying incline angle and flying height. Ordinary speaking, 12° incline angle is recommended.

Assume the drone flying incline angle as θ , drone working height as H, max alarm distance as R_{\max} , then it comes:

$$\frac{H}{\sin(\theta + 3)} > R_{\max}$$

And then:

$$\theta < \arcsin\left(\frac{H}{R_{\max}}\right) - 3$$

If make $\theta_0 = \arcsin\left(\frac{H}{R_{\max}}\right) - 3$, then θ_0 is the largest drone incline angle that the radar install can accept; If the drone incline angle is bigger than θ_0 , then it needs amendment, which will need the radar be installed upward inclined. The installation angle is θ_{comp} and make $\theta - \theta_{\text{comp}} < \theta_0$, Then the installation angle should be:

$$\theta_{\text{comp}} > \theta - \theta_0$$

Furthermore, the more stable of platform, the smaller fluctuation will radar beam has. And the smaller install angle, the more stable detection the radar will have for front obstacles.

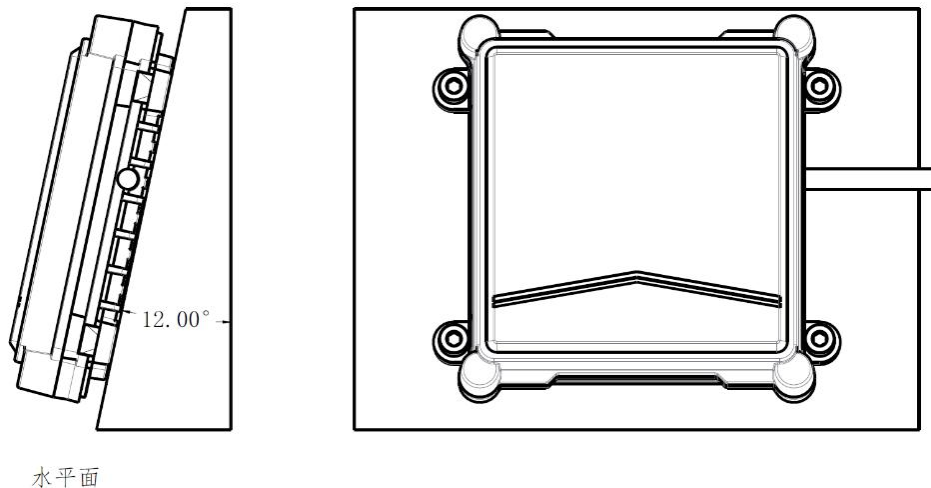


Figure 3 Radar Installation Figure

6. Quick Guidance

- Pin definition

Pin	Cable Mark	Cable Definition
1	VCC (Red)	Power Positive
2	GND (Black)	Power Negative
3	TX_CAN_H (Green)	CAN_H
4	RX_CAN_L (White)	CAN_L

Table 1 UAV-R21-1 Pin Interface Definition

● Data Analysis

UAV-R21-1 radar supports CAN interface. The CAN-Bus Communication network complies with ISO11898-2 standard, and the default transmission rate is 500Kbps. Target measurement information is transmitted via the CAN interface. The message ID uses a 29-bit extended frame. The default ID of the UAV-R21-1 radar is: 0x73C for front obstacle avoidance and 0x74C for rear obstacle avoidance. The data length is 6 bytes and 48 bits. UAV-R21-1 bus message definitions are as follows:

Table 2 UAV-R21-1Radar Frame Information Definition

CAN	Frame Format	MIRS-H3 Radar ID	Data Length (bit)	Data Format	Target
1	CAN2.0A (29bit)	0x73C OR 0x74C	48	0-7: high 8 bits 8-15 :lower 8 bits	Target1
				16-23: high 8 bits 24-31 : lower 8 bits	Target2
				32-39:high 8 bits 40-48 :lower 8 bits	Target3

7. Use Cautions

- Radar needs carefully anti-static protection during transportation, storage, working and taking. If the radar continuously outputs irregular targets while there isn't any target in radar detection areas, or when the radar can't get any output signal while the power voltage or current data is under normal condition, then the radar may be damaged.
- Keep the radar cover clean during installation. Use soft wet cloth for radar cover wiping and dry it naturally by ventilating.
- Please pay attention to the shape of the radar when installing, ensure that the installed radar is not deformed, and do not squeeze, bump, or hit;
- When installing, make sure the radar is complete and do not disassemble or assemble it by yourself.

8. FAQ

1> Q: What is the detect range of UAV-R21-1? Why the minimum detect distance is 1.5m?

A: The drone obstacle detection range is 1.5~27m. Considering about the drone wing length, it needs to stop while the distance between drone and obstacle is less than 1.5m. So the minimum detection distance is 1.5m.

2> Q: Don't know how to calculate the best install angle, is there a recommended angle?

A: According to the installation angle recommendation and the test result, we suggest radar sensor be inclined 12° upward for installation.

3> Q: Will the radar have data output if it hasn't detected any obstacles?

A: Radar outputs data in real time. While radar hasn't detected any obstacle or the obstacle distance longer than 27m, it outputs data 0; While radar detected obstacle successfully, it outputs the actual distance of obstacle.

Please contact service manager freely if need any help during installation.

MicroBrain will always be here for your service!

Microbrain Intelligent Technology Co.,Ltd

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