# 24G Radar Altimeter (SR-PA24R)

# **User Manual**

Version: V1.0



Hunan Nanoradar Science and Technology Co., Ltd.

#### Disclaimers

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## Version History

Date	Version	Description
2019-04-23	1.0	SR-PA24R user manual v1.0



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#### 1 SR-PA24R Introduction

SR-PA24R is a professional 24G millimeter-wave radar altimeter for industrial drones. It uses 24GHz-ISM frequency band, with 2cm measurement accuracy, compact size, high sensitivity, light weight, easy integration and stable performance. The radar can output the distance from the drone to the ground in real time with strong anti-interference ability. It can work in the all-weather environment. The product can be directly adapted to DJI A3/N3 FCU, DJI M600 Pro, Pixhawk and other flight platforms.

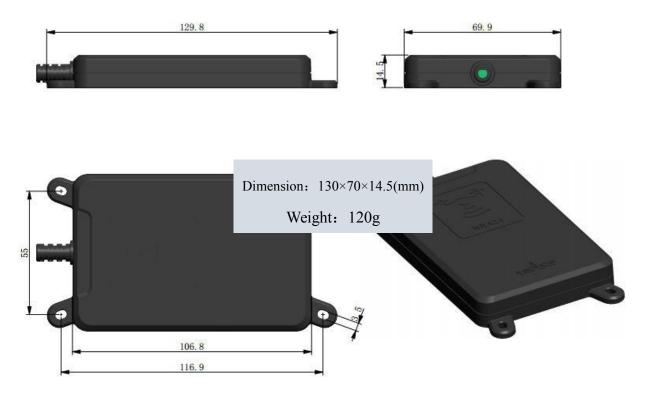


Figure 1 SR-PA24R outline

#### 2 Precautions

(1) The power supply pin needs to be externally connected to a

- 5~12V DC regulated power supply;
- (2) Fix the radar SR-PA24R with 4 M3 screws.



#### 3 Radar Parameter

Parameter	Specification
Transmitting frequency	24.00-24.20GHZ
Detection range	≥100m
Measurement accuracy	± 0.02m
Beam wave width	Azimuth28°, Elevation 18°
Interface	UART
Working voltage	5~12VDC
Consumption	1.5W(typical value)
Working Temperature	-40~80°C
Weight	120g
Dimension	130x70x14.5mm(LxWxH)

#### Table 1 Parameter

### 4 Quick use steps

#### 4.1 Pin Definition

SR-PA24R Interface pin definitions, as shown in Table 2:

Pin	Definition	Range
1	VCC(red)	5~20V DC
2	GND(black)	-
3	UART_RX (white)	TTL 3.3V DC
4	UART_TX (yellow)	TTL 3.3VDC

#### 4. 2 Test

Use USB to serial device to connect the output serial port, connect the USB port to the PC serial port debugging assistant software, the radar output data will be displayed.



For details, please refer to the serial data protocol description. The test tools or software is shown in the following table:

No	Device	Qty
1	SR-PA24R	1
2	РС	1
3	USB to TTL adapter	1
4	5V or12Vpower adapter	1
5	Serial port debugging	1
	assistant software	1

Note: The TX and RX pins of the USB to TTL adapter and the TX and RX pins of the SR-PA24R Radar need to be cross-connected.

#### 5Data Parsing

The 24G radar altimeter outputs data through the serial port, 115200bps, 8N1, no data no output, the specific protocol format is as follows:

Data type	Number of	Description
	bytes	
Header byte	1Btyes	static, 0x48
Height data	2Btyes	The lower 8 bits are in the front, the higher 8 bits are in
		the back; the unit is cm; the signed integer is used, and
		the highest bit of each byte should be discarded when
		acquiring data;

Radar altimeter 3-byte protocol: 0x48, DataL, DataH; In order to adapt to open source flight control, the actual distance is calculated in the following formula:

actual distance (cm) = [(DataH&0x7F)\*128 + (DataL&0x7F)]\*2.5.

#### 6 Open source platform

The SR-PA24R is compatible with the open source flight control altimeter protocol



and can be directly connected to the general open source flight control platform. The following is a brief description of the integrated application settings of the SR-PA24R on the APM flight control platform.

Flight Control Hardware: PixhawkV3 Flight Control Software: ArduPilot Copter 3.5.5 Ground station software: MissionPlanner 1.3.62

#### 6.1 Radar installation and wiring

The radar serial port is connected to the pixhawk TELEM2 interface. The radar power supply needs to be powered separately. The interface definition is as follows:



#### **TELEM 1 & 2**

Pin #	Name	Dir	Wire Color	Description
1	VCC_5V	out	red / gray	Supply to GPS from AP
2	MCU_TX	out	yellow / black	3.3V-5.0V TTL level, TX of AP
3	MCU_RX	in	green / black	3.3V-5.0V TTL level, RX of AP
4	MCU_CTS (TX)	out	gray / black	3.3V-5.0V TTL level or TX of AP
5	MCU_RTS (RX)	in	gray / black	3.3V-5.0V TTL level or RX of AP
6	GND	-	black	GND connection

Pic 2 pixhawk TELEM2 interface definition

For the installation method, please refer to the following figure (taking the D600 M600 Pro flight control platform as an example):





Pic 3 Radar Installation reference

# 6.2 MissionPlanner Ground station for flight control parameter setting

(1) Set the TELEM2 serial port parameters, the SERIAL2 baud rate is set to 115200bit/s (SERIAL2\_BAUD is set to 115), and the communication protocol is set to Lidar (SERIAL2\_PROTOCOL is set to 9), as shown in the following figure:

Command Value U	it Eauge	Description
TATT STRIAL NUM -1		Pattery serial number, estomatically filled in for SWPss batteries, otherwise will be "I
BALL_SAKLAL_NW -1		Dattery serial number, witomatically filled in for SMD45 Batteries, otherwise will be "I
HER SERI RESCES 2	0:Disubled 1:Enabled 2: Auto	Enable flow control on zerial 1 (telemetry 1) on Finhaek You must have the RTS and CTS pinz connecte-
HRU_SERI_KISUIS 2 HRU_SERI2_KISUIS 2	Utdusabled ItEnabled 2:Auto 0:Bitabled 1:Enabled 2:Auto	to your radio. The standard BF13 6 pin connector for a 318 radio does have those pins connected. If Enable flow control on serial 2 (telemetry 2) on Fishawk and F34. You wast have the BTS and CTS pins
HED_SERIAL NUM 0	U US BADLES 1 ERABLES 2: MUTO	connected to your radie. The standard IFI3 6 pin connecter for a 300 radio does have those pins com User-defined serial number of this vehicle, it can be any arbitrary number you want and has no effect
as	-22100 32101	
OPS INTECT TO 127	0 mend to first 025 1 mend to 2nd 075 127 mend to all	The GOS can wend raw serial packets to inject data to waltiple GFSes.
■ NT	U.Renn to Hirst Urs 1.Renn to ind Urs 121.Benn to all	ine out that bent yew berial parkets to inject sate to multiple order.
MAT TIPE 0	0.8mm 1.Servo 2.508.Solo 3.Alement Serial 4.STo8822 MAVLink 5.STo8832 Serial	Norma Tyres (None, Serve or MAVLink)
■ 295750	U.BODE 1.54740 2.305.5010 3.ALETBOX SETSAL 4.5100552 MARLINE 5.5105552 SeTIAL	mount 199+ (Mone, Servo or MANLINK)
BREED TYPE 0	0:None 1:Analog 2:MaxbotisI2C 3:LidarLiteV2=I2C 5:FX4-FWM 6:H8D-FRV 7:LightMareI2C 8:LightWareSerial 9:Bebop	What type of rangefinder device that is connected
ENERTIC C	10:MANLink 11:uLanding 12:LeddarOne 13:MarbotinSerial 14:TrOneI20 15:LiderLiteV3-I20	nine ()pr of Paugrannaer device that is connected
INCOME TIPE 0	0:News 1:Analog 2:MaxbetisI2C 3:LidarLiteV2-I2C 5:FX4-FWM 6:BBD-FRV T:LightMareI2C 8:LightWareSerial 9:Bebep	What type of requestinger device that is connected
SERIALO	10:MAVLink 11:mLanding 12:LeddarOne 13:MarbotinSerial 14:TrOneI2C 15:LidarLiteV3-I2C	nunt type on Paugenninger device that is condected
SERIALD BAND 115	1:1200 2:2400 4:4800 9:9600 19:19200 38:38400 57:57600 111:11100 115:115200 480:480800 500:500000 921:921600	
SERIALO PROTOCOL 1	1500:150000 1 #AVLink1 2 #AVLink2	support 500. The PI4 can support rates of up to 1900. If you notup a rate you cannot support on APM Control what pretocal to use on the console.
SERIALI	E INTELERE E INTELERE	CORTOR WHICH PERSON CO GLE OF CHE CALLORE.
SERIALI BAID 115	1 1200 2 2400 4 4600 9 9600 19 19200 38 38400 57:57600 111 111100 115 115200 500 500000 921 921600 1500 1500	one. The band rate used on the Televil port. The AJME2 ran support all bandrates up to 115, and also ran
SERIALI PROTOCOL 1	-1: None 1: MAVLink1 2: MAVLink2 3: Frsky D 4: Frsky SPort 5: GFS 7: Alexnor Ginbal Serial 8: SToBM32 Ginbal	Control shat protocol to use on the Teleni pert. Note that the Frsky options require external convert-
SEMALI_FINICOL I	Serial 9:Lidar 10:FrSky SPort Passtbrough EpenTE) 11:Lidar380 12:kerotenna ulanding 13:Beacon	hardware. See the wiki for details
SERIAL2 BAID 115	1 1200 2 2400 4 4800 9 9800 19 10200 38 38400 57 57800 111 111100 115 115200 500 500000 921 921800 1500 1500	
SENIAL2 PROTOCOL 9	-1:None 1:MAVLinki 2:MAVLink2 3:Fraky D 4:Fraky SPart 5:OFS 7:Alexmon Gimbal Serial 8:SToBM32 Gimbal	500. The FRW run support rates of up to 1500. If you satup a rate you cannot support on AFM2 and th Control shat protocol to use on the Telem2 pert. Note that the Fraky options require external convert
SERIAL2_FINITOOL 9	Serial 9:Lidar 10:FrSky SPart Paunthrough (DpenTX) 11:Lidar380 12:kerotenna ulanding 13:Beacon	hurdware. See the wiki for details
SERIALS BAID 30	1 1200 2 2400 4 4600 9 9600 19 15000 38 38400 57:57500 111:111100 115:115200 500:500000 921 921600 1500:1500	one The band rate used for the Serial 3 (GFS). The APM2 can support all bandrates up to 115, and also can
SERIALS PROTOCOL 5	-1:Bone 1:MAVLinki 2:MAVLink2 3:Fraky D 4:Fraky SPort 5:6FS 7:Alexmon Gimbal Serial 8:SToBM32 Gimbal	Control what protorol Serial 3 (HTS) should be used for. Note that the Fraky sptions require external
SERIALA	Serial 9:Lidar 10:FrSky SPort Paunthrough (DpenTX) 11:Lidar380 12:Aerotemus ulanding 13:Feacon	converter hardware. See the wiki for details.
SERIALA DAVID 135	1:1200 2:2400 4:4000 9:9600 19:19200 38:38400 57:57600 111:111100 115:115200 500:500000 921:921600 1500:1500	nn. The band rate used for Serial4. The AFM2 can support all bandrates up to 115, and also can support 50
SERIALA_PROTOCOL -1	-1: Nove 1: NAVLank1 2: NAVLink2 3: Frsky D 4: Frsky Sfort 5: GFS 7: Alexnos Ginbal Serial 8: STONM32 Ginbal	Control what protocol Serial4 port should be used for. Note that the Frshy options require external
STRINS	Serial 9:Lidar 10:PrShy SPort Passtbrough (DynnTR) 11:Lidar360 12:kerotenna uLanding 13:Deacon	converter hardware. See the wiki for details.
SERIALS BAID ST	1 1200 2 2400 4 4800 9 9800 19 19200 38 38400 57 57800 111 111100 115 115200 500 500000 921 921800 1500 1500	nn. The band rate used for SerialS. The ANM2 can support all bandrates up to 115, and also can support 50
SERIALS_BOID 51	-1 None 1 MAVLinki 2 MAVLink2 3 Frsky D 4 Frsky SPort 5 GFS 7 klesmos Ginbal Serial 8 SToMM32 Ginbal	The FIG can support rates of up to 1900. If you setup a rate you cannot support on AFMC and then can Control shat protocol SerialS port should be used for. Note that the Fruky options require external
SERIALS_PROTOCOL -1	Serial 9:Lidar 10:FrSky SFort Parstbrough OpenT2) 11:Lidar380 12:Aerotenna ulanding 13:Beacon	converter hardware. See the wiki for details.



#### Pic 4set TELEM2 serial port parameter

(2) Set the radar library parameters, set the radar type to ulanding (RNGFND\_TYPE is set to 11), and set the radar installation direction to vertical downward (RNGFND\_ORIENT is set to 25), as shown in the following figure:

fission Planner 1.3.62 build 1.3.6917.15581 Ardu	Copter V3.6-dev (co	e0f0938)	and a second sec		- 0
Ì 🛒 🍻 👍 🖾	Ţ L Ĵ	Xa			-
(United Strength	Value	Uni t	Eange	Jescription 🔺	加軟
EE#2					保存
調整 112_ALT_500101			O:Tse Baro 1:Use Range Finder 2:Use GPS 3:Use Range Beaten	This parameter controls the primary height senser used by the ESF. If the selected option cannot be used, it will default to Sure as the primary height course. Setting 0 will use the bure altitude at all times. Setting 0	50.SE
田公 HN2_BH0_I_GATE				This sets the percentage number of standard deviations applied to the range finder innovation consistency	副新参数
202_005_U_NSE					计软件系
112 383 USE BOT				The range finder will be used as the privary height source when below a specified percentage of the sensor maximum as set by the EMENTE_MAX_CM parameter. Set to -1 to prevent range finder use.	
参数 #112_8306_USE_SPD				The range finder will not be used as the primary height source when the horizontal ground speed is greater 所有有	州位都省
* 数表				福式排	雑存・不
診数树 < BRIFED_ADIR				This sets the bus address of the sensor, where applicable. Youd for the LightWare IDD sensor to allow for wiltiple sensors on different addresses. A value of 0 disables the sensor.	
ner BRGFRD_FURCTION				Control over what function is used to calculate distance. For a linear function, the distance is (voltage-	10511007
BROFED_GAIN				Used to adjust the speed with which the target altitude is changed when objects are sensed below the cepter	亚为默认
19679D_GUICLEAR				This parameter sets the expected range neurorement(in cm) that the range finder should return when the range vehicle is on the ground	
33972'SD_BAX_CN				Nazimum distance in contineters that rangefinder can reliably read	
BBOOFBED_MEM_CM				Minisum distance in contineters that rangefinder can reliably read	
RIFFED_OFFER				Offset in volts for zero distance for analog rangefinders. Offset added to distance in centimeters for 7700 E	
			0:Forward 1:Ferward-Right 2:Right 3:Back-Right 4:Back 5:Back-Left 5:Left 7:Ferward-Left	Orientation of rangefinder	
INCLAD THE			-1:Net Used 0.4782-A0 1:A282-A1 2:A282-A2 3:A282-A3 4:A282-A4 5:A282-A5 6:A282-A5 7:A282-A5 8:A282-A5 11:F24-airspeed port 15:Fishawk-airspeed port 64:A281-airspeed port	Analog pin that rangefinder in connected to. Set thin to 09 for the AFM2 analog pinn. Set to 64 on an AFM1 for the dedicated 'airspeed' port on the end of the board. Set to 11 on FI4 for the analog 'airspeed' port	
BROPHD_FOS_X				X position of the first rangefinder in body frame. Positive X is forward of the origin. Use the zero range datum point if supplied.	
BREED_FOS_F				Y position of the first rangefinder in body frame. Positive Y is to the right of the origin. Use the zero range datum point if supplied.	
1002780_F05_2				Z position of the first rangefinder in body frame. Positive Z is down from the origin. Use the zero range datum point if supplied.	
ENGEND_FREEMO				This parameter sets the estimated terrain distance in meters above which the sensor will be put into a power saving mode (if available). A value of zero means power saving is not enabled	
INSIST_INITIZE				This parameter sets whether an analog rangefinder is ratiometric. Wost analog rangefinders are ratiometric, meaning that their output weltage is influenced by the supply voltage. Some analog rangefinders (ruch as t"	
BROFND_SCALING				Scaling factor between rangefinder reading and distance. For the linear and inverted functions this is in meters per volt. For the hyperbolic function the units are meterVelts.	
100793D_SHITLE				The time in sillineconds that the rangefinder reading takes to settle. This is only used when a STOP_FIN is specified. It determines how long we have to wait for the rangefinder to give a reading after we set the S"	
BHOFND_STOP_FIN			-1:Net Vsed 50:Pinhaek AUGUVT 51:Pinhaek AUGUVT 52:Pinhaek AUGUVT 53:Pinhaek AUGUVT 54:Pinhaek AUGUVT 54:Pinhaek AUGUVT 55:Pinhaek AUGUVT 51:Pinhaek AUGUVT	Digital pin that enables/disables rangefinder measurement for an analog rangefinder. A value of -1 means no " pin. If this is set, then the pin is set to 1 to enable the rangefinder and set to 0 to disable it. This c"	
			O'Sone 1:Analog 2:MaxbotixI2C 3:LidarLiteV2-I2C 5:FX4-FMM 6:888-FBU 7:LightWareI2C 8:LightWareSerial 9:Beboy 10:MAVLink 11:uLanding 12:LeddarOne 13:MaxbotixSerial 14:TrOneI2C 15:Lr	" What type of rangefinder device that is connected	
STREET					
ENCENTS_ALOR				This sets the bus address of the sensor, where applicable. Word for the LightWare IDC sensor to allow for multiple sensors on different addresses. A value of 0 disables the sensor.	
IN-MARG-LINCLION			O:Linear 1:Inverted 2:Myperbalic	Centrel over what function is used to calculate distance. For a linear function, the distance is (voltage- offset)#scaling. For a inverted function the distance is (offset-voltage)#scaling. For a hyperbolic function	
BENEFATO_GEDCLEAS				This parameter sets the expected range measurement (in cm) that the second range finder should return when the vehicle is on the ground.	
3397FSTC_MAI_CM				Maximum distance in contineters that rangefinder can reliably read	
BROFSTO_MIN_CM				Minimum distance in contineters that rangefinder can reliably read	
BHUFBEC_OFFSET				Offset in volts for zero distance	
INFFEC_ORIENT			0:Forward 1:Ferward-Right 2:Right 3:Buck-Right 4:Buck 5:Buck-Left 6:Left 7:Ferward-Left 24:Up 25:Deen.	Orientation of 2md rangefinder	
BHOFBIC_PIN			-11841 Used O:ANR-AO 1:ANR-AI 2:ANR-AI 2:ANR-AS 4:ANR-AS 4:ANR-AS 8:ANR-AS 8:ANR-AS 7:ANR- AT 8:ANR-AS 9:ANR-A9 11:PEG-airspeed port 15:Fishowdrairspeed pert 64:ANR1-airspeed pert	Analog pin that rangefinder is connected to. Set this to 0.9 for the AMM2 analog pins. Set to 64 on an AMM3 for the dedicated 'airspeed' port on the end of the board. Set to 11 on 274 for the analog 'airspeed' part X position of the second rengefinder in being frame. Fourier X is forward of the origin. Now the zero range '	
) 😘 🖯 9.8 - T 🛛 😽	<u> </u>	0	Mp Mission Planner		下午 5:12 1/5/8 編8

Pic 5 Set radar library parameter

Finish set above parameters and save the setting, then restart the flight control to test the radar outdoors.

#### 7 FAQ

(1) What is the angular accuracy of the SR-PA24R?

The SR-PA24R is a 24GHz radar sensor is with one transmitter one reciever antenna, which can not be used to measure the angle of the target.

(2) When SR-PA24R facing vegetation and ground/water surface when measuring height, which target will be subject to it?

The SR-PA24R is a millimeter-wave radar with high range accuracy developed by our company. In practice, the height should be divided. If the height is less than 3m, the airflow under the aircraft is large and the vegetation is likely to be blown away. The

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reference point is the ground or the water surface. If the aircraft fly above 5m, the airflow will not affect the vegetation below. If the vegetation density is high, then the detected height will be the distance from vegetation to the aircraft.