

# RFS27-M-UART/CAN

## Altitude-Fixing Millimeter Wave Radar Application Manual

2022.08.02

### Disclaimer

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Any user must carefully read this statement before using the product. Once used, it is deemed as recognition and acceptance of the contents of this statement. Please install and use the product in strict accordance with the manual. SentiAu shall not be liable for any losses or damages caused by improper use.

## Version History



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Date	Version	Version Description
2019.08.23	1.0	First version of RFS27-M-UART/CAN Application Manual(UART Protocol)
2020.09.23	1.1	Revised version of RFS27-M-UART/CAN Application Manual(UART Protocol)
2021.06.11	1.2	Document format correction
2022.08.12	1.3	Parameter update

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## 1. Introduction to RFS27-M-UART/CAN

The RFS27-M-UART/CAN millimeter wave radar operates in the 77GHz-81GHz frequency band. It features 2cm measurement accuracy, compact

size, high sensitivity, light weight, easy integration, and stable performance. It can simultaneously detect the distance to vegetation and the ground, and adapt to various complex terrain environments. It meets the flight height guidance needs of unmanned aerial platforms such as agricultural plant protection drones and small express transport aircraft, and can also be applied in multiple fields such as hydrological monitoring and liquid level measurement.

## 2. Product Features

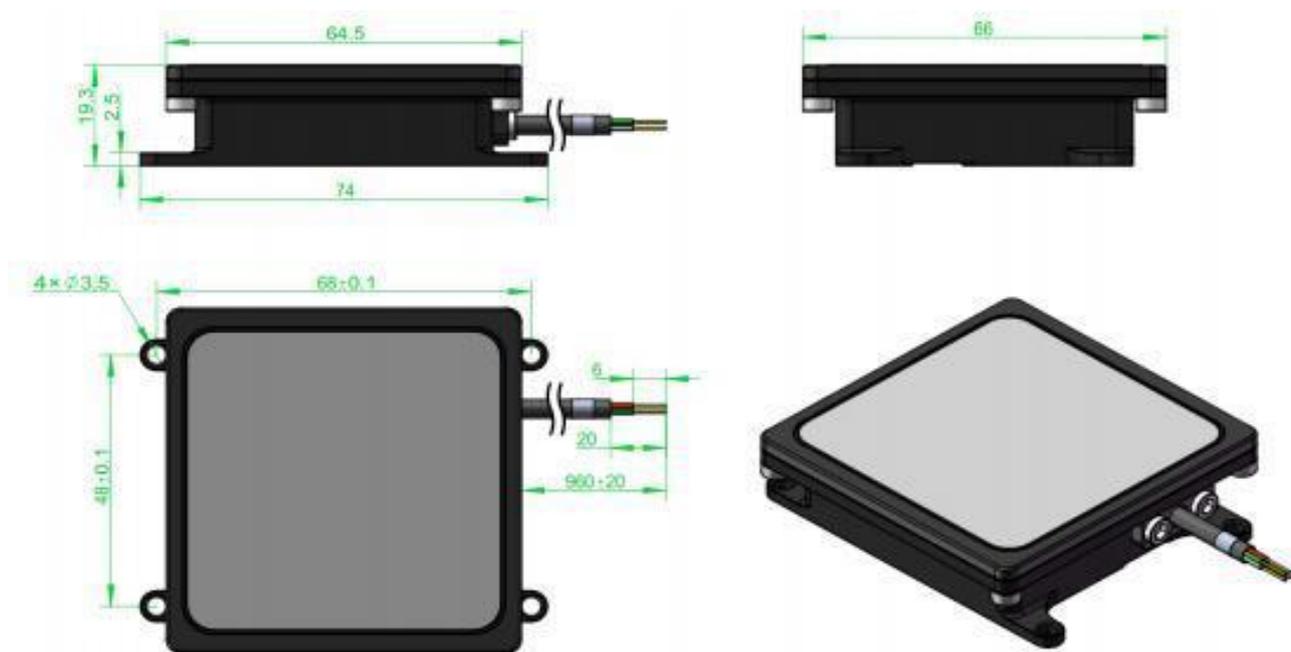


Figure 1 RFS27-M-UART/CAN Product Diagram

Note: Undimensioned tolerances:  $\pm 0.3\text{mm}$  when  $\leq 10\text{mm}$ ;  $\pm 0.5\text{mm}$  when between  $(10\sim 50)\text{mm}$ ;  $\pm 0.8\text{mm}$  when  $\geq 50\text{mm}$ .

## 3. Application Scenarios

The RFS27-M-UART/CAN millimeter wave radar is the first civil-grade radar adopting Frequency Modulated Continuous Wave (FMCW) modulation mode on the market. Within the measurement range, it can accurately measure the distance between the radar and obstacles, the ground, or the water surface, and can meet the application needs of multiple fields such as hydrological monitoring and liquid level measurement.

- FMCW modulation mode for distance measurement, with high stability;

- Millimeter-level high-precision distance measurement;
- Resists interference from harsh environments, effectively reducing maintenance costs.

## 4. Performance Parameters

The RFS27-M-UART/CAN adopts Frequency Modulated Continuous Wave (FMCW) modulation mode. Within the measurement range, it can accurately measure the distance between the radar and the ground or water surface, and can simultaneously calculate the height of vegetation. The parameters of the RFS27-M-UART/CAN radar are shown in the following table.

Table 1 RFS27-M-UART/CAN Main Parameter List

Feature	Parameter	Technical Index
Receiving Antenna Performance	Azimuth Beamwidth (3dB)	$\pm 34^\circ$
	Elevation Beamwidth (3dB)	$-6.5^\circ \sim +3^\circ$
	Maximum EIRP (dBm)	22
Radar Performance	Distance Measurement Range (m)	0.1-27
	Distance Measurement Accuracy (m)	0.02
	Distance Resolution (m)	0.12
Radar Attributes	Transmission Frequency (GHz)	77-81
	Refresh Rate (Hz)	20
	Frequency Modulation Bandwidth (GHz)	1.3
System Attributes	Operating Voltage (V)	8~24
	Operating Temperature ( $^\circ\text{C}$ )	$-40^\circ\text{C} \sim 85^\circ\text{C}$
	Power Consumption (W)	2.0
	Data Interface	UART
	PCB Size (mm)	50*50

## 5. Quick Start Steps

## Pin Defection

Table 2 RFS27-M-UART/CAN Pin Interface Definition

Pin	Definition	Range
1	POWER_IN (Red)	8~24V DC
2	GND (Black)	-
3	TX (Green)	0~3.3V
4	RX (White)	0~3.3V

## Test Usage

The upper computer test software can acquire and parse RFS27-M-UART/CAN sensor data, intuitively display observation results, and help use the RFS27-M-UART/CAN multi-target altitude-fixing millimeter wave radar altimeter. The test method using the UART protocol is as follows: First, obtain the RFS27-M-UART/CAN upper computer test software and user manual from the customer service of SentiAcu. Customers install and configure the upper computer test software according to the user manual.

Table 3 Product Test Tools

Serial Number	Equipment Name	Quantity
1	RFS27-M-UART/CAN Radar Sensor	1
2	PC	1
3	TTL-WIFI Box	1
4	8~24V Power Adapter	1
5	Upper Computer Test Software	1

1. Connect the PC to the RFS27-M-UART/CAN radar sensor through the TTL-WIFI box. The connection diagram is as follows:

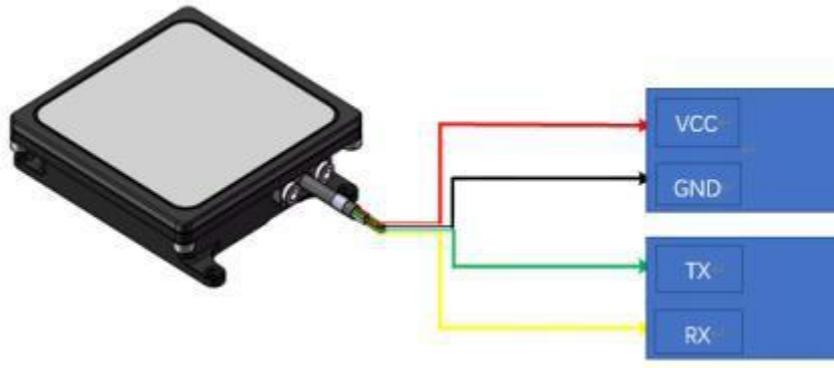


Figure 2 Serial Cable Connection Diagram

Note: The TTL-WIFI box shown in the figure below is required for communication with the RFS27-M-UART/CAN during testing. The TTL-WIFI box is not included in the default delivery list. Customers can obtain the purchase link of the TTL-WIFI box from the customer service of SentiAcu and purchase it by themselves.



Figure 3 TTL-WIFI Box Diagram

2. Connect the TTL-WIFI box to the PC, open the upper computer software, click Start, and the test results are shown in the figure:

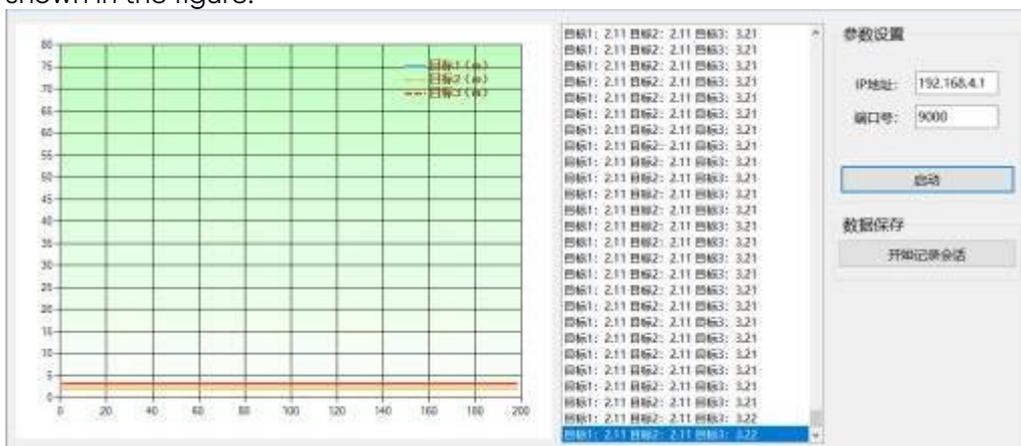


Figure 4 Radar Upper Computer Test Interface

## 6. Performance Parameters

The RFS27-M-UART/CAN radar sensor adopts a UART-TTL interface, with a preset default transmission rate of 115200bit/s. Each data packet starts with a start sequence and ends with an end sequence; the default data refresh cycle is 50ms, and the data is accurate to two decimal places. The data packet format definition of the RFS27-M-UART/CAN radar sensor is as follows:

Name	Length (Byte)	Value Range	Description
HEAD	2	0xFEFC	Start Sequence
DATA[0]DATA[1]	2	-	Height(Negative values are invalid; high byte first, unit: cm)
DATA[2]DATA[3]	2	-	Reserved, no processing required(Negative values are invalid; high byte first, unit: cm)
DATA[4]DATA[5]	2	-	Reserved, no processing required(Negative values are invalid; high byte first, unit: cm)
SEQ	1	0-255	Frame Cycle(This bit indicates the number of transmitted frames; when the number of frames exceeds 255, the frame count resets to zero)
CRC	1	-	Check Bit(Sum of the previous 9 bytes for verification)
TAIL	2	0x1D1D	End Sequence

Table 4 Data Packet Format Definition

Transmitted Data: Each frame fixedly transmits 12 bytes, the transmitted data is in hexadecimal. The height information is DATA[0] and DATA[1], with the high byte first. DATA[2]-DATA[4] are reserved, and the data can be left unprocessed.

Example: (0xFE 0xFC 0x00 0xE1 0x00 0xAD 0x01 0x26 0xC7 0x76 0x1D 0x1D)  
 $H = (\text{uint16\_t})((0x00 * 256) + 0xE1)$  (cm)  
 $\text{CRC} = (0xFE + 0xFC + 0x00 + 0xE1 + 0x00 + 0xAD + 0x01 + 0x26 + 0xC7) \ \& \ 0xFF;$

## 7. Product Usage Notes

- The power pin must be connected to an external 8~24V DC regulated power supply separately;
- Fix the RFS27-M-UART/CAN with 4 M4 screws;
- Keep the radar cover clean during installation. To clean the cover, use a soft damp cloth and let it air dry naturally;
- Pay attention to the shape of the radar during installation to ensure that the installed radar is not deformed. Do not squeeze, collide, or drop it;
- Ensure the radar is a factory-fresh unit during installation. Do not disassemble or assemble it by yourself.

## 8. Frequently Asked Questions (FAQ)

What is the height accuracy of your company's RFS27-M-UART/CAN?

The height accuracy of the RFS27-M-UART/CAN is 2cm. The RFS27-M-UART/CAN altitude radar is an independently developed 77GHz-81GHz radar by our company, adopting an advanced 2-transmit 4-receive integrated planar microstrip array antenna. It has a wide detection range, can simultaneously detect 3 targets, and can collect distances to multiple targets. Within the 0.5~30m measurement range, it can accurately measure the distance to the ground or water surface, and can simultaneously provide the heights of crops and the ground.

When the RFS27-M-UART/CAN measures height and encounters both vegetation and the ground, which target is taken as the reference?

When there is water on the ground, is the ground or the water surface taken as the reference?The RFS27-M-UART/CAN is a multi-target millimeter wave radar with high distance accuracy developed and designed by our company. In practical application, it depends on the height. If the height is lower than 3m, the air flow under the aircraft is strong at this time, and the vegetation is likely to be blown away, so the reference point is the ground or the water surface. If the aircraft reaches 5m, the air flow no longer affects the vegetation below. If the vegetation density is high, the reference point becomes the vegetation.

If you encounter any unsolvable problems during the installation process, please contact the customer service personnel of SentiAcu. We will serve you wholeheartedly!