24G Human Presence Radar

R24AVD2-A

User Manual (V1.2)

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1. Introduction

This document mainly describes the use of radar, the problems that may be encountered at different stages, to minimize the design costs and increase the stability of the product, and to improve the efficiency of the project.

Hardware circuit reference design, radar antenna and housing layout requirements, how to distinguish between interference and multi-functional UART protocol output.

The radar is a self-contained space sensing sensor, which is composed of RF antenna, radar chip and high-speed main frequency MCU. It relies on stable and flexible algorithm architecture core to provide solution for scene detections. It's equipped with upper computer or host computer to output detection status and data, and meet several groups of GPIO for user customization and development.

2. Function description

2.1 Description of standard function point

Function point for radar	State change time/function explanation
Human presence information report	Real time detection of the status of the environment with or without people Report within 0.5s from non-presence to presence Output non-presence state in 30s from presence to non-presence
Movement information report	Real time detection of the human motion state Report within 0.5s from static to active Report within 2s from active to static Report non-presence state when no one is present
Approaching/Leaving-away query	Report within 0.5s; if someone is approaching/leaving away from the device, report the approaching/leaving-away state

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Body movement parameter report	Output data every 1 second Quantify the amplitude of motion. 0 represents non-presence，1 represents static，2-30 represents slight limb movements，31-100 represents normal or rapid limb movements。
Maximum distance setting for presence sensing boundary	The human breathing detection distance is set to reduce the radar's false alarm rate. Reduce interference outside the detection range
Maximum distance setting for motion triggering boundary	The human motion detection distance is set to reduce the radar's false alarm rate. Reduce interference from walking near the doors and glass doors beyond the detection range.
Motion distance value reporting	Motion distance: The module detects the linear distance of human motion
Module reset	When setting the reset command, the radar enters a restart state ,and the parameters will not return to default values
Proactive reporting switch	When the 'active reporting switch' is turned off, the radar will not actively report any data
Message of initialization complete	After the radar module is powered on, it will enter the initialization state to query and report the radar functional points. The radar can only enter the working state normally after initialization is completed.

3. Protocol description

This protocol is applied to the communication between the 24G millimeter wave human presence detection radar and the host computer.

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This protocol outlines the radar workflow, gives a brief introduction to the interface protocol composition architecture, and explains the control commands and data required for radar operation. The serial communication is defined as follows:

- Interface level: TTL
- Baud rate: 115200bps
- Stop bit: 1
- Data bit: 8
- Parity check: No

4. Definition of communication command and parameter - standard function point/open underlying function point

4.1 Definition and description of frame structure

4.1.1 Definition of frame structure

Frame header	Control word	Command word	Length identification		Data	Check digit	Frame tail
0X53 0X59	Control	Command	Lenth_H	Lenth_H	Data	Sum	0X54 0X43
2 Byte	1 Byte	1 Byte	1 Byte	1 Byte	n Byte	1 Byte	2 Byte

4.1.2 Description of frame structure

- Frame header: 2Byte, fixed to 0X53,0X59;
- Control word: 1 Byte

(0x01-heartbeat packet identification, 0x02-product information, 0x03-OTA upgrade, 0x05-working status, 0x80-human presence)

- Command word: 1Byte (identification of current data)
- Length identification: 2Byte, equal to the specific byte length of data
- Data: nByte, defined according to the actual function
- Check digit: 1 Byte (check digit calculation: (frame header + control word + command word + length identifier + data) take the lowest eight bits after summation)
- Frame end: 2Byte, fixed to 0X54,0X43;

4.2 Description of address assignment and data information

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4.2.1 Description of standard function point

Category	Function description	Transmission direction	Frame header	Control word	Command word	Length identification	Data	Check field	Frame tail	Remarks
System functions	Heartbeat packet report	Report	5359	01	01	0001	0F	sum	5443	
	Heartbeat package query	Issue	5359	01	80	0001	0F	sum	5443	
		Reply	5359	01	80	0001	0F	sum	5443	
	Module reset	Issue	5359	01	02	0001	0F	sum	5443	
		Report	5359	01	02	0001	0F	sum	5443	
	Proactive reporting switch	Issue	5359	01	03	0001	00: Disable 01: Enable	sum	5443	
		Report	5359	01	03	0001	00: Disable 01: Enable	sum	5443	
	Proactive reporting switch query	Issue	5359	01	83	0001	0F	sum	5443	
		Report	5359	01	83	0001	00: Disable 01: Enable	sum	5443	
Information query										
Product Info	Product model query	Issue	5359	02	A1	0001	0F	sum	5443	
		Reply	5359	02	A1	len	len B product information	sum	5443	
	Product id query	Issue	5359	02	A2	0001	0F	sum	5443	
		Reply	5359	02	A2	len	len B product id	sum	5443	
	Hardware model query	Issue	5359	02	A3	0001	0F	sum	5443	
		Reply	5359	02	A3	len	len B hardware	sum	5443	

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							model			
	Firmware version query	Issue	5359	02	A4	0001	0F	sum	5443	
		Reply	5359	02	A4	len	len B firmware version query	sum	5443	
Working status	Function point reporting									
	Message of initialization complete	Report	5359	05	01	0001	00: Initialization failed; 01: Initialization finished	sum	5443	
	Information query									
	Initialization completion information query	Issue	5359	05	81	0001	0F	sum	5443	
		Reply	5359	05	81	0001	01: Completed 02: Not completed	sum	5443	
	Human presence report and function point setting									
	Human presence information report	Report	5359	80	01	0001	00: Non-presence 01: Presence	sum	5443	Report method: Report on status changes
	Movement information report	Report	5359	80	02	0001	00: No 01: Static 02: Active	sum	5443	Report method: Report on status changes
	Body movement parameter report	Report	5359	80	03	0001	1B body movement parameters	sum	5443	Report method: Report every 1s Value range:

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										0-100
	Maximum distance setting for presence sensing boundary	Issue	5359	80	06	0001	1B distance setting	sum	5443	Ranging from 1 to 4 (distance setting interval of 1), Unit: m
		Reply	5359	80	06	0001	1B distance setting	sum	5443	
	Information query									
	Presence information query	Issue	5359	80	81	0001	0F	sum	5443	
		Reply	5359	80	81	0001	00: Non-presence 01: Presence	sum	5443	
	Movement information query	Issue	5359	80	82	0001	0F	sum	5443	
		Reply	5359	80	82	0001	00: No 01: Static 02: Active	sum	5443	
	Body movement parameter query	Issue	5359	80	83	0001	0F	sum	5443	Value range: 0-100
		Reply	5359	80	83	0001	1B body movement parameters	sum	5443	
	Maximum distance query for presence sensing boundary	Issue	5359	80	86	0001	0F	sum	5443	Ranging from 1 to 4 (distance setting interval of 1), Unit: m
		Reply	5359	80	86	0001	1B distance setting	sum	5443	
Reporting function	Approach/ Stay Away	Report	5359	82	0A	0001	00: No 01: Leaving	sum	5443	

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							away 02: Approaching			
	Maximum distance setting for motion triggering boundary	Issue	5359	82	0C	0001	1B distance setting	sum	5443	Ranging from 1 to 8 (distance setting interval of 1), Unit: m
		Reply	5359	82	0C	0001	1B distance setting	sum	5443	
	Motion distance value reporting	Report	5359	83	16	0001	1B distance value	sum	5443	Unit: dm
	Information query									
	Approaching/Leaving-away query	Issue	5359	82	8A	0001	0F	sum	5443	
		Reply	5359	82	8A	0001	00: No 01: Leaving away 02: Approaching	sum	5443	
	Maximum distance query for motion triggering boundary	Issue	5359	82	8C	0001	0F	sum	5443	Ranging from 1 to 8 (distance setting interval of 1), Unit: m
		Reply	5359	82	8C	0001	1B distance setting	sum	5443	
	Motion distance value query	Issue	5359	82	96	0001	0F	sum	5443	
		Reply	5359	82	96	0001	1B distance value	sum	5443	Unit: dm
OTA function	Start OTA upgrade	Issue	5359	03	01	0004	4B upgrade packet size	sum	5443	
		Reply	5359	03	01	0004	4B firmware size per frame	sum	5443	

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	Upgrade package transmission	Issue	5359	03	02	Len+4	4Byte packet offset address + len B upgrade packet	sum	5443	
		Reply	5359	03	02	0001	01: Received 02: Failed to receive	sum	5443	
	Stop OTA upgrade	Issue	5359	03	03	0001	01: Upgrade package transmission completed 02: Upgrade package transmission uncompleted	sum	5443	
		Reply	5359	03	03	0x0001	0F	sum	5443	

Appendix 1: Example of data instruction generation

Example: Presence information query:

The data structure for confirming the presence information query according to the protocol form above:

- Frame header: 0X53 0X59
- Control word: 0X80
- Command word: 0X81
- Length identification: 0X00 0X01
- Data: 0X0F
- Check digit: 1 Byte (SUM)
- Frame end: 0X54 0X43
- Combined to a complete command as: 53 59 80 81 00 01 0F sum 54 43
- Check digit sum: (0X53+0X59+0X80+0X81+0X00+0X01+0X0F) = 0X01BD
  Take the lower byte to get sum = 0XBD

So the complete presence information query command is: 53 59 80 81 00 01 0F BD 54 43

5. Disclaimer

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8. Updates history

Revision	Release Date	Summary
V1.0	2024/11/04	first draft
V1.1	2024/11/18	1、Optimize the calculation method of motion triggering boundary and presence sensing boundary; 2、Delete Non-presence time settings
V1.2	2025/01/21	Change product model