Rd-03 UART Communication Protocol

Version V1.0.0

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Document resume

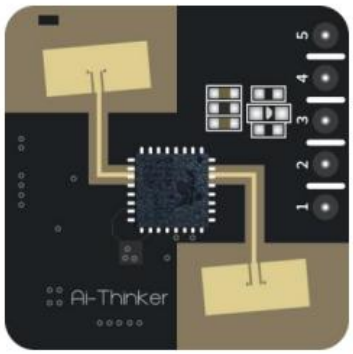
Version	Date	Develop/revise content	Edition	Approve
V1.0.0	2025/5/7	First Edition	Qian Zekai	Wei Jie

Content

1. Introduction of communication interface

1.1. Pin definition and wiring

Rd-03_V2 module is connected to a total of 5 pins,as shown in the schematic diagram of the pin, the pin function definition table is the interface definition.



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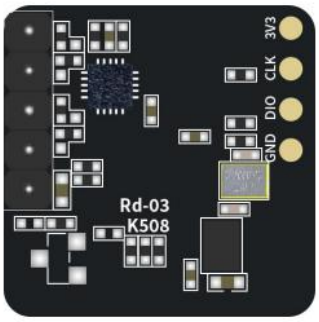

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Figure 1. Module pin diagram

Table 1 Rd-03-V2.0 connected to the TTL

Rd-03 V2	USB to TTL
1 (3.3V)	3.3V
2 (GND)	GND
3 (RX)	TXD
4 (OT1)	RXD
5 (OT2)	Output high and low levels according to the detection results, no wiring

1.2. Configuration parameters and parameter description

Users can modify the configuration parameters of the module through the serial port of Rd-03

to adapt to different application requirements. The configurable radar detection parameters are shown in Table 2. The agreement does not support to modify the threshold for currently.

Table 2 Rd-03 configuration parameters

Parameters name	Available range	Description
Minimum detection distance gate	0~15	Use to set the minimum detection range of radar, a distance gate is 70cm
Maximum detection distance gate	0~15	Used to set the maximum detection distance of the radar. The length of a range gate is 70cm.
Target disappearance delay time	0~65535	It takes a while for the target state to switch from occupied to unoccupied. The unit is seconds.The unit is seconds.
Motion trigger threshold	0~65535	modulus squared
Motion hold threshold	0~65535	modulus squared
Micro moving-threshold	0~65535	modulus squared
Power supply interference alarm	0, 1, 2	0: Not performed; 1: No interference; 2: Interference. This parameter is read-only.
Running mode(Normal mode)	No	Serial printout status
Report mode	No	Report the energy value and detection results of each distance gate (host computer do the analysis)

2. Communication protocol

This communication protocol is mainly separated from the visualization tool for secondary development for the user. Rd-03_V2 communicates with the outside world through a serial port (TTL level). Data output and parameter configuration commands of the radar are performed under this protocol. The default port rate of radar serial port is 115200,1 stop bit, no parity bit.

2.1. Protocol format

2.1.1. Protocol Data Format

The serial port data communication of Rd-03_V2 uses a small end format, and all data in the following table are hexadecimal.

2.1.2. Command protocol frame format

The radar configuration command and ACK command formats defined by the protocol are shown in Tables 3 to Table 6.

Table 3 Send command protocol frame format

Frame header	Intra-frame data length	Intra-frame data	End of frame
FD FC FB FA	2bytes	See table 4	04 03 02 01

Table 4 send intra-frame data format

Command Word (2 bytes)	Command value (N bytes)

Table 5 ACK command protocol frame format

Frame header	Intra-frame data length	Intra-frame data	End of frame
FD FC FB FA	2bytes	See table 6	04 03 02 01

Table 6 ACK intra-frame data format

Send command word （2bytes）	Command execution status (2 bytes)	Return value (N bytes)

2.2. Send command with ACK

2.2.1. Open command mode

Any other command issued to the radar must not be executed until this order is issued, otherwise it is invalid.

Command word：0x00FF

Command value：0x0001

Return value: 2 bytes ACK status (0 success, others value is failure) + 2 bytes protocol version (0x0001) + 2 bytes buffer size (0x0040)

Send data:

FD FC FB FA	04 00	FF 00	01 00	04 03 02 01

Radar ACK(Success)：

FD FC FB FA	08 00	FF 01	00 00	02 00	20 00	04 03 02 01

2.2.2. Close command mode

End configuration command, Radar resumes working mode after execution. If you need to issue other commands again, you need to send the enable configuration command first.

Command word：0x00FE

Command value：No

Return value：2bytes ACK status（0 success，others value is failure）

Send data：

FD FC FB FA	02 00	FE 00	04 03 02 01

RadarACK(Success)：

FD FC FB FA	04 00	FE 01	00 00	04 03 02 01

2.2.3. Parameter Configuration Command

This command sets the minimum detection range gate of radar (configuration range 0~15), the maximum detection range, the minimum number of target frames, the minimum number of frames of target disappearance, and the delay time parameter of target disappearance (configuration range 0~65535 seconds). Please refer to Table 7 for the specific parameters.

Command word：0x0007

Command value：2bytes parameter word+4bytes parameter word

Return value：2bytes ACK status（0 success，1 failed）

Table 7 0x0007protocol parameter word

Parameter name	Parameter word
Minimum detection distance gate	0x0000
Maximum detection distance gate	0x0001
Target disappearance delay time	0x0004
Motion trigger threshold	0x0010~0x001F
Motion hold threshold	0x0020~0x002F
Micro-threshold	0x0030 ~ 0x003F
Power supply interference alarm	0x0005

Send data: Maximum detection distance gate 3 (not saved after power failure)

Frame Header	Intra-frame data length	Command word	Parameter ID	Parameter Value	End of Frame
FD FC FB FA	08 00	07 00	01 00	03 00 00 00	04 03 02 01

Radar ACK(success)：

Frame Header	Intra-frame data length	Command word	ACK	End of Frame
FD FC FB FA	04 00	07 01	00 00	04 03 02 01

The following configuration is required to save the parameters set when power is off:

Query ABD, and add ABD parameters when sending parameters

1. To read ABD, send the following command

Frame header	Intra-frame data length	Command word	ABD	End of Frame
FD FC FB FA	04 00	08 00	2F 00	04 03 02 01

2. The radar's ACK data will contain ABD parameters

Frame header	Intra-frame data length	Command word	ACK	ABD parameters	End of Frame
FD FC FB FA	04 00	08 01	00 00	64 00 00 00	04 03 02 01

3. Maximum detection distance gate 3 Power-off save reference, add ABD and parameters based on the command not sent

Frame header	Date length in frame	Command word	Parameter ID	Parameter value	ABD	ABD parameter	End of frame
FD FC FB FA	0E 00	07 00	01 00	03 00 00 00	2F 00	64 00 00 00	04 03 02 01

Motion trigger threshold and motion hold threshold setting guide:

The threshold value is the signal-to-noise ratio, the input value is S/N, the calculation formula is 10lg (S/N), the range is 0~ (2^32)-1

If the final threshold value is 47.47, the calculation method is 47.74= 10lgX, X= 10^4.774, X is calculated as 59,429, and the final hexadecimal value is E825

4. Modify the motion trigger threshold of the first distance gate to 47.47 and save (the motion trigger threshold distance gate starts from 10, and the motion

hold threshold distance gate starts from 20)

Frame header	Data length in the frame	Command word	Parameter ID	Parameter value	ABD	ABD parameter	End of frame
FD FC FB FA	0E 00	07 00	11 00	25 E8 00 00	2F 00	64 00 00 00	04 03 02 01

2.2.4. Read the parameter command

This command reads the current configuration parameters of the radar

Command word: 0x0008

Command value: 2-byte parameter words

Return value: 2 byte

ACK status (0 successful, other value failed) + 4 byte parameter value

Send data: Read the maximum distance gate configuration parameters

FD FC FB FA	04 00	08 00	01 00	04 03 02 01

Radar ACK:

FD FC FB FA	08 00	08 01	00 00	0C 00 00 00	04 03 02 01

2.2.5. Configure system parameters

This command can configure the radar system parameters

Command word: 0x0012

Command value: (2-byte parameter word ID + 4-byte parameter value) * N

Return value: 2-byte ACK status (0 success, other values failure)

Table 8 0x0012 Protocol Parameter Words

Parameter name	Parameter word	Description
Report mode	0x04	The serial port reports the energy value and

		detection result of each distance gate.
Running mode	0x64	Serial port print output status

Send data: set to report mode.

FD FC FB FA	08 00	12 00	00 00	04 00 00 00	04 03 02 01

Send data: set to run mode

FD FC FB FA	08 00	12 00	00 00	64 00 00 00	04 03 02 01

Radar ACK:

FD FC FB FA	04 00	12 01	00 00	04 03 02 01

2.2.6. Start automatic door threshold generation command

This command sets the parameters for automatic threshold generation and enables the MCU to start automatically generating threshold calculations.

Table 8 Automatically generated threshold parameter table

Parameter name	Parameter range	Description
Motion trigger threshold generation coefficient	0x000A~0x00C8	10 times magnification factor, for example, when the factor is 2, the parameter value is 0x0014
Motion hold threshold generation coefficient	0x000A~0x00C8	10 times magnification factor, for example, when the factor is 2, the parameter value is 0x0014
Micro-motion hold threshold generation coefficient	0x000A~0x00C8	10 times magnification factor, for example, when the factor is 2, the parameter value is 0x0014

Command word: 0x0009

Command value: 6-byte parameter value

Return value: 2 bytes ACK status (0 success, 1 failure)

Send data (Example: Trigger threshold generation factor is 4, hold threshold generation factor is 1.5):

Frame header	Data length in the frame	Command word	Parameter value	End of frame
FD FC FB FA	08 00	09 00	2bytes trigger threshold + 2bytes hold threshold + 2bytes micro-threshold	04 03 02 01

ACK (Success) :

Frame header	Data length in the frame	Command word	ACK	End of Frame
FD FC FB FA	04 00	09 01	0000: Success; Others: Failure	04 03 02 01

2.2.7. Automatic threshold progress query command

This command can query the progress of automatic threshold generation. The return value includes the progress percentage. When the percentage is 100, it means that the threshold is generated.

Command word: 0x000A

Command value: None

Return value: 2 bytes ACK status (0 success, 1 failure) + 2 bytes percentage

Send data:

Frame header	Data length in the frame	Command word	End of frame
FD FC FB FA	02 00	0A 00	04 03 02 01

ACK (successful, example: the percentage is 60%):

Frame header	Data length in the frame	Command word	ACK	Percentage (%)	End of frame

FD FC FB FA	06 00	0A 01	00 00	3C 00	04 03 02 01

2.2.7. Report automatic threshold interference

This command reports the millimeter wave sensor automatic threshold motion human interference alarm.

Frame header	Data length in the frame	Command word	End of frame
FD FC FB FA	02 00	14 00	04 03 02 01

ACK:

Frame header	Data length in the frame	Command word	Parameter value	End of frame
FD FC FB FA	06 00	14 00	2-byte status byte + 2-byte range gate status, status byte: 0000: Success, no interference; 0001: Failure, interference Range gate status: Example: 0x84, converted to binary as 1000_0100_0000_0010, corresponding to 1, 10, 15 range gates exist	04 03 02 01

2.3. Radar data output protocol

Rd-03_V2 outputs the radar detection results through the serial port, and outputs the basic target information by default, including the target state and motion distance. If the radar is configured in reporting mode, the radar will output additional energy values for each distance gate. The radar data is output in the specified frame format.

2.3.1. Reporting data frame format

Under the radar operation mode defined by the protocol, the data format is shown in Table 9 . In reporting mode, the reported datatype values are defined in Table 10.

Table 9. Operating mode

Target status	Movement distance
Distance:	range （cm）
OFF	none

Table 10 Reporting mode

Package head	Data				Package end
	Data length	Result	Target range	Each range gate energy	
0xF4,0xF3,0xF2,0xF1	0x0023	Have someone or no one （1byte）	2byte	16*4byte	0xF8,0xF7,0xF6,0xF5

2.4. Radar command configuration mode

2.4.1. Radar command configuration step

The procedure for setting the parameters：

1. The host computer sends the Open Command Mode to bring the MCU into the command mode. At this time, the MCU does not perform human detection, and only waits for the command of the upper computer
2. The host computer sends the parameter setting, parameter reading and other commands
3. The host computer sends the "exit command mode", and the MCU enters the normal working mode for human detection

2.4.2. Attentions for radar configuration

Note：

1. Serial command single maximum data length is not more than 64 bytes (the size shall be

subject to the actual situation, each platform may not be the same, when the host computer send the start command, the results of the lower computer contain command communication cache size), so when read and write multiple registers, if more than 64 bytes, need to be divided into multiple commands.

2. Byte order: little endian

3. Because the serial port will output the radar waveform data by default, it needs to switch to the command mode before issuing the command, which is usually divided into three steps:

(1) Send "Open command mode" (because the chip may still output data, the data received by the serial port will contain waveform data)

(2) Empty serial port cache data (generally delay around 100ms, to ensure that serial port data is emptied)

(3) Send the Open Command Mode, once again, and analyze returned results

After the command mode ends, send the turn off command mode to start the waveform data transfer

4. The custom command ID interval is recommended between 0 x 0060-0 x00A0.

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