Rd-03 serial communication protocol

Version V1.0.0

Document resume

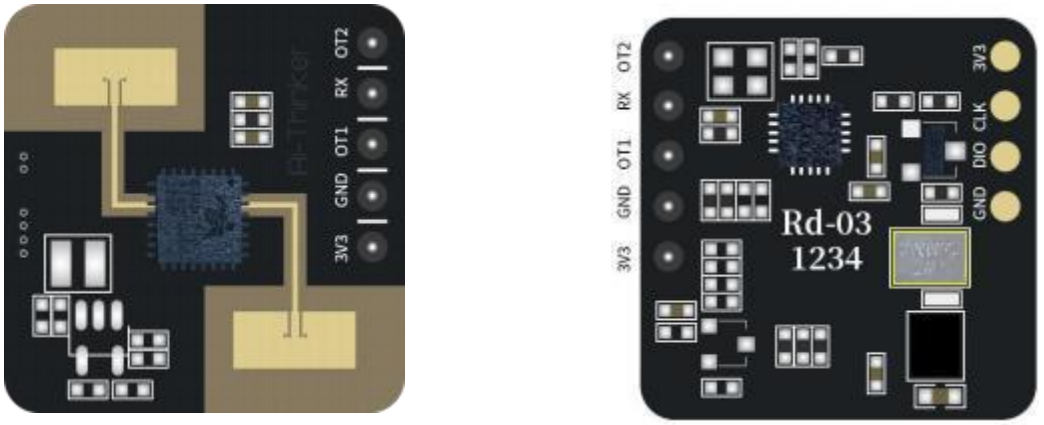
Version	Date	Develop/revise content	Edition	Approve
V1.0.0	2023/6/29	First Edition	Qian Zekai	Wei Jie

Content

1. Introduction of communication interface

1.1. Pin definition and wiring

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



Front Back

Figure 1. Module pin diagram

Table 1 Rd-01 connected to the TTL

Rd-03	USB to TTL
3.3V	3.3V
GND	GND
RX	TXD
OT1	RXD
OT2	Target status output: Human presence detected: output high level No human presence: output low level

1.2. Configuration parameters and parameter description

Users can modify the configuration parameters ofthe module through the serial port ofRd-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
Maximum detection distance gate	0~15	Use to set the minimum detection range of radar, a distance gate is 70cm
Target disappearance delay time	0~65535	It takes a delay time T to switch the target state from someone to no one, During this period, if someone is detected, restart the time period. The radar will switch to the unmanned state only after the unmanned state is detected for a full T time.The unit is seconds.
Debugging mode	No	Serial port report RDMap (host computer do the resolution)
Running 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 communicates with the outside world through a serial port (TTL level). Data output and parameter configuration commands ofthe radar are performed under this protocol. The default port rate ofradar 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 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|0x0100（2bytes）	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	01 00	40 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 ofradar (configuration range 0~ 15), the maximum detection range, the minimum number oftarget frames, the minimum number of frames oftarget disappearance, and the delay time parameter oftarget 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
Minimum number oftarget frames for detected	0x0002
Minimum number offrames when the target disappears	0x0003
Target disappearance delay time	0x0004

Send data: the farthest detection distance gate 3（Power failure does not save）

FD FC FB FA	08 00	07 00	01 00	03 00 00 00	04 03 02 01

Radar ACK(success)：

FD FC FB FA	04 00	07 01	00 00	04 03 02 01

The following parameters need to be configured to save the Settings:

1、Read the ABD parameter (0X002F), identify the 0X002F parameter before saving, radar sends:

FD FC FB FA	04 00	08 00	2F 00	04 03 02 01

2、Assume that the radar ACK is (ACK may be different between different modules, it needs to be determined according to the actual situation)：

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

3、Set the ABD reference (set three distance gates 03 00 00 00 00 because 0X002F reads 64 00 00 00 00 in step 2, add 2F 00 64 00 00 00 00 after the set instruction), the radar sends：

FD FC FB FA	07 00	01 00	03 00 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 ofthe 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: the farthest detection distance gate 3

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	03 00 00 00	04 03 02 01

2.2.5. Configure system parameters

This command can configure the radar system parameters, parameter word **0x0000-systemMode**.

Command word: 0x0012

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

Return value: 2 bytes ACK status (0 succeeded, other values failed)

Table 8 0x0012 Protocol Parameter Words

Parameter name	Parameter word	Description
Debugging mode	0x00	Serial port reporting RDMap
Report mode	0x04	The serial port reports the energy value and detection result ofeach distance gate.
Running mode	0x64	Serial port print output status

Send data: set to debug mode

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

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

2.3. Radar data output protocol

Rd-03 outputs the radar detection results through the serial port, and outputs the basic target information by default, including the target state and motion distance. Ifthe 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

The reported message frame format is shown in Table 9. In debugging mode and reporting mode, the reported data type values are defined in Table 10 and Table 11.

Table 9. Operating mode

Target status	Movement distance
ON	range （cm）
OFF	none

Table 10. Debugging mode

Package head	Data	Package end
0xAA,0xBF,0x10,0x14	20 * 16 * 4 bytes (20 Doppler, 16 ranges, 4 bytes for each point, data value of4 bytes per point)	0xFD,0xFC,0xFB,0xFA

Table 11 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	2byte	16*2byte	0xF8,0xF7,0xF6,0xF5

		（1byte）			

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 ofthe 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 ofthe lower computer contain command communication cache size), so when read and write multiple registers, ifmore 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 offcommand 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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