Interface Agreement of 60G Radar Module for Respiration and Heartbeat Monitoring

IR60BH1A

DALIAN IFLABEL TECHNOLOGY CO., LTD.

CONTENTS

1. Protocol Description

This protocol is applied to the communication between the company's radar and the host computer. This protocol clearly defines many operation commands including radar equipment control, test, upgrade and information query, as well as the transmission data format and command between radar and host computer. This protocol outlines the radar work flow, briefly introduces the composition architecture of the interface protocol, and gives the relevant control commands and data required by the radar work.

1. 1 Application Scope of the Protocol

This agreement is applicable to 60g IR60BH1A radar sensors developed by our company.

1. 2 Explanation of relevant terms

1) Uplink transmission: the radar transmits data and instructions to the upper computer;

2) Downlink transmission: the upper computer transmits instructions or other contents to the radar;

3) Upper computer: the communication target corresponding to the radar terminal, which is used for radar data reception, radar control, etc;

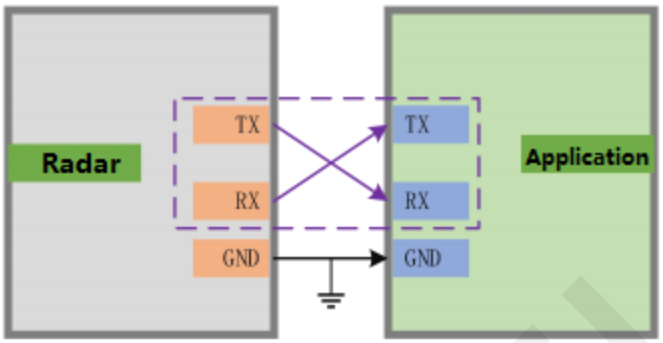
The upper computer can be a computer, embedded device or network server;

4) Heartbeat packet: the CMD that the radar sensor notifies the application terminal of its status regularly. The default time interval is 1 minute;

5) Short for remote upgrade;

6) Data frame: the transmission between radar and host computer is carried out in data frame mode;

The interface diagram between radar and application equipment is shown in the figure below.



The radar interface adopts serial communication (UART), and the interface level is TTL (3.3V). Under the condition of users' needs, the interface conversion is realized through the external RS485 interface circuit, but the transmission data format does not change.

2.2 Interface Protocol

The interface between radar module and application terminal includes data interface and control interface. The interface parameters are as follows:

	Function	Control Interface	Remark
1	Interface Level	TTL	
2	Baud Rate	115200bps	
3	Data Bit	8	
4	Stop Bit	1	
5	Parity Check	No	

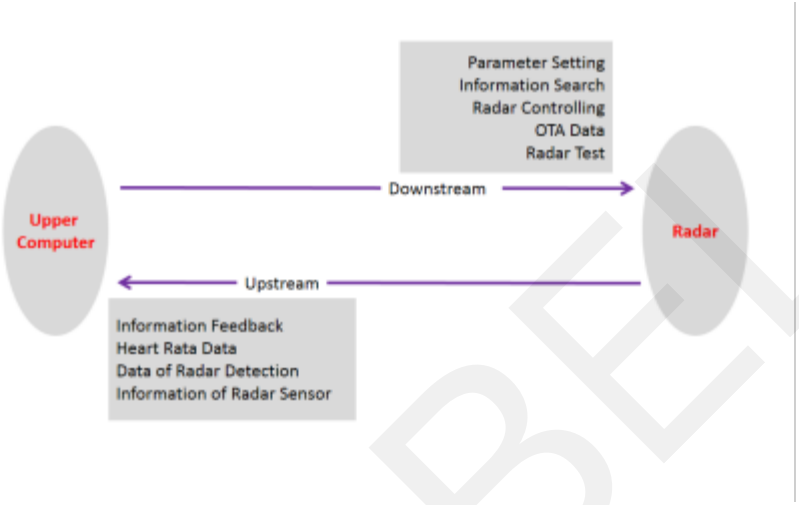


Figure 1 Radar Information Transmission Architecture

3.2 Definition of Frame Format

The definition of frame format is shown as below:

FH	CD	OD	L1	DA	CH	FT

Specifics：

No.	Field	Mark	Length（B）	Description
1	Frame Header	FH	2	Default"0x53 0x59" //"S Y"
2	Control Word	CD	1	0x01-Heartbeat packet; 0x02-Product information; 0x03-OTA Upgrade; 0x04-Radar test; 0x05-Working status; 0x06-Radar position information; 0x80-Human presence; 0x81-Respiratory rate and heart rate;
3	Command Word	OD	1	Identify the current data content, to be defined

4	Length Identification	L1	2	Data length of DA
5	Data	DA	_	0～2048Byte
6	Check Filed	CH	1	Checksum
7	End of Frame	FT	2	Default“0x54 0x43” //“T C”

Note: in the above table, OD content may have different definitions in different radar applications；

No	Product Category	Function	Transmission Direction	Frame Header	Control Word	Command Word	Length Marking	Data	Check Field	End Of Frame	Remark
1	Heartbeat Packet Parameters	Heartbeat packet query	issue	0x53 0x59	0x 01	0x01	0x000 1	0x0f	Sum	0x54 0x43	
			report	0x53 0x59	0x 01	0x01	0x000 1	0x0f	Sum	0x54 0x43	
2	Product Information parameters	Product model query	issue	0x53 0x59	0x 02	0x01	0x000 1	0x0f	Sum	0x54 0x43	
			report	0x53 0x59	0x 02	0x01	len	Product information	Sum	0x54 0x43	
3		Product model setting	issue	0x53 0x59	0x 02	0x02	len	Product information	Sum	0x54 0x43	
			report	0x53 0x59	0x 02	0x02	len	Product information	Sum	0x54 0x43	
4		Product ID query	issue	0x53 0x59	0x 02	0x03	0x000 1	0x0f	Sum	0x54 0x43	
			report	0x53 0x59	0x 02	0x03	len	Product ID	Sum	0x54 0x43	
5		Product ID setting	issue	0x53 0x59	0x 02	0x04	len	Product ID	Sum	0x54 0x43	
			report	0x53 0x59	0x 02	0x04	len	Product ID	Sum	0x54 0x43	
6		Hardware mode query	issue	0x53 0x59	0x 02	0x05	0x000 1	0x0f	Sum	0x54 0x43	
			report	0x53 0x59	0x 02	0x05	len	Hardware model	Sum	0x54 0x43	
7		Hardwaremodel setting	issue	0x53 0x59	0x 02	0x06	len	Hardware model	Sum	0x54 0x43	
			report	0x53 0x59	0x 02	0x06	len	Hardware model	Sum	0x54 0x43	
8		Firmware	issue	0x53	0x	0x07	0x000	0x0f	Sum	0x54	

		model query		0x59	02		1			0x43	
			report	0x53 0x59	0x 02	0x07	len	Firmware model	Sum	0x54 0x43	
9		Firmware model setting	issue	0x53 0x59	0x 02	0x08	len	Firmware model	Sum	0x54 0x43	
			report	0x53 0x59	0x 02	0x08	len	Firmware model	Sum	0x54 0x43	
10		Protocol information query	issue	0x53 0x59	0x 02	0x09	0x000 1	0x0f	Sum	0x54 0x43	
			report	0x53 0x59	0x 02	0x09	len	Protocol information	Sum	0x54 0x43	
11		Protocol information setting	issue	0x53 0x59	0x 02	0x0a	len	Protocol information	Sum	0x54 0x43	
			report	0x53 0x59	0x 02	0x0a	len	Protocol information	Sum	0x54 0x43	
12	OTA Parameters	OTA upgrade start	issue	0x53 0x59	0x 03	0x01	0x001 3	4 Byte firmware package +15 Byte firmware version	Sum	0x54 0x43	
			report	0x53 0x59	0x 03	0x01	0x000 1	0x01:agree 0x02:reject	Sum	0x54 0x43	
13		Upgrade package transmission	issue	0x53 0x59	0x 03	0x02	0x040 4	4Byte packet offset address+ 1024Byte data packet	Sum	0x54 0x43	
			report	0x53 0x59	0x 03	0x02	0x000 1	0x01:received 0x02:failed	Sum	0x54 0x43	
14		OTA upgrade over	issue	0x53 0x59	0x 03	0x03	0x000 1	0x01:sent 0x02:failed	Sum	0x54 0x43	
			report	0x53 0x59	0x 03	0x03	0x000 1	0x0f	Sum	0x54 0x43	
15		Operating mode setting	Issue	0x53 0x59	0x 05	0x01	0x000 1	1Byte operating mode	Sum	0x54 0x43	
			report	0x53 0x59	0x 05	0x01	0x000 1	1Byte operating mode	Sum	0x54 0x43	
16		Operating mode query	issue	0x53 0x59	0x 05	0x02	0x000 1	0x0f	Sum	0x54 0x43	

			report	0x53 0x59	0x 05	0x02	0x000 1	1Byte operatin g mode	Sum	0x54 0x43	
17		Operatin g hour query	issue	0x53 0x59	0x 05	0x03	0x000 1	0x0f	Sum	0x54 0x43	
			report	0x53 0x59	0x 05	0x03	0x000 4	Operatin g hour	Sum	0x54 0x43	
			report	0x53 0x59	0x 06	0x09	0x000 2	2Byte FOV angle	Sum	0x54 0x43	
18	Radar for human presence perception	Presence informati on	report	0x53 0x59	0x 80	0x01	0x000 1	0x00:no body 0x01:so me body	Sum	0x54 0x43	Report in real- time
19		moveme nt informati on	report	0x53 0x59	0x 80	0x02	0x000 1	0x00:No 0x01:app roaching 0x02:leav ing 0x03:ord er-less motion	Sum	0x54 0x43	Report in real- time
20		Body motion paramete rs	report	0x53 0x59	0x 80	0x03	0x000 1	1Byte body motion paramet er	Sum	0x54 0x43	Report periodic ally
21	Radar for respiration and heart rate monitoring	Heart rate informati on	report	0x53 0x59	0x 81	0x01	0x000 1	1Byte Heart rate informati on	Sum		Heart rate informa tion 0x01:No rmal 0x02:To o high0x0 3:心率 Too low
22		Heart rate value	report	0x53 0x59	0x 81	0x02	0x000 1	1Byte Heart rate value	Sum	0x54 0x43	
23		Heart rate wavefor m	report	0x53 0x59	0x 81	0x03	0x000 1	1Byte Heart rate wavefor m	Sum	0x54 0x43	
24		Respirati on informati on	report	0x53 0x59	0x 81	0x04	0x000 1	1Byte Respirati on informati on	Sum	0x54 0x43	0x01:No rmal 0x02:To o high 0x03:To o low 0x04:de tecting

25		Respiration value	report	0x53 0x59	0x 81	0x05	0x0001	1Byte Respiration value	Sum	0x54 0x43	
26		Respiration waveform	report	0x53 0x59	0x 81	0x06	0x0001	1Byte Respiration waveform	Sum	0x54 0x43	
27		Abnormal in location detection	report	0x53 0x59	0x 81	0x07	0x0001	1Byte Local alert	Sum	0x54 0x43	Alert when the detected target exceeds the detection range 0x00:beyond range 0x01: Within range
28		Stationary distance	report	0x53 0x59	0x 81	0x08	0x0002	2Byte Stationary distance	Sum	0x54 0x43	Unit cm
29		Stationary angle	report	0x53 0x59	0x 81	0x09	0x0002	2Byte Stationary angle	Sum	0x54 0x43	Unit °

4. 2 Data Description

4.2 . 1 Data of Heart Rate

The total length of data is 4 Byte, which is temporarily reserved.

4.2 . 2 Feedback of Product Model Information

Query of complete information of the equipment, feedback information including equipment hardware information, firmware information, protocol information, etc., which are reported in turn according to hardware information feedback, firmware information feedback and protocol information feedback.

Query of product model and feedback of product model with a length of 10 Byte.

4.2 . 3 Product ID Information Feedback

Product ID query, Product ID feedback length is 12 Bit.

4.2 . 4 Hardware Information Feedback

The length of hardware feedback information is 12 Byte. See equipment coding specification for information specification.

4.2 . 5 Firmware Information Feedback

The length of firmware information is 15 Byte. See equipment coding specificatio for information specification.

4.2 . 6 Protocol Information Feedback

The length of protocol information is 8 Byte. See equipment coding specification for information specification.

4.2 . 7 Content Transmission of OTA

The first 4 Byte is the firmware package off set address, followed by the firmware content of 1024 Byte.

When the module starts to work when it is initially powered on, it is necessary to completely reset the internal circuit of the module and fully evaluate the environmental noise to ensure the normal operation of the module. Therefore, when the module is initially powered on, it needs a startup stability time of ≥20s to ensure the validity of subsequent output parameters.

5.2. Limitations on Heartbeat Monitoring

Since this module is a respiratory and heartbeat detection radar, the detection distance should not be too far, and the appropriate distance is 0.4m-2m. When there are objects with stro nger reflectivity than the measured target around the measured target, the radar may track the strongly r eflected target during operation. At this time, the radar detection parameters are abnormal and the radar position needs to be adjusted.

At present, the radar module can only measure a single target, and multi-target measurement is temporarily unavailable. Therefore, when multiple people are located in the radar detecti on area, the detection parameters are disordered, which needs attention.

5.3. Radar biological detection performance

Because human biological characteristics belong to ultra-low frequency and weak reflection character istic signals, radar processing requires a relatively long cumulative processing. During the cumulative process, many factors may affect the radar parameters, so occasional detection failure is normal.

5.4. Power

The radar module requires higher power quality than conventional low frequency circuits. When powering the module, it is required that the power supply has no threshold glitches or ripples and that it effectively shields the power supply noise caused by accessory equipment. The radar module needs to be well grounded. Due to the ground noise brought by other circuits, the performance of the radar mod ule may even be reduced or even work abnormally; the most common cause is a shorter detection d istance or an increased false alarm rate.

In order to ensure the normal operation of the VCO circuit inside the module, the power supply requir ement for this module is + 5V- + 9V power supply, voltage of power supply no less than 5V. The external p ower supply must provide sufficient current output capability and transient response capability.

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8. Contact Information

Dalian iFlabel Technology Co., Ltd.

Email address: info@iflabel.com

TEL: 0411-84619565

Address: Zhongnan Building, No.18, Zhonghua West ST,

Ganjingzi DST, Dalian, CHINA