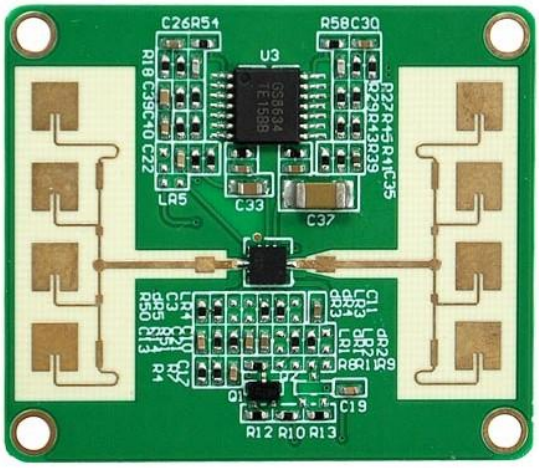
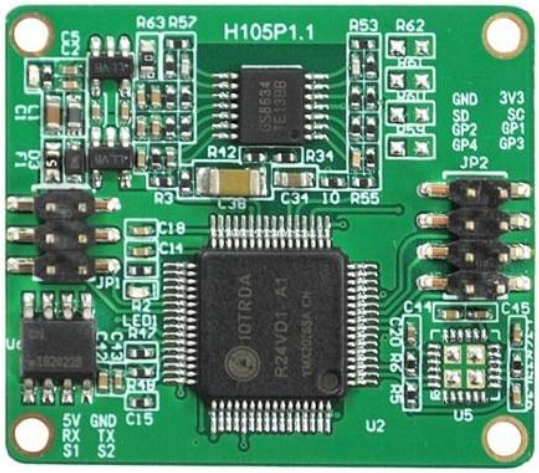
Datasheet of Wireless Bio-Radar Sensor for Human Presence Detection IR24VDA

Dalian iFlabel Technology Co., LTD.

Specification





Model	**Standard**
Description	**Wireless Bio-Radar Sensor for Human Presence Detection**
Part Number	**IR24VDA**
Date	**2021/03/19**
Version	**1.1**

	Design Team		
	Approval	**Check**	**Edit**

R.1513, Zhongnan Building Block A, NO.18 Zhonghua W. Rd, Ganjingzi Dist, Dalian

Tel: +86-411-84619565
Email: info@iflabel.com
Site: www.iflabel.com

Contents

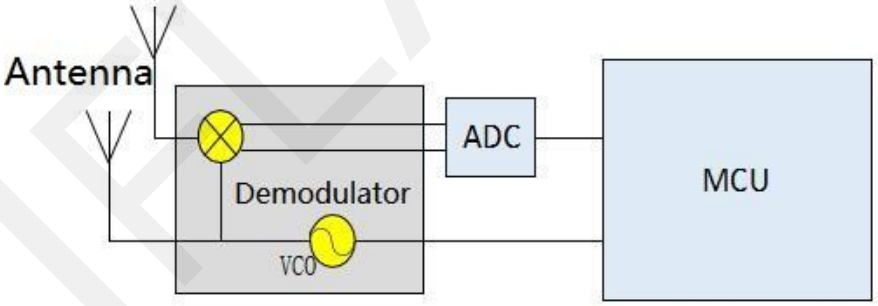
Overview

This document mainly describes the use of the radar and the problems needing attention in each stage, so as to reduce the design cost and increase the stability of the product as much as possible and improve the completion efficiency of the project.

From the hardware circuit reference design, the layout requirements of radar antenna and shell, how to distinguish interference and multifunctional standard UART protocol output.

The radar is a self-contained space sensing sensor, which is a module composed of RF antenna, radar chip and high-speed main frequency MCU. Relying on the stable, flexible and superior algorithm architecture core, the radar can solve the user's various scene detection needs. It can be equipped with upper computer or host computer to flexibly output detection status and data, meet several groups of GPIO, and can be customized and developed by users.

1. Operating Principle



The radar transmits 24G band millimeter wave signal, the measured target reflects electromagnetic wave signal, demodulates the transmitted signal, and then obtains echo demodulated signal data through amplification, filtering, ADC and other processing. The amplitude, frequency and phase of echo signal are solved in MCU unit, and finally the measurement of target parameters (breathing, motion, micro motion, etc.) and scene evaluation are realized.

2. Precautions for Hardware Design

The rated power supply voltage of the radar shall meet 4.9 - 6V. Under normal working conditions, the rated current requires an input of more than 200mA. Power supply design, power ripple shall be ≤ 100mV.

2.1. Circuit for Reference of Power Supply Design

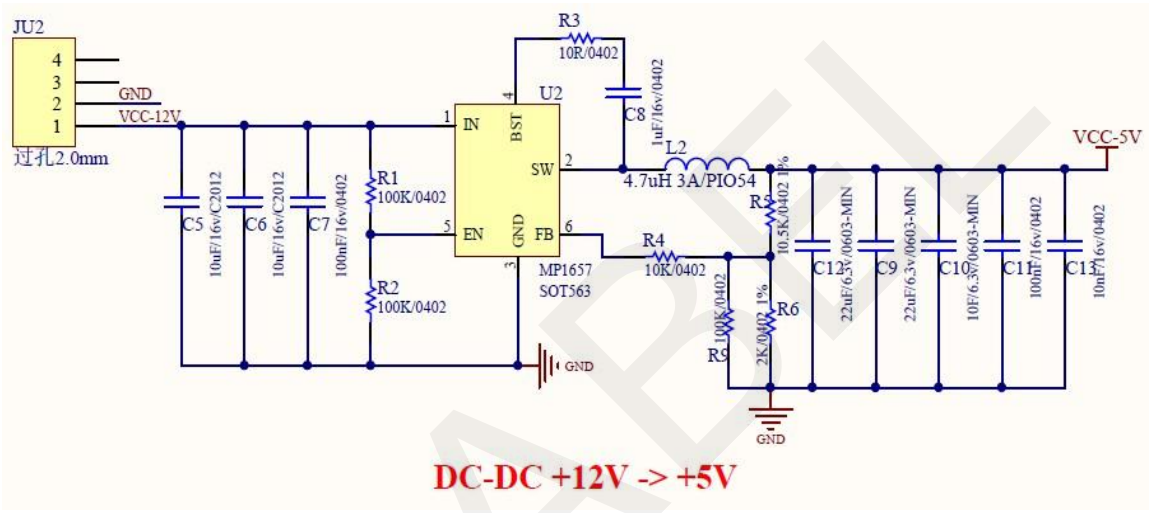


Figure. 1

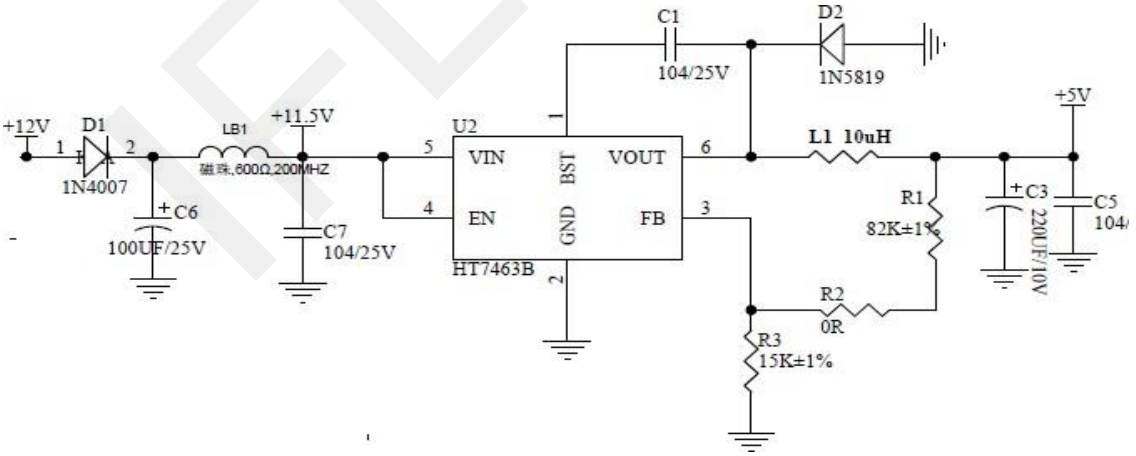


Figure. 2

2.2. Wiring Diagram

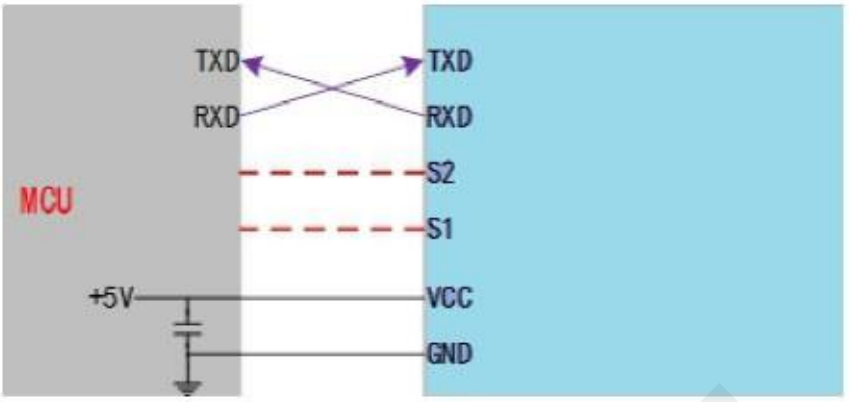


Figure 3. Wiring Diagram of Radar Module and Peripheral Device

3. Layout Requirements of Antenna and Case

PCBA：Height of Radar Mount Above Other Components≥ 1mm

Case Structure：Radar Antenna Plane to Case: 2 - 5mm

External Detection Surface：Non-metallic plane, no curve to avoid affection on performance of detection coverage

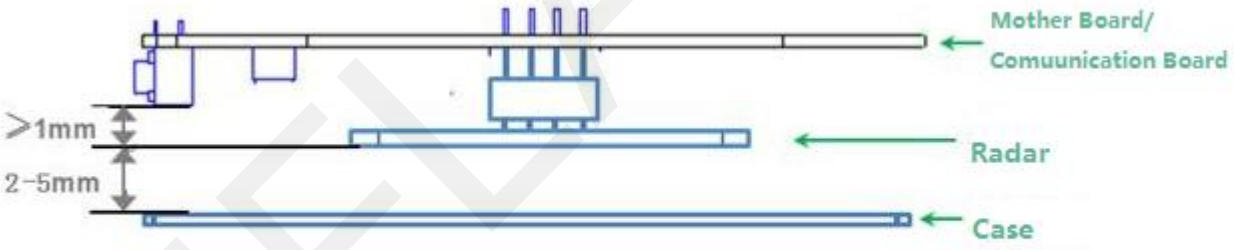


Figure 4

4. Electrostatic Protection

The radar product has an electrostatic sensitive circuit inside, which is vulnerable to electrostatic hazards. Therefore, it is necessary to do a good job in electrostatic protection in the process of transportation, storage, work and taking. Do not touch and grasp the antenna surface and connector pins of the radar module, but only the corners.

When operating the radar sensor, please wear anti-static gloves.

5. Factors Interfering Radar Function

5.1 Abnormal Output of Nobody State

A. Movements from doorway, the other side of wooden wall detected due to too large radar scanning coverage

Adjustment：Tune down sensitivity and set up scenario for radar

B. Radar faces down air-conditioning, fan in operating

Adjustment：Readjust the position of radar

C. Swinging objects by airflow from air-conditioning

Adjustment：Cotton, non-metallic objects will not cause false-alarm and metallic objects need to be fixed

D. False alarm by Vibration of Radar not fixed

Adjustment：Avoid shaking or vibration

E. Pets, flying birds or other moving objects

Adjustment：Because of the high sensitivity of slight motion detection, this cannot be excluded

F. False judgement from interference of power supply

Adjustment：Stabilize the current and reduce ripple

5.2 Abnormal Output of Somebody State

Radar judges human presence via sending and receiving electromagnet wave, closer to radar, higher the accuracy

A. Human body beyond radar scanning coverage
Adjustment：Readjust the installation angle. Detection range varies slightly in different environments due to different reflection coverage

B. False output due to shading by metallic objects
Too thick office desks, chairs made from metal will block electromagnet wave and cause a false alarm

C. Difference in scanning angle
Adjustment：Human body not scanned by radar, causing a false alarm

D. Low sensitivity of radar
Adjustment：Use parameter condition of radar to improve

6. Functions

6.1. Description of Functions

Function Points	Time of State Change/Explanation
DP1：somebody/nobody	nobody to somebody, report within 0.5s somebody to nobody, output "No" in 1to 2mins
DP2：stationary/active	shift between stationary and active, report within 0.5s
DP3：personnel approaching/leaving/no directional movement	output every 2s
DP4：parameter of body motion amplitude from 0 – 100	output every 5s refer to（section 6.2)
DP5：sensitivity gear from 0 – 9	10 gears for default scenario
DP7：scenario（bed,bathroom,hotel,bedroom,office, default）	different scenarios according to size of coverage
DP8：confirm reminder of false alarm of nobody	

6.2. Output Description of Body Motion Amplitude Parameters

Parameter of Body Motion Amplitude		
0%	nobody	nobody in environment
1%	stationary	no body movement only respiration
2%-30%	slight motion	slight motion from head or limbs
31%-60%	walk/quick body movement	relatively slow body movement
61%-100%	run/big movement in close distance	quick body movement

7. Instruction of Protocol

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

This protocol briefly introduces the radar work flow, briefly introduces the composition architecture of the interface protocol, and gives the control commands and data required for relevant radar work. The definition of serial port communication is as follows:

Interface level：TTL

Baud rate：9600bps

Stop bit：1

Data bit：8

Parity check：No

8. Communication Commands and Parameter Definition

8.1. Definition and Instruction of Frame Structure

A. Definition of Frame Structure

Initial Code	Data Length		Function Code	Address Code 1	Address Code 2	Data	Check Code	
0X55	Lenth_L	Lenth_H	Command	Address_1	Address_2	Data	Crc16_L	Crc16_H
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	n Byte	1 Byte	1 Byte

B. Instruction of Frame Structure

a.b Initial code：1Byte, default 0X55

Data length：2 Byte, low byte first, high byte after

length=data length+function code+address code 1+address code 2+data+check code

c Function：1Byte

Data read：0X01

Data write：0X02

Passive report command：0X03

Active report command：0X04

d Address：address code 1 function classify, address code 2 specific function

e Please refer to instruction of address distribution and data information

f.g Data：n Byte

Check code：2 Byte, low byte first, high byte after

Use CRC16 for check, please refer to Appendix 1

8.2. Address Distribution and Data Information Instruction

Interface Contents of 24G Bio-perception Radar					
	Function code	Address code 1	Address code 2	Data	Remark
1	Read 0x01	Mark looking up 0x01	Device ID 0X01		
2			Software version 0x02		
3			Software version 0x03		
4			Protocol version 0x04		
		Looking-up radar information 0x03	Environment state 0X05		
11			Vital sign parameter 0x06		
12		System parameter looking-up 0x04	Threshold gear 0x0C		
			Scenario setting 0x10		
16	Write 0x02	System parameter 0x04	Threshold gear 0x0C	Enumeration range 0~9	Respectively to gear level 0 1 2 3 4 5 6 7 8 9 (default is 6) higher gear level, higher sensitivity
			Scenario setting 0x10	Default mode 0x00	
				Area detection (Top-mounted) 0x01	
				Bathroom (Top-mounted) 0x02	
				Bedroom (Top-mounted) 0x03	
				Living room (Top-mounted) 0x04	
				Office (Top-mounted) 0x05	
				Hotel (Top-mounted) 0x06	

		Other function 0X05	Restart 0X04		
17	Passive report command 0x03	Report Radar information 0x01	Device ID 0x01	12 Byte data	
18			Software version 0x02	10 Byte data	
19			Hardware version 0x03	8 Byte data	
20			Protocol version 0x04	8 Byte data	
27		Report Radar information 0X03	Environment state 0x05	Nobody 00 FF FF	
28				Stationary personnel 01 00 FF	
29				Active personnel 01 01 01	
30			Vital parameters 0x06	4 Byte Float data **(see appendix 2)**	

	Passive report 0x03	Report other information 0X04	Threshold gear 0X0C	Current gear (0X00~0X09)	
			Scenario setting 0x10	Default 0x00	
				Area detection (Top-mounted) 0x01	
				Bathroom (Top-mounted) 0x02	
				Bedroom (Top-mounted) 0x03	
				Living room (Top-mounted) 0x04	
				Office (Top-mounted) 0x05	
				Hotel (Top-mounted) 0x06	
31	Active report 0X04	Report radar information 0x03	Environment state 0x05	Nobody 00 FF FF	
32				Stationary personnel 01 00 FF	
33				Active personnel 01 01 01	
34			Parameter of body motion 0X06	4 Byte Float data	
			Approaching/Leaving 0x07	Fixed character 0x01 0x01	No 0x01
					Approaching 0x02
					Leaving 0x03
		Report other information 0X05	Heartbeat 0X01	Nobody 00 FF FF	
				Stationary personnel 01 00 FF	
				Active personnel 01 01 01	
			Reset of abnormal 0X02	0X0F	

Instruction：1）Data read/write:command sent from host computer to radar

2）Report command:information sent from radar to host computer

Appendix 1：Parsing Code for Reference of CRC Check Code

```
const unsigned char cuc_CRCHi[256]=
{
  0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
  0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
  0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
  0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
  0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
  0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
  0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
  0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
  0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
  0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
  0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
  0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
  0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
  0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
  0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
  0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
  0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
  0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
  0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
  0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
  0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
  0x00, 0xC1, 0x81, 0x40
};
```

```
const unsigned char cuc_CRCLo[256]=
{
    0x00, 0xC0, 0xC1, 0x01, 0xC3, 0x03, 0x02, 0xC2, 0xC6, 0x06, 0x07, 0xC7,
    0x05, 0xC5, 0xC4, 0x04, 0xCC, 0x0C, 0x0D 0xCD, 0x0F, 0xCF, 0xCE, 0x0E,
                                        ,
    0x0A, 0xCA, 0xCB, 0x0B, 0xC9, 0x09, 0x08, 0xC8, 0xD8, 0x18, 0x19, 0xD9,
   0x1B, 0xDB, 0xDA, 0x1A, 0x1E, 0xDE, 0xDF, 0x1F, 0xDD 0x1D, 0x1C, 0xDC,
                                                  ,
    0x14, 0xD4, 0xD5, 0x15, 0xD7, 0x17, 0x16, 0xD6, 0xD2, 0x12, 0x13, 0xD3,
    0x11, 0xD1, 0xD0, 0x10, 0xF0, 0x30, 0x31, 0xF1, 0x33, 0xF3, 0xF2, 0x32,
     0x36, 0xF6, 0xF7, 0x37, 0xF5, 0x35, 0x34, 0xF4, 0x3C, 0xFC, 0xFD, 0x3D,
     0xFF, 0x3F, 0x3E, 0xFE, 0xFA, 0x3A, 0x3B, 0xFB, 0x39, 0xF9, 0xF8, 0x38,
     0x28, 0xE8, 0xE9, 0x29, 0xEB, 0x2B, 0x2A, 0xEA, 0xEE, 0x2E, 0x2F, 0xEF,
   0x2D, 0xED, 0xEC, 0x2C, 0xE4, 0x24, 0x25, 0xE5, 0x27, 0xE7, 0xE6, 0x26,
    0x22, 0xE2, 0xE3, 0x23, 0xE1, 0x21, 0x20, 0xE0, 0xA0, 0x60, 0x61, 0xA1,
    0x63, 0xA3, 0xA2, 0x62, 0x66, 0xA6, 0xA7, 0x67, 0xA5, 0x65, 0x64, 0xA4,
   0x6C, 0xAC, 0xAD, 0x6D, 0xAF, 0x6F, 0x6E, 0xAE, 0xAA, 0x6A, 0x6B, 0xAB,
    0x69, 0xA9, 0xA8, 0x68, 0x78, 0xB8, 0xB9, 0x79, 0xBB, 0x7B, 0x7A, 0xBA,
    0xBE, 0x7E, 0x7F, 0xBF, 0x7D, 0xBD, 0xBC, 0x7C, 0xB4, 0x74, 0x75, 0xB5,
    0x77, 0xB7, 0xB6, 0x76, 0x72, 0xB2, 0xB3, 0x73, 0xB1, 0x71, 0x70, 0xB0,
    0x50, 0x90, 0x91, 0x51, 0x93, 0x53, 0x52, 0x92, 0x96, 0x56, 0x57, 0x97,
    0x55, 0x95, 0x94, 0x54, 0x9C, 0x5C, 0x5D 0x9D, 0x5F, 0x9F, 0x9E, 0x5E,
                                        ,
    0x5A, 0x9A, 0x9B, 0x5B, 0x99, 0x59, 0x58, 0x98, 0x88, 0x48, 0x49, 0x89,
    0x4B, 0x8B, 0x8A, 0x4A, 0x4E, 0x8E, 0x8F, 0x4F, 0x8D, 0x4D, 0x4C, 0x8C,
    0x44, 0x84, 0x85, 0x45, 0x87, 0x47, 0x46, 0x86, 0x82, 0x42, 0x43, 0x83,
   0x41, 0x81, 0x80, 0x40
};
```

```
 static unsigned shortint     us_CalculateCrc16(unsigned char *lpuc_Frame,unsi
gned short int    lus_Len)
{
    unsigned char luc_CRCHi = 0xFF;
    unsigned char luc_CRCLo = 0xFF;
    int li_Index=0;

    while(lus_Len--)
    {
        li_Index = luc_CRCLo ^ *(lpuc_Frame++);
        luc_CRCLo = (t_BYTE)( luc_CRCHi ^cuc_CRCHi[li_Index]);
        luc_CRCHi = cuc_CRCLo[li_Index];
    }
    return (unsigned short int )(luc_CRCLo << 8 |luc_CRCHi);
}
```

Appendix 2：Parsing Code for Reference of Body Motion Sign Parameters

```
typedef union
{
    unsigned char
    Byte[4]; float Float;
}Float_Byte;

void main()
{
    Float_Byte fb;
    fb.Byte[0] = 0x9A;
    fb.Byte[1] = 0xFB;
    fb.Byte[2] = 0xE7;
    fb.Byte[3] = 0x3F;
    printf("%f\r\n",fb.Float);
}
```