HJ-180IMH-10

Ultra-small Chip (5mm*5.5mm), ultra-low power Bluetooth 5.1 module

DataSheet version: V2.2

Contents

1 Overview

1.1 Characteristic Parameter

●The products have passed BQB FCC CE SRRC ROHS REACH and other certifications
●Power supply: 1.7V~3.6V
●GPIO maximum number: 17
●Built-in high performance antenna(External antenna can also be used)

●Function
- Support BLE 5.1, embedded Bluetooth low energy protocol stack and GATT service
- BLE supported master-slave integration
- Support OTA firmware upgrade
-Default support low speed 1 slave 1 master, master and slave work at the same time, do not affect each other
-5 Slave version, can be simultaneously external 5 mobile phones or host passive connection, work at the same time
-Ultra high speed slave version
-High-speed master-slave integration
-Supported standard edition of UART transparent transmission, supported WeChat, MiSDK. You also can develop your own firmware and download to the unprogrammed module.

●RF Features
- Operating Frequency: 2.4GHz, Support ISM free Frequency band
- Transmit Power: -20dBm ~ +4dBm
- High Receive sensitivity: -96dBm
- Peak Current at Transmitting and Receiving < 4.6mA
-Wireless transmission range of built-in antenna in open area: 5~10 meters
-Wireless transmission range of external antenna in open area: 40 to 80 meters

●Low Power Dissipation
- Dormant current < 2μA
- One second broadcast current: 12.2μA(0dBm)or 15.5μA(+4dBm)
- Two second broadcast current: 6.5μA

●Package: LGA24, pad spacing: 0.75mm and 0.8mm
●Size: 5mm*5.5mm*1.3mm(Internal with built-in antenna)
●Weight: 0.10g
●Operating temperature range: -40 ~ +85℃

1.2 Electrical Parameters

●Absolute Maximum Ratings

Table 1-1 Absolute maximum ratings

Parameter	MIN	MAX	Unit
Power Supply Voltage (VCC)	1.7	3.6	V
IO Supply Voltage	0	VCC	V
Operating Temperature	-40	+85	℃
Storage Temperature	-40	+85	℃

●Recommended Operating Conditions

Table 1-2 Recommended operating conditions

Parameter	MIN	TYP	MAX	Unit
Power Supply Voltage (VCC)	1.8	3.3	3.6	V
IO Supply Voltage	0	3.3	VCC	V
Dormant working current		<2		μA
Maximum Operating Current		5		mA
Operating Temperature	-40	+25	+85	℃

●I/O DC Characteristics

Table 1-3 I/O DC Characteristics

I/O Pin	Driving Capability	MIN	MAX	Unit
Input low voltage		0	0.4	V
Input high voltage		0.7	VCC	V
Output low voltage	5mA	0	0.6	V
Output high voltage	5mA	3.3	VCC	V

●Power Dissipation

Table 1-4 Power Dissipation

Test conditions	TYP	Unit
Dormancy mode	<2	μA
20ms Interval Broadcasting in Slave Mode	705	μA
1S Interval Broadcasting in Slave Mode	13.5	μA
20ms Connection Gap Holding Connection in Slave Mode	138	μA
7.5ms Connection Gap Holding Connection in Slave Mode	350	μA
Scanning in Host Mode	4.4	mA
20ms Connection Gap Holding Connection in Host Mode	150	μA

●RF Features

Table 1-5 RF Features

Attribute	Value	Remarks
Modulation	GFSK	
Frequency range	2.402 ~ 2.480GHz	Bandwidth: 2MHz
Number of channels	40	
Air speed	1Mbps、2Mbps	
RF Port Impedance	50Ω	
Transmit Power	MAX: +4dBm	
TX Current consumption	TYP: 4.6mA@0dBm	
RX Current consumption	TYP: 4.6mA	
Receive sensitivity	TYP: -96dBm, MAX: -97dBm	
Antenna	Internal Antenna	External antenna can be used

2 Hardware specification

2.1 Package and dimensions

The package of HJ-180IMH-10 is LGA24, welding pad spacing is 0.75 mm transversely and 0.8 mm longitudinally. Detailed dimensions are shown in the figure 2-1, 2-2, 2-3, 2-4.

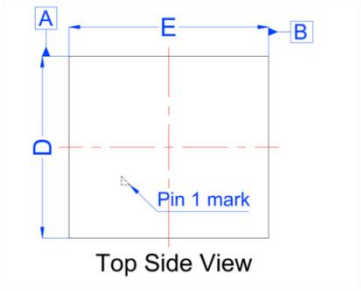

Figure 2-1 Top view

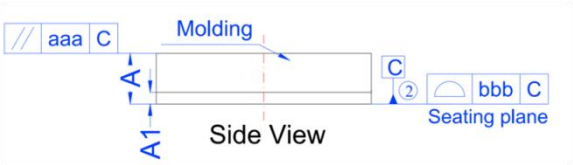

Figure 2-2 Side view

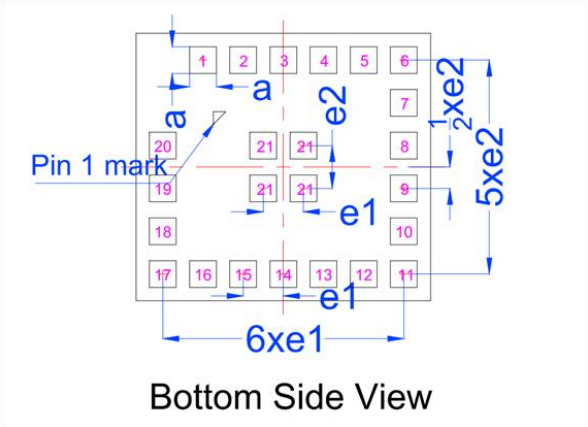

Figure 2-3 Bottom view

DIMENSIONAL REFERENCES *Units:mm*

SYMBOL	DIMENSIONAL REQMTS			SYMBOL	Tolerance of Form &Position
	MIN	NOM	MAX	aaa	0.10
A	1.26	1.30	1.34	bbb	0.10
A1	0.27	0.30	0.33		
D	4.90	5.00	5.10		
E	5.40	5.50	5.60		
a	0.45	0.50	0.55		
e1	0.75 REF				
e2	0.80 REF				

Figure 2-4 Dimensions picture

2.2 Pin Definition

Table 2-1 Pin definition table

Pin	Name	Type	Description	Functions of transparent transmission mode
1	SWDCLK	INPUT	Clock Line of SWD Interface	
2	P0.17	IO	general purposed io port	**Host Connection Status Indicator Pin** When this pin's output is high level, the module has been successfully connected to the external slave. When this pin's output is low level, the module has disconnected from the external slave.
3	P0.14	IO	general purposed io port	**Transmit Path Selection Pin for Data Received by Serial Port** Assuming that the module has been connected to the slave. When this pin is input at high level, the data received by the module from the serial port is sent to the connected slaves. When this pin is input at low level or not connected, the data received by the module from the serial port is sent to the host or mobile APP which connected to module. When the module is not connected to the external slave, no matter what the state of this pin is, the data is sent to the host or mobile APP which connected to the module.
4	P0.12	IO	general purposed io port	**BLE-TX Pin** In the transparent transmission mode, this pin is the TX pin of the serial port, which is connected to the RX pin of the MCU.
5	P0.08	IO	general purposed io port	**BLE-RX Pin** In the transparent transmission mode, this pin is the RX pin of serial port, which is connected to the TX pin of the MCU.
6	P0.11	IO	general purposed io port	**Slave Connection Status Indicator Pin** When this pin's output is high level, the module as slave has been successfully connected by the mobile phone. When this pin's output is low level, the module as slave has been disconnected by the mobile phone.

7	VCC_IN	POWER INPUT	Power input port, supply volrage: DC1.7V ~ 3.6V	
8	P0.05/AIN3	IO/AI	general purposed io port/Analog input 3	**APP Receiving Data Indicator Pin** When the module receives the data sent by the mobile APP or the external device which connected to the module, the BLE module needs to send data through the TX pin of the module's serial port. Whether the module is a host or slave, this pin is raised T1 before data is sent out through the TX pin of the module's serial port, and this pin can be lowered only after data is sent out. T1 is a parameter, it can be set 1~255, It's in milliseconds. Usually this pin keeps a low level to represent idleness. This pin is used as a wake-up sign for long-time connections to low-power devices.
9	P0.01/XL2	IO/LF_XO P	general purposed io port/external 32.768KHz crystal input port	**Serial Port Receiving Function Enabling Pin (Can Be Set, The Default Is Active Low)** When the setting is active low, P0.01=0, serial port receiving function enabled. At this time, the module works at full speed. It can send instructions or transmit data in transparent transmission mode.The current consumption of the module will be up 300-400μA ; P0.01=1, the serial port receiving function has been disabled. Module working in low power mode. If you broadcast once a second, the current consumption of the module will be less than 15μA. If the broadcast is stopped, the current consumption of the module will be less than 2μA. When the setting is active high, P0.01=1, serial port receiving function enabled;P0.01=0, the serial port receiving function has been disabled.
10	P0.03/AIN1	IO/AI	general purposed io port/Analog input 1	**App's Configuration Function Enable Pin** When this pin is input to a high level, module allows APP to send instructions to configure all parameters of the module. When this pin is input to low level, it is forbidden for APP to configure or read the parameters of the module. The default input mode for this pin is Pulldown.

11	P0.04/AIN2	IO/AI	general purposed io port/Analog input 2	**At the host mode, successful flag for writing data with feedback response** When sending data to slave devices which has the function of sending data with feedback response, if P0.04=0, the slave is idle at this time, and the module can continue to send data. If P0.04=1, data is being sent, you need to wait until P0.04=0 to send the next data.
12	P0.00/XL1	IO/LF_XO N	general purposed io port/external 32.768KHz crystal input port	**the Control Pin of Whether the Slave Can Enter the Simple Matching Mode** When this pin is input to high level, then the slave enter the simple matching mode, the HJ-180IMH-10 can binding this slave. When this pin is input to low level, then the slave exit the simple matching mode.
13	P0.18	IO	general purposed io port	**IN0** This is an input pin. Using UART command or APP command, you can set the period of the automatic reporting status function for IN0. The input status of this pin will be reported to APP in the "configble channel(0XFFF3)" by notification. The based time is 100ms. You can use command to read the status of IN0 all the time. The default input mode for this pin is Pulldown.
14	P0.15	IO	general purposed io port	**IN1** This is an input pin. The function of this pin is same to IN0.
15	P0.16	IO	general purposed io port	**OUT0** This is an output pin. Using UART command or APP command, you can set the state of OUT0 to high or low, you also can save the output state of OUT0. This pin save the final state after each power cut. You can read OUT0's output state every time. **Enable External PA** When the function of this pin is to enable external PA, this pin will automatically control the output level of this pin according to the transmission status of the antenna of the current Bluetooth

				module, and the external PA of the module can automatically control according to the level of this pin.
16	P0.20	IO	general purposed io port	**OUT1** This is an output pin. The function of this pin is same to OUT0. **Enabling External LNA** When the function of this pin is to enable external LNA, this pin will automatically control the output level of this pin according to the receiving status of the antenna of the current Bluetooth module, and the external LNA of the module can automatically control according to the level of this pin.
17	SWDIO	Debug Port	Input and Output Ports of SWD Interface	
18	P0.21/ nRESET	IO/Reset Pin	general purposed io port/External reset pin(Active low)	**External reset pin(Active low)** If reset is required, this pin needs to be kept at least 10 ms low.
19	EXT-ANT	EXT ANT RF OUTPUT	Interface of External Antenna, it can realize the output of radio frequency signal.	
20	OB-ANT	Onboard ANT	On-board antenna input port	If you want to use a built-in antenna, Short-circuit the Pin19 and Pin20.
21	GND	Ground	power ground	

2.3 Internal Structure

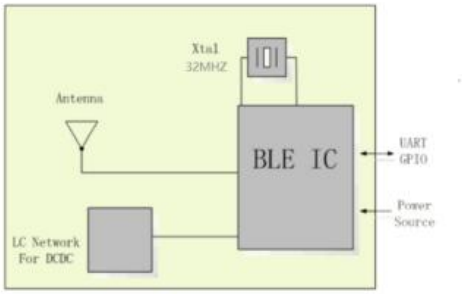

Figure 2-5 HJ-180IMH-10 internal structure frame

2.4 Reference Design

2.4.1 Utilizing the Internal 32.768KHz Low Frequency Clock

A.The connection method of using internal antenna

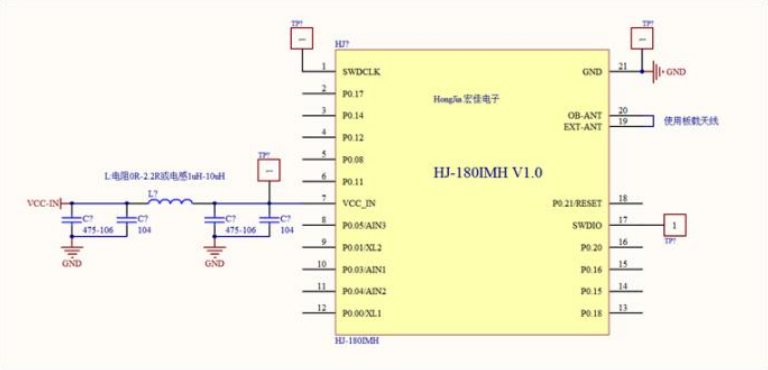

Figure 2-6 Use internal clocks and antennas

B.The connection method of using external antenna

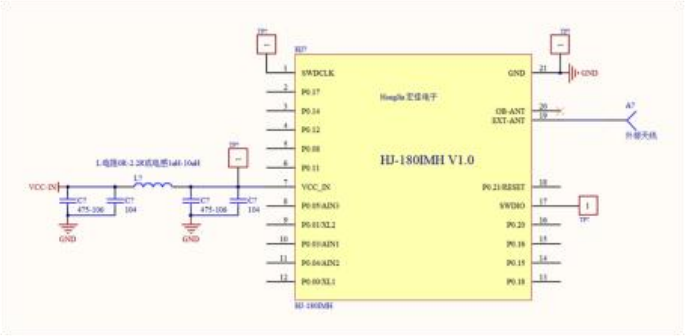

Figure 2-7 Use internal clocks and external antennas

C.To use the internal clock, the file sdk_config.h in NRF52 SDK17.1 needs to be modified as follows:

a.Unfold"nRF_Drivers"->"NRFX_CLOCK_ENABLED"Make the changes as shown in Figure 2-8

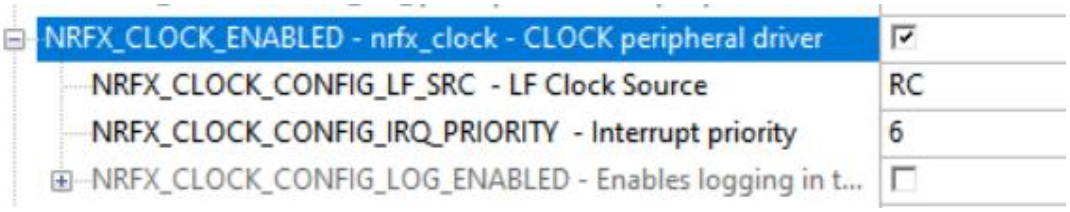

Figure 2-8 NRFX_CLOCK_ENABLED

b.Unfold”nRF_Drivers”->””NRF_CLOCK_ENABLED”Make the changes as shown in Figure 2-9

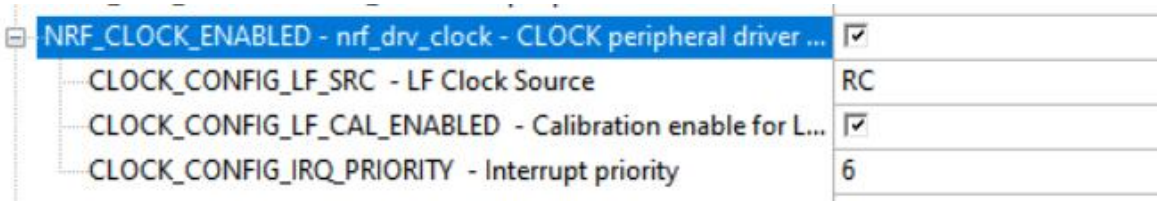

Figure 2-9 NRF_CLOCK_ENABLED

c.Unfold”nRF_SoftDevice”->”NRF_SDH_ENABLED”->”Clock - SoftDevice clock configuration”Make the changes as shown in Figure 2-10

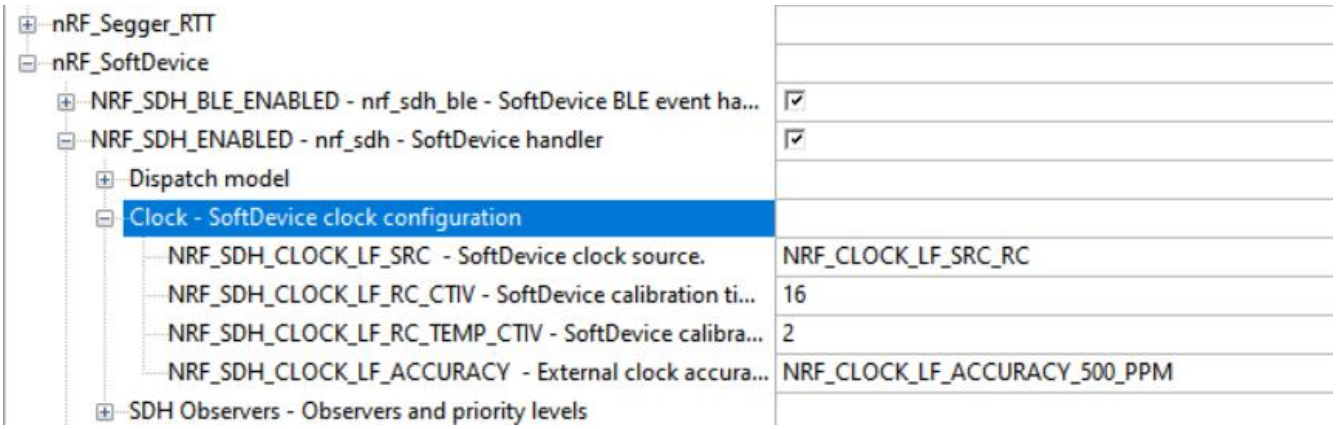

Figure 2-10 NRF_SDH_ENABLED

2.4.2 Utilizing External 32.768KHz Low Frequency Clock

Simply attach an external clock to the XL1 and XL2 based on the two design solutions shown in 2.4.1 Section A and B. This is shown in Figure 2-11.

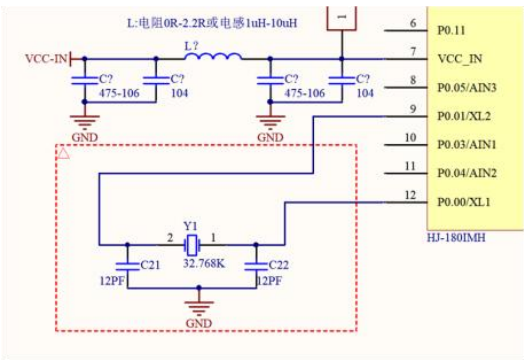

Figure 2-11 Use External clocks

2.5 The External Antenna Part is Designed for Reference

2.5.1 Use Internal High Performance Antennas

Simply short connect PIN19 with PIN20 to enable the internal high-performance antenna, as shown in Figure 2-12 below, with an open communication distance of 5 to 10 meters.

It should be noted that no devices or wires can be placed near the antenna, no devices can be placed on the back of the module, the copper cladding should avoid the internal antenna area, and the module GND copper cladding is large enough.

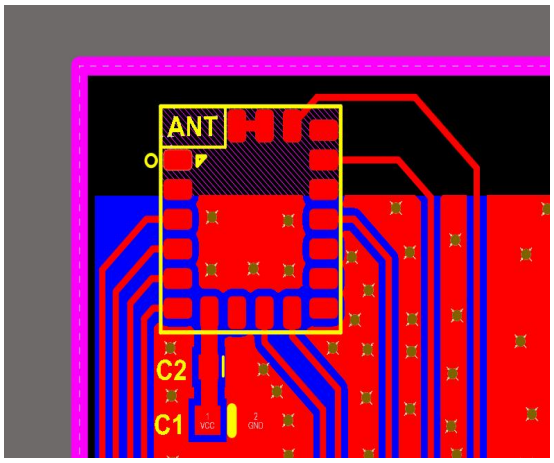

Figure 2-12 Internal antenna circuit design

2.5.2 Use External PCB Antenna

The pin of PIN20 is suspended, and the pin of PIN19 is connected to the PCB antenna through a π-shaped filter circuit, as shown in Figure 2-13 below. The communication distance in the open field can reach 40 to 80 meters.

It should be noted that no devices or wires can be placed near the antenna, no devices can be placed on the back of the module, and coppers should be wrapped around the module and PI filter circuit to avoid the PCB antenna.

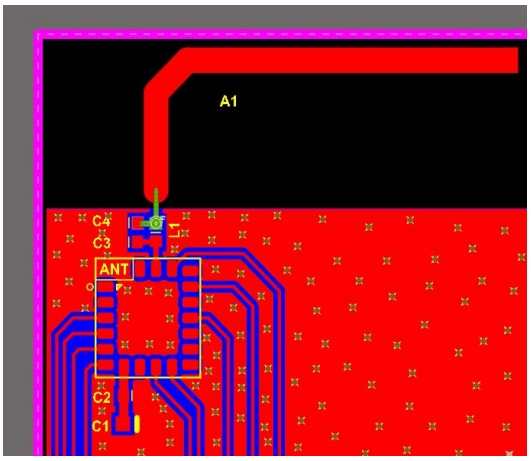

Figure 2-13 External PCB antenna circuit design

2.6 Developed by the user, external access PA/LNA for power expansion to achieve long-distance communication, please refer to the following code and instructions:

2.6.1 PA/LNA control code

As an example, we use P0.00 as the PA send enable control pin; P0.12 as the LNA receive enable control pin;

```
#define PA_CTRL_PIN     0
#define LNA_CTRL_PIN   12

//PA + LNA Ctrl Init
void pa_lna_init(uint32_t gpio_pa_pin, uint32_t gpio_lna_pin)
{
    ret_code_t err_code;
    static const uint32_t gpio_toggle_ch = 0;
    static const uint32_t ppi_set_ch = 0;
    static const uint32_t ppi_clr_ch = 1;

    // Configure SoftDevice PA/LNA assist
    ble_opt_t opt;
    memset(&opt, 0, sizeof(ble_opt_t));
    // Common PA/LNA config
    opt.common_opt.pa_lna.gpiote_ch_id    = gpio_toggle_ch;          // GPIOTE channel
    opt.common_opt.pa_lna.ppi_ch_id_clr = ppi_clr_ch;               // PPI channel for pin clearing
    opt.common_opt.pa_lna.ppi_ch_id_set = ppi_set_ch;               // PPI channel for pin setting
    // PA config
    opt.common_opt.pa_lna.pa_cfg.active_high = 1;                   // Set the pin to be active high
    opt.common_opt.pa_lna.pa_cfg.enable          = 1;               // Enable toggling
    opt.common_opt.pa_lna.pa_cfg.gpio_pin       = gpio_pa_pin;      // The GPIO pin to toggle
    // LNA config
    opt.common_opt.pa_lna.lna_cfg.active_high    = 1;               // Set the pin to be active high
    opt.common_opt.pa_lna.lna_cfg.enable          = 1;              // Enable toggling
    opt.common_opt.pa_lna.lna_cfg.gpio_pin        = gpio_lna_pin;   // The GPIO pin to toggle
    err_code = sd_ble_opt_set(BLE_COMMON_OPT_PA_LNA, &opt);
    APP_ERROR_CHECK(err_code);
}
```

2.6.2 To add this function to the int main(void) function, after you add it to ble_stack_init(), before advertising_start starts broadcasting, as shown in Figure 2-14:

```
/**@brief Application main function.
 */
int main(void)
{
    bool erase_bonds;

    // Initialize.
    uart_init();
    log_init();
    timers_init();
    buttons_leds_init(&erase_bonds);
    power_management_init();
    ble_stack_init();
    gap_params_init();
    gatt_init();
    services_init();
    advertising_init();
    conn_params_init();

    // Init GPIO's to control PA and/or LNA, must be done before start advertising.
    pa_lna_init(PA_CTRL_PIN , LNA_CTRL_PIN);

    // Start execution.
    printf("\r\nUART started.\r\n");
    NRF_LOG_INFO("Debug logging for UART over RTT started.");
    advertising_start();

    // Enter main loop.
    for (;;)
    {
        idle_state_handle();
    }
}
```

Figure 2-14 int main(void)function

3 Announcements

3.1 Notices for Hardware Design

1.All IO ports can be used. Please pay attention to the pin diagram for all pins, and the IO connected to it should pay attention to the IO mode and status.

2.The input power is recommended to be filtered by magnetic beads or inductors. Power input we added PI filter, L? You can choose resistance or inductance, of course, if the space is limited, you can also not add, directly external parallel a 475-106uF capacitor can be.

3.Filter capacitors C1 and C2 should be placed as close to the power input pin of the module as possible.

4.TP? For test points, conditions and Spaces can be added.

5.When using an external antenna, be sure to contact us and let us confirm that your external PCB antenna or IPEX lead antenna PCB design is reasonable.

6.The external 32.768KHz low-frequency crystal oscillator is not necessary, and the internal LF oscillator can be used to replace it. You only need to simply change the SDK, see the C content in Section 2.4.1 for details, and consult our company if you have any questions.

7.The module should not be placed in a metal housing. If a metal housing must be used, the antenna must be removed.

8.In the product that needs to install the wireless module, some metal parts, such as screws, inductors, etc., should be kept away from the radio frequency antenna part of the wireless module.

9.In the Bluetooth module near the antenna and on the back, try not to place other components, and can not be wired. If the device or trace is placed, the Bluetooth performance will be affected.

10.The module antenna should be placed around the edge of the circuit board. The antenna part is near the edge or corner of the motherboard. It is best to place the module in the corner of the circuit board.

11.Each layer of the circuit board is copper-clad to GND as a whole, and it is necessary to ensure that the copper-clad area of the module, especially the antenna part, is large enough and well grounded.

12.Through holes should be punched in the copper clad area of the entire circuit board. In particular, as many as possible should be punched in the copper clad area near the module and antenna.

13.If there are high power devices or high voltage conversion circuits on the circuit board, the GND copper cladding of the module should be isolated from the GND copper cladding of other parts, connected by single point grounding, and perforated as many as possible to reduce the interference with the RF signal.

14.The pins that do not need to be used can be suspended.

3.2 Notices for Ultrasound Welding

Warning: Please carefully consider using ultrasonic welding technology. If it is necessary to use ultrasonic welding technology, please use 40KHz high frequency ultrasound welding technology. Keep the module away from the ultrasonic soldering line and the fixing column during the design method to prevent damage to the module!

For specific ultrasonic welding matters, please contact our company for technical consultation.

4 Soldering Recommendations

Reflow soldering is recommended for welding.

HJ-180IMH-10 module use high temperature resistant materials, manufacturing by Lead-free Process. The maximum temperature resistance is 265℃. Ten continuous reflow soldering has no effect on properties and strength. Specific parameters as shown in Table 4-1.

Table 4-1 Reflow soldering parameters

Parameter	Value
Features	Lead-free process
Average ramp up rate(T_{SMAX} to Tp)	3℃/sec. max
Temperature Min($T_S$min)	150℃
Temperature Max(TSmax)	200℃
Preheat time (Min to Max) (tS)	80~100sec
Peak Temperature (T_P)	250±5℃
Ramp-down Rate	6℃/sec. max
Time 25℃ to Peak Temp (T_P)	8 min. max

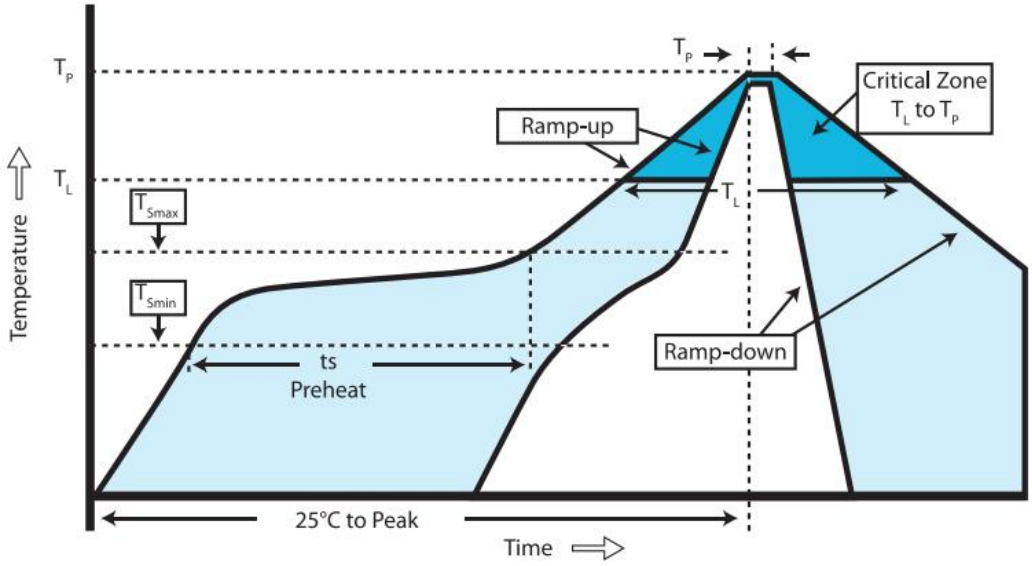

Figure 4-1 Temperature Curve of Reflow Welding

5 Supply Information

5.1 Model Definition

Table 5-1 Model Definition

Type	Model	Description
Low speed master-slave OTA	HJ-180IMH-10	Include UART port transparent transmission firmware, the firmware module is a bridge between the Bluetooth device or the mobile phone and the MCU. The Customer does not need to understand the BLE protocol stack, and control the UART port command operation and the UART port data, and the operation is simple, short Development cycle to speed up product launch. Support OTA firmware upgrade, update firmware at any time according to the use environment.
High-speed master-slave integrated OTA	HJ-180IMH-10_LUH	This version supports all functions of the standard serial port through transmission firmware, and on this basis, the use of our master and slave computer communication rate is improved, suitable for large amounts of data transmission scheme.
5 Slave OTA	HJ-180IMH-10_5C	This version is similar to the standard serial pass-through firmware, which supports connecting up to 5 slaves without affecting each other.
Ultra-high speed Slave OTA	HJ-180IMH-10_LHFC	This version is similar to the standard serial pass-through firmware, which supports connecting up to 5 slaves without affecting each other.

5.2 Packaging method

Packaging with tapes and reel. Sealed with chip-level anti-static aluminum foil bag, each bag contains desiccant, use industrial grade vacuum machine to ensure airtight, moisture-proof, waterproof and dustproof (IP65). The actual packing effect is shown in Figure 5-1.

Figure 5-1 External Packing Image

All packages will be labeled with goods information. All packages will be marked with the cargo information, including ROHS and anti-static signs. The production batch information in the item number is 15 bits.

TangShan HongJia Electronic Technology Co., Ltd.

HJ-180IMH-10

Pb Free Reflow(260℃)

DATE CODE:P16aI15bS17c001

QTY:500PCS SEAL DATE:20170504

Remarks: P16a I15b S17c001 represents PCB production in January 2016, IC production in February 2015, and SMT patch in the first time in March 2017.

Figure 5-2 Label Sample Diagram

6 Version History

Table 6-1 Revision History

No.	Version Number	Release Time	Reviser	Checker	Description
1	V1.3	20190702	ZDY	LMY	First edition
2	V1.62	20190705	ZDY	LMY	Update some numeric and pin functions
3	V1.68	20190709	ZDY	LMY	Update some statements
4	V1.70	20190710	ZDY	LMY	Update Pin Definition
5	V1.71	20190713	ZDY	LMY	Update Pin Definition
6	V1.72	20190719	ZDY	LMY	Update "Transmission Distance of External Antenna"
7	V1.8	20190727	ZDY	LMY	Update the pin definition of pin P0.16 and pin P0.20
8	V1.9	20190904	LMY	LJH	Update the pin definition of pin P0.01
9	V2.0	20230412	FJW	LMY	Format adjustment
10	V2.1	20230412	FJW	LMY	Update the characteristic parameters, change the "onboard antenna" to "built-in antenna", add the design reference of the external antenna part, add the user's self-developed code and instructions, and add the hardware precautions
11	V2.2	20231010	FJW	LMY	Module name changed to "HJ-180IMH-10"