



HJ-380IMH_Hardware Design Manual

Based on Nordic NRF52832

Support BLE master-slave integration

Chip-level high-performance (6x5.5x1.3mm)

low-power BLE 5.4 module

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Preface

Thanks for using the Bluetooth module provided by HJSIP. HJ-380IMF series standard Bluetooth module, is a high-performance iot Bluetooth transceiver. The module adopts LGA41 package and supports both external and internal antennas. The product also has the characteristics of low power consumption, small size, strong anti-interference ability, etc., suitable for a variety of application scenarios.

This module is mainly used for data communication, and the company does not assume responsibility for property losses or personal injuries caused by improper operations of users. Please develop the product according to the technical specifications and reference design in the manual. At the same time, pay attention to the general safety matters that should be concerned about when using mobile products.

Before the announcement, the company has the right to modify the content of this manual according to the needs of technological development.

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Version History

Version	Date	Change Description	Reviser	Reviewer
V1.0	2019/05/01	Initial Version	LMY	LJH
V2.2	2021/04/01	Add the pin diagram	FJW	LMY
V2.3	2021/11/29	Update the mechanical dimension annotations	FJW	LMY
V2.5	2023/02/24	Update the characteristic parameters, change "on-board antenna" to "built-in antenna", add design references for the external antenna part, add user-developed code and instructions, and add hardware precautions	FJW	LMY
V2.6	2025/02/07	1) 1) Unify the manual format; 2) 2) Add the contents of 3,9.1, 9.2 and 9.5; 3) 3) Update the label information of 8.2; 4) The BLE standard has been upgraded from 5.0 to 5.4.	WYW	LMY
V2.7	2025/10/13	1) To achieve the best effect when using the internal antenna, an PI circuit can be added. Please refer to 3.2.1 for details. 2) When using an external antenna, the PCBA board needs to be sent to our company for PI circuit matching. Please refer to 3.2.2 for details. 3) The model of the core chip is described. 4) Table 2-1: The transmission distance of the external antenna has been changed from 40-80m to 30-120m. 5) Table 2-2: A note has been added for the RST pin. It must be connected to I/O. If not connected, a 1K strong pull-up resistor should be added.	WYW	LMY
V2.8	2026/06/29	Added contact information.	WYW	LMY

Applicable module selection

No.	Module type	Type	Description
1	HJ-380IMH	Serial port transparent transmission standard version	Built-in serial port transparent firmware, the firmware module is a two-way communication bridge between Bluetooth devices or mobile phones and MCU, users do not need to understand the Bluetooth protocol stack, through the serial port command operation and serial port exchange data can, simple operation, shorten the user development cycle, speed up the product to market.
2	HJ-380IMH_CUS	Customized version for customers	This version supports customer customized firmware, customers according to product needs to propose functions, we will customize modules with dedicated firmware versions to supply to customers.
3	HJ-380IMH_EMP	Customer development version	Provide standard SDK to facilitate customers' secondary development of OPEN CPU.

1 Introduction

The HJ-380IMH standard Bluetooth module is a high-performance IoT Bluetooth transceiver based on Nordic NRF52832. The module is packaged in LGA41 and supports both internal and external antenna. The product also has the characteristics of low power consumption, small size, strong anti-interference ability, etc., suitable for a variety of application scenarios.

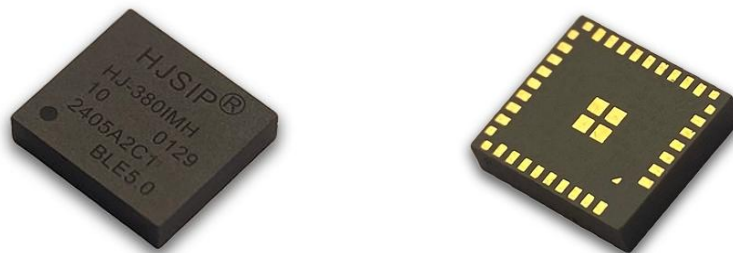


Figure 1.1: HJ-380IMH Top and bottom view

2 Product overview

2.1 Key features

Table 2-1: HJ-380IMH key characteristics

Characteristic	Description
Function	- Supports BLE 5.4, embedded low-power Bluetooth protocol stack and GATT service - Supports BLE master-slave integration - Supports OTA firmware upgrade - It supports basic transparent transmission functions or has no program modules for customers to develop firmware by themselves
Receiving sensitivity	-96dBm
Size	6mm*5.5mm*1.3mm (L*W*H, contain a built-in antenna.)
Package	LGA41
Weight	0.15g
supply voltage	1.7V~3.6V, TYP. 3.3V;
Peak current for transmission and reception	TX: 5.3mA @ 0dBm; RX: 5.4mA
Power consumption	- Sleep current < 2μA - 1-second interval broadcast current 12.2μA - 2-second interval broadcast current 7μA
Operation and storage Temperature	-40 ~ +85°C
Working frequency band	2.402~2.480GHz(2.4GHz ISM Band)
Transmission power	-20dBm ~ +4dBm
GPIO Port	32 (Max)
Transmission distance	The wireless transmission distance of the built-in antenna in open areas: 5 - 10 m. The wireless transmission distance of the external antenna in open areas: 30 - 120 m.
Product Certification	The product has passed certifications BQB, FCC, CE, SRRC, ROHS and REACH,etc.

2.2 Application Scenarios

- 2.4GHz Bluetooth Low Energy system;
- Smart home, wireless remote control;
- Consumer electronics products such as sports and healthcare;
- Industrial monitoring;
- Intelligent transportation, etc.

2.3 Functional block diagram

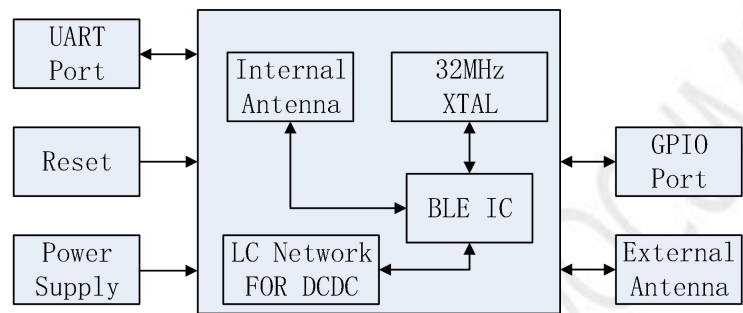


Figure 2.1: HJ-380IMH functional block diagram

2.4 Pins distribution diagram

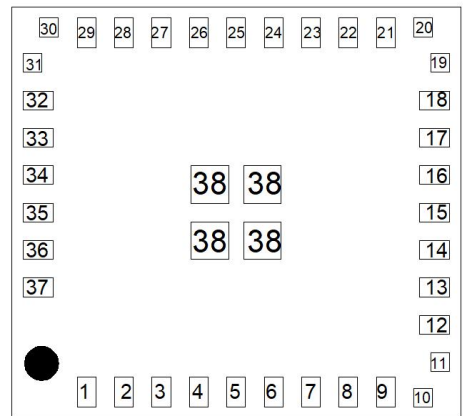


Figure 2.2: HJ-380IMH Pins distribution diagram(front view)

2.5 Pins description table

Table 2-2: HJ-380IMH Pins definition table

PIN	Name	Type	Description	Remarks
1	P0.20	IO	GPIO	/
2	P0.21/nRE SET	IO/ Reset Pin	GPIO/reset	Hardware reset pin,active low, and the low level duration should be greater than 1 second. Note:

				<u>The RST pin must be connected to I/O. If it is not connected, a 1K strong pull-up resistor must be added.</u>
3	P0.18	IO	GPIO	As the host connection status pin: When =1, it indicates that the connection has been established. When =0, it indicates that the connection to the host has been disconnected
4	P0.16	IO	GPIO	As the slave connection status pin: When =1, it indicates that the mobile phone has been connected. When =0, it indicates that the connection with the mobile phone has been disconnected
5	P0.15	IO	GPIO	Enable host scanning control: When =1, the module enters the active scanning process, scans peripheral devices, and outputs the information of peripheral devices in a certain format through the serial port. When =0, the module disables the active scanning function.
6	P0.13	IO	GPIO	Serial port receiving enable control: When =1, the module's serial port receiving is enabled. At this time, external data can be sent to the module through the serial port for instruction control and data transmission. When =0, the serial port reception of the module is turned off.(Note: 1. This function does not affect the data transmission through the serial port; 2. This pin can also be used as a low-power control because when the serial port enables reception, the bus will work at full speed and the power consumption will increase.)
7	P0.14	IO	GPIO	Serial port data output synchronization signal: Before each serial port sends data, this IO will be pulled high before sending the data, and then pulled low after the data transmission is completed to output the data transmission synchronization signal. Keep it at a low level usually.
8	VCC_IN	POWER INPUT	DC1.7V ~ 3.6V	/
9	P0.12	IO	GPIO	BLE module serial port TX
10	P0.10	IO	GPIO	/
11	P0.09	IO	GPIO	/
12	P0.07	IO	GPIO	BLE module serial port RX
13	P0.04/AIN2	IO/AI	GPIO/Analog input 2	Enable the APP configuration function When =1, the module allows the APP to send instructions to configure all parameters of the module; When =0, prohibit the APP from configuring all parameters of the module. Default input dropdown.
14	P0.03/AIN1	IO/AI	GPIO/Analog input 1	Input IN0 This pin is for input detection IO. When notification is enabled, if the input status of this pin changes, it will be reported to the APP as a Notify notification. Default input dropdown.
15	P0.02/AIN0	IO/AI	GPIO/Analog input 0	Input IN1 This pin is for input detection IO. When notification is enabled, if the input status of this pin changes, it will be reported to the APP as a Notify notification. Default input dropdown.
16	P0.01/XL2	IO/LF_XO P	GPIO/External 32.768KHZ crystal input	/
17	P0.00/XL1	IO/	GPIO/External	/

		LF_XO N	32.768KHZ crystal input	
18	P0.05/AIN3	IO/AI	GPIO/Analog input 3	Input IN2 This pin is for input detection IO. When notification is enabled, if the input status of this pin changes, it will be reported to the APP as a Notify notification. Default input dropdown.
19	P0.06	IO	GPIO	Output OUT0 The APP can control the IO output status. By default, the output is at a low level.
20	P0.08	IO	GPIO	Output OUT1 The APP can control the IO output status. By default, the output is at a low level.
21	P0.31/AIN7	IO/AI	GPIO/Analog input 7	Output OUT2 The APP can control the IO output status. By default, the output is at a low level.
22	P0.27	IO	GPIO	Disconnect all slaves connections (By default, this IO is input dropdown. When the input rises, all slave connections are disconnected.)
23	P0.30/AIN6	IO/AI	GPIO/Analog input 6	Analog input 6 (Direct input analog voltage: 0-3.3V)
24	P0.29/AIN5	IO/AI	GPIO/Analog input 5	Analog input 5 (Direct input analog voltage: 0-3.3V)
25	P0.28/AIN4	IO/AI	GPIO/Analog input 4	Analog input 4 (Direct input analog voltage: 0-3.3V)
26	P0.17	IO	GPIO	Disconnect all host connections (By default, this IO is input dropdown. When the input rises, all input connections are disconnected.)
27	P0.11	IO	GPIO	Turn off the broadcast control Default dropdown input. Broadcasting stops when the input is at a high level. When input a low level broadcasts normally.
28	P0.25	IO	GPIO	/
29	P0.26	IO	GPIO	/
30	P0.19	IO	GPIO	/
31	SWDCLK	Debug Port	Burn the debug interface clock	/
32	P0.24	IO	GPIO	/
33	P0.23	IO	GPIO	/
34	P0.22	IO	GPIO	/
35	SWDIO	Debug Port	Simulation debugging download data	/
36	EXT_ANT	EXT ANT RF Output	External antenna connection port	/
37	OB-ANT	Onboard ANT	Built-in antenna input	An internal matching circuit has been integrated. By simply connecting PIN36 and the PIN37, the built-in antenna can be used. If you want to achieve the best effect, you can add a PI circuit between PIN36 and PIN37 to make further adjustments.
38	GND	Ground	Power GND	/

3 RF Features

The module can be configured in two modes: internal antenna and external antenna.

3.1 Antenna interface and operating frequency band

Module antenna interface characteristic impedance 50 ohms.

The radio frequency working band is 2.402 ~ 2.480GHz.

3.2 Antenna application reference

3.2.1 Use module built-in antenna

The wireless transmission distance of the built-in antenna in open areas: 5 - 10 m, and it offers two usage options.

① An internal matching circuit has been integrated. Directly connecting PIN36 and PIN37, the built-in antenna of the module can be used. However, the transmission distance is relatively short. The wiring method is shown in Figure 3.1.

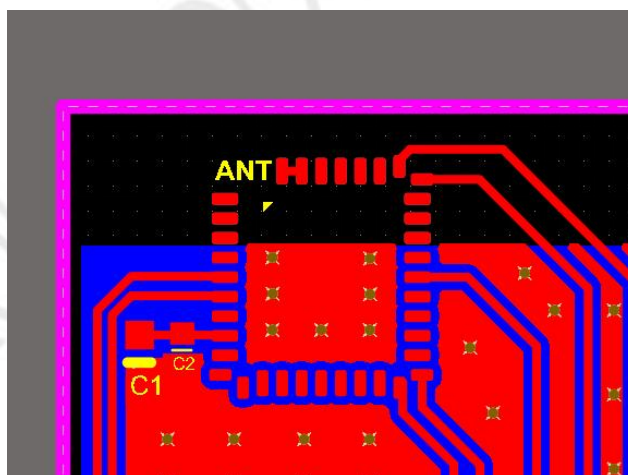
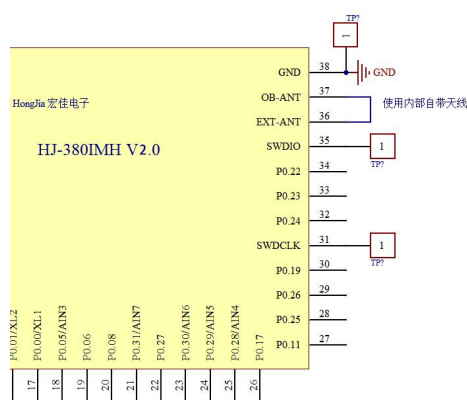


Figure 3.1: Direct connection method

② If there is sufficient space, an additional PI can be used for re-adjustment (connecting PIN36 through a π -type filter circuit to PIN37). The transmission distance will be better. The wiring method is shown in Figure 3.2.

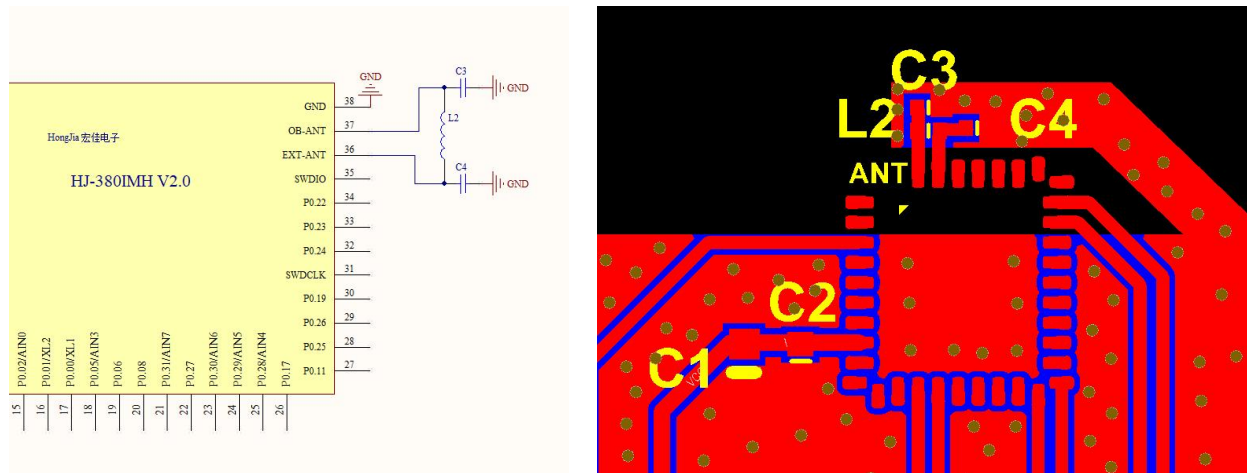


Figure 3.2: Connected through the PI circuit

Note

During PCB circuit design, no components should be placed near the antenna, no traces should be routed there. Components should not be placed on the back of the module. The copper layer should avoid the internal antenna area. (Except for the antenna part) the copper layer of the module GND should be large enough. The antenna part should try to increase the clearance area.

3.2.2 Use the external antenna wiring diagram

PIN37 is suspended, and PIN36 is connected to the PCB antenna through a π filter circuit, as shown in Figure 3.3 below, and the communication distance in open ground can reach 30~120 meters.

*** Special attention ***

- 1) If you have requirements for the distance of the product and the external π circuit needs to be matched, please send the PCBA circuit board to our company to complete this task.
- 2) When designing the circuit, no devices or wires should be placed near the antenna, and no devices should be placed on the back of the module. The copper cladding should cover the module and the π -shaped filter circuit, avoiding the PCB antenna.

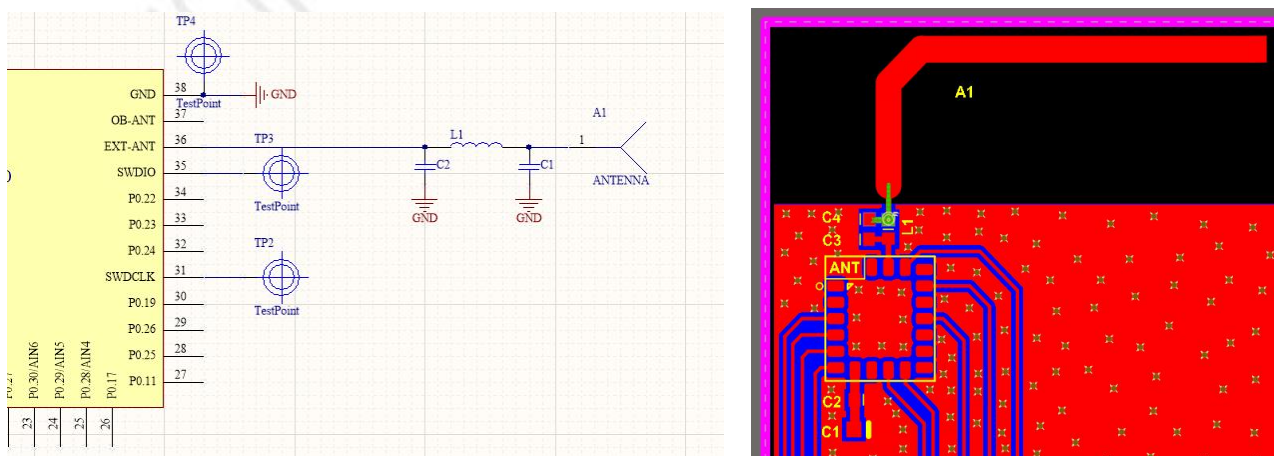


Figure 3.3: Use an external antenna

3.3 RF features

Table 3-1: RF features

Attribute	Value	Remarks
Wireless modulation mode	GFSK	/
Frequency range	2.402 ~ 2.480GHz	bandwidth: 2MHz
Number of channels	40	/
Air speed	1Mbps、2Mbps	/
Rf port impedance	50Ω	/
Transmission power	Max.: +4dBm	/
Emission current	TYP.: 5.3mA@0dBm	DC3V
Receive current	TYP.: 5.4mA	DC3V,1Mbps
Receiving sensitivity	TYP.: -96dBm	1 Mbps BLE
antenna	Built in antenna	Can also be connected to an external antenna

4 Electrical Parameters

4.1 Absolute Maximum Ratings

Table 4-1: Absolute Maximum Ratings

Parameter	MIN	MAX	Unit
supply voltage VCC	1.7	3.9	V
IO Supply Voltage	0	VCC+0.3(3.9)	V
Operating Temperature	-40	+85	°C
Storage Temperature	-40	+85	°C

4.2 DC Characteristics

Table 4-2: Recommended Operating Conditions

Parameter	MIN	TYP	MAX	Unit
Supply voltage VCC	1.7	3.3	3.6	V
IO Supply Voltage	0	3.3	VCC	V
Dormant working current	/	<2	/	μA
Operating Temperature	-40	+25	+85	°C

Table 4-3: Dc features of I/O ports

IO Pin	Drive capability	Min	Max	Unit
Input low level	/	0	0.3*VCC	V
Input high level	/	0.7*VCC	VCC	V
Output low level	5mA	0	0.4	V
Output high level	5mA	VCC-0.4	VCC	V

Table 4-4: Electricity consumption

Test condition	TYP	Unit
sleep mode	2.0	uA
Broadcast at 20ms interval in slave mode	55	uA
Broadcast in slave mode with 1S gap	12.2	uA
Maintain the connection in slave mode with a 20ms connection gap	190	uA

Scan in host mode	4.5	mA
In host mode, the connection is maintained at a 20ms interval	180	uA

5 Reference design for users to develop their own programs

5.1 Use the internal 32.768KHZ low-frequency clock

To use the internal clock, you need to modify the sdk_config.h file in NRF52 SDK17.1 as follows:

- Unfold “nRF_Drivers”-> “NRFX_CLOCK_ENABLED”Please modify as shown in Figure 5.1:

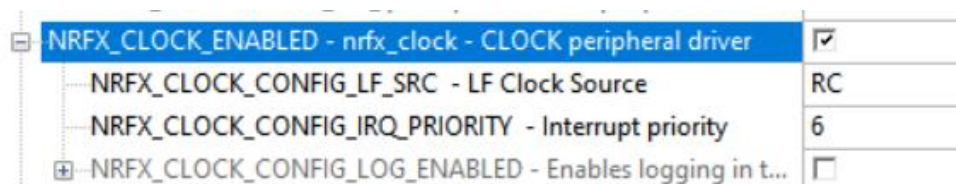


Figure 5.1: NRFX_CLOCK_ENABLED

- Unfold“nRF_Drivers”->“NRF_CLOCK_ENABLED”Please modify as shown in Figure 5.2:

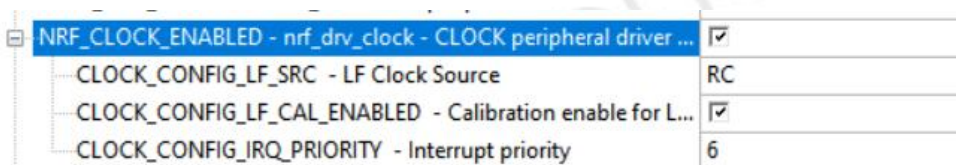


Figure 5.2: NRF_CLOCK_ENABLED

- Unfold“nRF_SoftDevice”->“NRF_SDH_ENABLED”->“Clock - SoftDevice clock configuration”Please modify as shown in Figure 5.3:

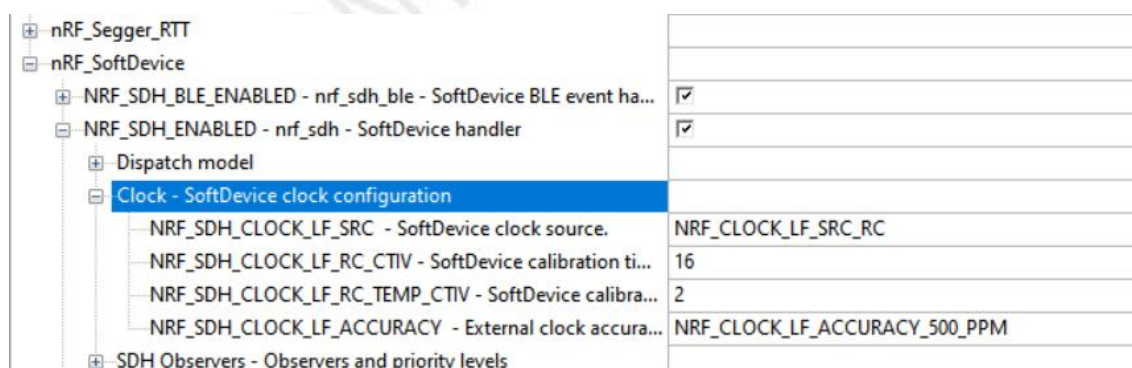


Figure 5.3: NRF_SDH_ENABLED

5.2 Use external 32.768KHZ low frequency clock

Simply connect the XL1 and XL2 to an external clock based on the two designs in Section 3.2. Figure 5.4 shows.

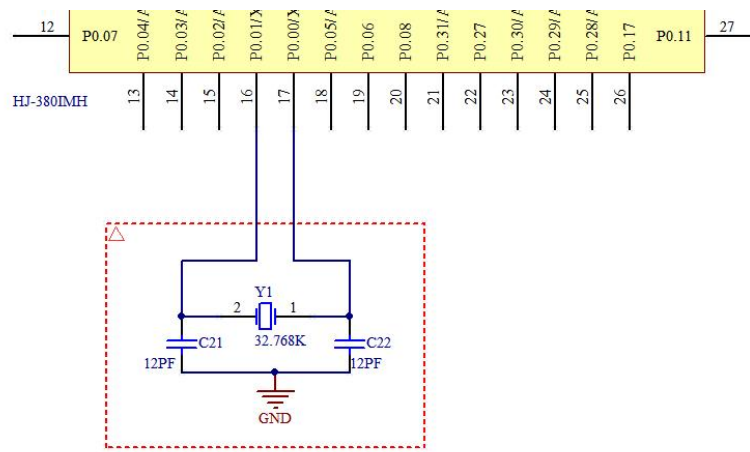


Figure 5.4: External clock connection diagram

5.3 External PA/LNA is connected for power expansion

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

5.3.1 PA/LNA control code

For example, We use P0.00 as the PA send enable control pin; P0.12 as LNA receiving enable control pin, refer to the following code.

```
#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);
}
```

5.3.2 Add the above function to the int main(void) function, please add that behind “ble_stack_init();”, before “advertising_start”, Reference figure 5.5:

```

/**@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 5.5: int main(void) function

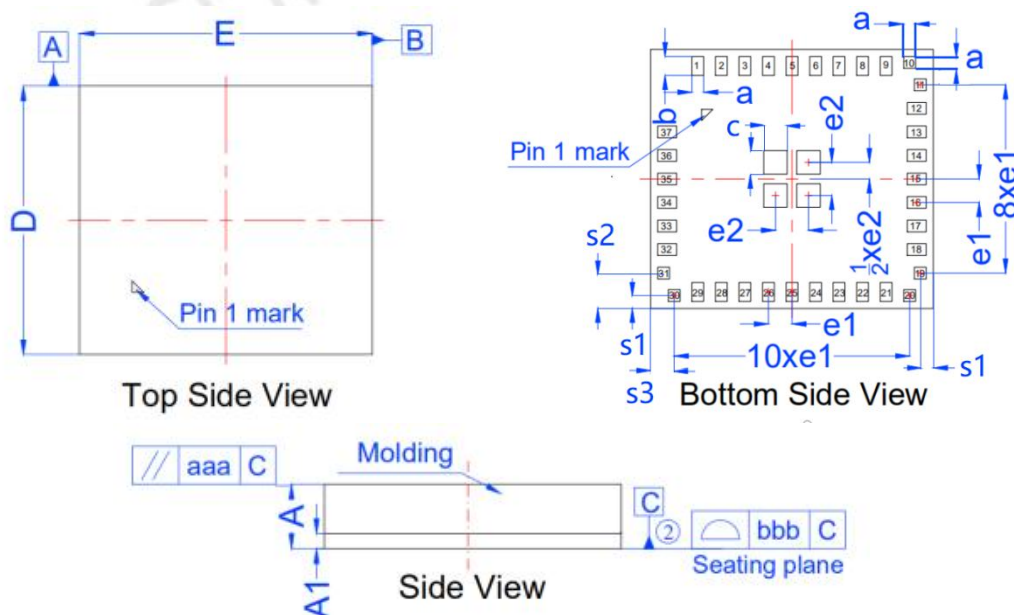
6 Hardware Design Attentions

- All IO ports can be used, please refer to the pin diagram and pay attention to the IO mode and status when connecting to the IO.
- Non-battery-powered or mains power-downgraded power supply. It is recommended to apply magnetic beads or inductors for filtering the input power.
- The filter capacitors at the power supply should be placed as close as possible to the power input pins of the module. If it is capacitor power supply or there is limited space, the filter capacitors at the power supply can be removed. The filter capacitors already exist inside the module.
- The entire layer of the circuit board should be copper-covered for GND connection, and ensure that the copper-covered area is large enough (except for the antenna part). Also, ensure good grounding.
- When using an external PCB antenna, please contact us to confirm whether your PCB antenna

design is reasonable.

- The external 32.768KHz low-frequency crystal oscillator is not necessary. The internal LF oscillator can be used as a substitute. Just make a simple change in the SDK. See Section 5.1 for details. If you have any questions, please consult us.
- The module should not be placed in a metal enclosure. If a metal enclosure must be used, the antenna should be led out.
- For products using this wireless module, metal components such as screws and inductors should be kept as far away as possible from the RF antenna part of the module.
- Near and on the back of the Bluetooth module antenna, do not place other components and do not route wires. Otherwise, it will affect the Bluetooth performance.
- The PCB antenna of the module should be placed at the four edges of the circuit board. The antenna part should be close to the edge or corner of the main board. It is best to place the module on the corner of the circuit board.
- Over holes should be drilled in the copper-covered area of the entire mainboard, especially in the copper-covered area near the module and the antenna. Try to drill as many holes as possible.
- If there are high-power devices or high-voltage conversion circuits on the circuit board, the GND copper-covered of the module should be isolated from other parts' GND copper-covered, and connected by a single-point grounding method. Try to drill as many holes as possible to reduce interference to the RF signal.
- Unnecessary pins can be left floating.

7 Machine Dimension



DIMENSIONAL REFERENCES				Unit: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	5.40	5.50	5.60		
E	5.90	6.00	6.10		
a	0.20	0.25	0.30		
b	0.35	0.40	0.45		
c	0.45	0.5	0.55		
e1	0.50 REF				
e2	0.70 REF				
s1	0.275 REF				
s2	0.75 REF				
s3	0.50 REF				

Note : +

1. All dimensions are in mm.
2. Datum 'C' is the mounting surface, with which the package is in contact.

Figure 7.1: HJ-380IMH dimension

8 SMT production

8.1 Precautions for ultrasonic welding

NOTES

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.

8.2 Soldering Recommendations

The module is recommended to be soldered using reflow soldering.

HJ-380IMH module use high temperature resistant materials, manufacturing by Lead-free Process. The maximum temperature resistance is 265°C. Ten continuous reflow soldering has no effect on properties and strength. Specific parameters as shown in Table 8-1.

Table 8-1: Reflow soldering parameters

Parameter	Value
Features	Lead-free process
Average ramp up rate(T _{SMAX} to T _p)	max3°C/sec. max
Temperature Min(T _{Smin})	150°C
Temperature Max(T _{Smax})	200°C
Preheat time (Min to Max) (tS)	80~100sec
Peak Temperature (T _P)	250±5°C

Ramp-down Rate	6°C/sec. max
Time 25°C to Peak Temp (T_P)	8 min. max

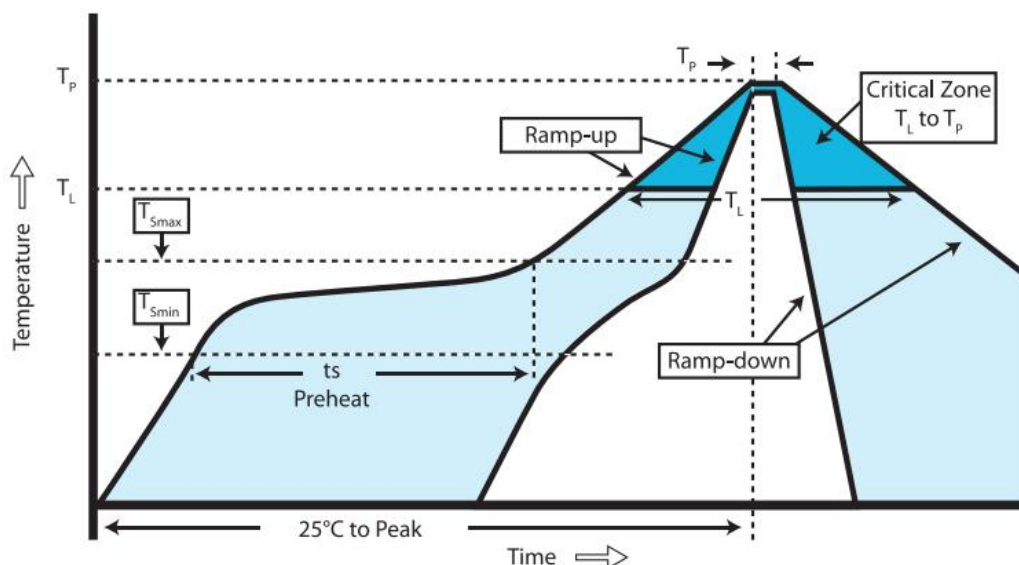


Figure 8.1: Temperature Curve of Reflow Welding

8.3 Humidity sensing properties

The HJ-380IMH module has a humidity sensitivity of level 3.

If any of the following two conditions are met, the HJ-380IMH module should be fully baked prior before reflow soldering, otherwise the module may cause permanent damage during reflow soldering.

- After unpacking or vacuum packaging is damaged and air leaks, the module needs to be SMT within 168 hours when the temperature is less than 30 degrees and the relative humidity is less than 60%. If the above conditions are not met, bake.
- Vacuum packaging is not opened, but beyond the shelf life, also need to be baked.

9 Packaging

9.1 Packaging method

Table 9-1: Packaging method

Type	Packaging method	Minimum packing quantity(PCS)
HJ-380IMH_XX	Roll tape	3000

Use chip-grade anti-static aluminum foil bags to seal, roll packaging. Each bag is put in desiccant. Industrial grade vacuum pump ensures no air leakage, moisture, water and dust (IP65). The actual packaging effect is shown in Figure 9.1.



Figure 9.1: package figure

9.2 Label information

All packages are labeled with cargo information, ROHS label, anti-static label, etc.

【A】	Tangshan Hongjia electronic Technology Co., LTD
【B】	HJ-XXX-XXX
【C】	Pb Free Reflow(260°C)
【D】	Date Code:2508 HJ0218
【E】	Note: Must be stored in a vacuum Seal
【F】	Warning: Humidity sensitivity level MSL:XX
【G】	QTY:1500PCS SEAL DATE:20250218

Figure 9.2: Product label drawing

Table 9-2: Module information description

No.	Description
A	company name
B	product model
C	Lead-free reflow mark and reflow temperature setting value
D	Production date Example: 2508 HJ0218 represents the product produced in the 8th week of 2025, on February 18
E	Storage precautions
F	Humidity sensitivity level
G	Quantity of product + date of sale