

HJSIP®

HJ-180IMH-11 — **Hardware Design Manual**

Based on Nordic NRF52811

Ultra-small chip-level

5.5x5x1.3mm

BLE5.4 module

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Preface

Thanks for using the Bluetooth module provided by HJSIP. The HJ-180IMH-11 series standard Bluetooth module is a high-performance IoT Bluetooth transceiver based on Nordic NRF52811. The module adopts LGA24 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	2023/11/17	Initial Version	ZDY	LMY
V1.1	2025/02/05	1) Standardize the manual format; 2) Update the information of the 8.2 label; 3) Adjust the BLE standard from 5.0 to 5.4; 4) Remove "Serial Port Transparent Transmission WeChat Version" from the module selection.	WYW	LMY
V1.2	2025/04/30	1) When using the internal antenna, a PI circuit needs to be added to achieve the best effect. For details, see 3.2.1. 2) When using an external PCB antenna, the PCBA board needs to be sent to our company for PI circuit matching. For details, see 3.2.2. 3) Add a description of the core chip. 4) The duration of the external reset low level is changed from 10ms to 1s. 5) Table 2-2: Add a note to the RST pin, which must be connected to I/O. If not connected, add a 1K strong pull-up. 6) Table 2-1: The external antenna transmission distance is adjusted from 40-80m to 30-120m.	WYW	LMY

Applicable module selection

No.	Module model	Type	Description
1	HJ-180IMH-11_SPPv2	Serial port transparent transmission standard version	It is equipped with built-in serial port transparent transmission firmware. This firmware module serves as a bridge for two-way communication between Bluetooth devices or mobile phones and the MCU. Users do not need to understand the Bluetooth protocol stack. They can operate and send and receive serial port data through serial port instructions. The operation is simple, shortening the user's development cycle and accelerating product launch.
2	HJ-180IMH-11_CUSv2	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-180IMH-11_EMP	Customer development version	Provide standard SDK to facilitate customers' secondary development of OPEN CPU.

1 Introduction

The HJ-180IMH-11 series standard Bluetooth module is a high-performance IoT Bluetooth transceiver based on Nordic NRF52811. The module adopts LGA24 packaging and supports both built-in and external antennas. It also features low power consumption, small size, and strong anti-interference ability, making it suitable for a wide range of application scenarios.

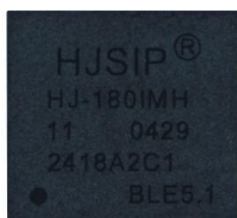


Figure 1.1: HJ-180IMH-11 top view

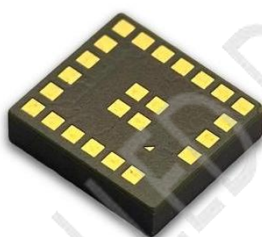


Figure 1.2: HJ-180IMH-11 bottom view

2 Product overview

2.1 Key features

Table 2-1: HJ-180IMH-11 key characteristics

Characteristic	Description
Function	- Supports BLE 5.4, embeds low-power Bluetooth protocol stack and GATT services. - Support BLE master-slave integration. - Support data transmission, or provide a non-programming module for customers to develop their own firmware independently.
supply voltage	1.7~3.6VDC
Working frequency band	2.402~2.480GHz(2.4GHz ISM Band)
The max transmission power	+4dBm
Peak current for transmission	4.6mA@0dBm
Peak current for reception	4.6mA
Receiving sensitivity	-97dBm @1 Mbps, -104dBm @125 kbps
Antenna	Built-in and external antennas are available for selection.
Transmission distance	The wireless transmission distance of the built-in antenna in open areas: 5 to 10 meters; External antenna: 30~120m

Power consumption(1Mbps)	- sleep current < 2 μ A - 1-second interval broadcast current 12.2 μ A(0dBm) or 15.5 μ A(+4dBm) - 2-second interval broadcast current 6.5 μ A
GPIO Port	17 (Max)
Size	5.5mm*5mm*1.3mm (L*W*H, with antenna)
Package	LGA24
Weight	0.1g
Operation and storage temperature	-40 ~ +85°C
ROHS	Compliant with the ROHS standards

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

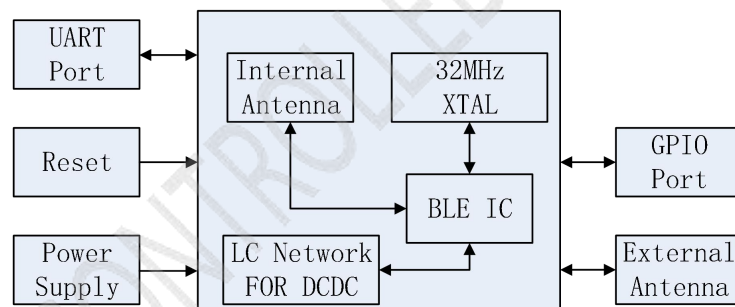


Figure 2.1: HJ-180IMH-11 functional block diagram

2.4 Pins distribution diagram

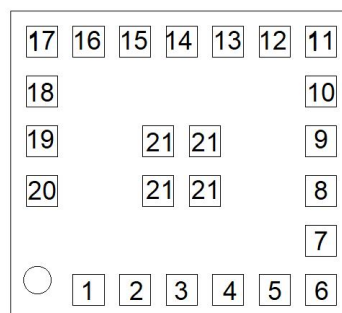


Figure 2.2: HJ-180IMH-11 pins distribution diagram(front view)

2.5 Pins description table

Table 2-2: HJ-180IMH-11 pins definition table

PIN	Name	Type	Description	Through-transmission module function
1	SWDCLK	INPUT	Programming and debugging interface clock	/
2	P0.17	IO	GPIO	<u>Host connection status indicator pin</u> (When the output is a high level, the module has successfully connected to the external slave device; when the output is a low level, the module disconnects the connection to the external slave device.)
3	P0.14	IO	GPIO	<u>The selection pin for the transmission path of the data received via the serial port</u> When the module is connected to the slave device, when a high voltage is input, the data received by the module from the serial port is sent to the connected slave device; when a low voltage or a floating state is input, the data received by the module from the serial port is sent to the host device connected to the module or the mobile phone APP. When the module is not connected to an external slave device, regardless of the level of the pin, the data will be sent to the host device connected to the module or the mobile APP.
4	P0.12	IO	GPIO	<u>The serial port TX pin of the Bluetooth module</u> (In transparent mode, this pin is the TX pin of the serial port and connected to the RX pin of the MCU.)
5	P0.08	IO	GPIO	<u>The serial port RX pin of the Bluetooth module</u> (In transparent mode, this is the RX pin of the serial port and connected to the TX pin of the MCU.)
6	P0.11	IO	GPIO	<u>The indicator pin for the connection status of the slave device</u> (When the output is a high level, the module has successfully been connected as a slave by the host; when the output is a low level, the module has been disconnected from the host as a slave.)
7	VCC_IN	POWER	DC1.7V ~ 3.6V	/
8	P0.05/ AIN3	IO/AI	GPIO/Simulated Input 3	<u>APP data reception indicator pin</u> When the module receives data sent by the mobile APP or the external device connected to this module, the BLE module needs to send the data out through the module's serial port TX pin. Whether the module is the host or the slave, this pin will be pulled high for T1 (ms) (T1 can be set and the range is 1-255ms) before the data is sent through the module's serial port TX pin. When the data transmission is completed then the pin pulled low. Normally, this pin remains at a low level to indicate idle. This pin is used as the wake-up signal for long connection low-power devices.
9	P0.01/ XL2	IO /LF_XO P	GPIO/External 32.768KHz crystal input	<u>Serial port receive enable pin(can be set, the default low level is valid.)</u> When the low level is set as the valid level: P0.01 = 0, the serial port receiving function of the module is enabled. At this time, the module operates at full speed

				and can send commands or perform data transmission. The power consumption of the module will increase by 300 to 400 μA; P0.01 = 1, the serial port receiving function of the module is disabled, and the module operates in a low-power state. At this time, if a broadcast is performed once every second, the power consumption is less than 15 μA. If the broadcast is stopped, the power consumption is less than 2 μA. When the high level is set as the valid level: P0.01 = 1, the serial port receiving function of the module is enabled; P0.01 = 0, the serial port receiving function of the module is disabled.
10	P0.03/ AIN1	IO/AI	GPIO/simulated Input 1	<u>Enable APP configuration function</u> When this pin receives a high voltage input, it enables the mobile APP to send instructions to configure all the parameters of the module. When this pin receives a low voltage input, prohibit the mobile APP configurate or read the parameters of the module. Default input dropdown.
11	P0.04/ AIN2	IO/AI	GPIO/Simulated Input 2	<u>In host mode, the successful data transmission flag with feedback response</u> (When sending data to the slave device with feedback response, if this pin is low, it indicates that the slave device is in an idle state and data can be sent continuously; when this pin is at a high level, it indicates that the data has not been sent completely and it is necessary to wait until it becomes low before sending again.)
12	P0.00 /XL1	IO /LF_XO N	GPIO/External 32.768KHz crystal input	<u>The control pin for the slave device to enter the simple pairing mode</u> (When this pin is input with a high level of 1, the module acts as a slave and enters the simple pairing mode, and the host device connected to the module can bind this slave device; when this pin is input with a low level of 0, the module acts as a slave and exits the simple pairing mode.)
13	P0.18	IO	GPIO	<u>Input IN0</u> This is an input pin. 1. The "automatic reporting status function" cycle of IN0 can be set through the serial port or the APP. The input status of this pin will be automatically reported to the APP in the configurable channel (0XFFF3) channel in the form of notification (Notify). The reference time is 100ms. 2. The input IO status can also be read at any time through instructions. 3. The default input is pulled down.
14	P0.15	IO	GPIO	<u>Input IN1</u> This is an input pin. The function description is the same as IN0.
15	P0.16	IO	GPIO	<u>Output OUT0</u> This is an output pin. 1. Through serial port commands or APP commands, the output level state of the OUT0 pin can be set, and the output level state of OUT0 can also be saved. The saved state will be retained even after power loss. 2. The output state of OUT0 can be read at any time.

				<u>Enable external PA</u> When the function of this pin is to enable the external PA, this pin will automatically control the output level based on the current transmission status of the Bluetooth module antenna. The PA externally connected to the module can then automatically control according to the level of this pin.
16	P0.20	IO	GPIO	<u>Output OUT1</u> This is an output pin. The function description is the same as that of OUT0. <u>Enable external LNA</u> When the function of this pin is to enable the external LNA, this pin will automatically control the output level of the pin based on the current receiving status of the antenna of the Bluetooth module. The LNA externally connected to the module can then automatically control according to the level of this pin.
17	SWDIO	Debug Port	Simulation debugging download data	/
18	P0.21/ nRESET	IO/ Reset Pin	GPIO/external reset pin	<u>External hardware reset pin</u> Low level is the effective level, and the duration of the low level should be more than 1S. <u>Note:</u> <u>The RST pin must be connected to the I/O. If it is not connected, a 1K strong pull-up resistor must be added.</u>
19	EXT-ANT	RF OUTPUT	RF signal output	Connect the built-in antenna or the external antenna
20	OB-ANT	Onboard ANT	Built-in antenna interface	An internal matching circuit has been integrated. If using the onboard antenna, simply connect PIN19 and PIN20. According to your product structure, to achieve the best antenna effect, an additional PI is required. Please refer to 3.2.1 for details.
21	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 wiring diagram

An internal matching circuit has been integrated. If using the onboard antenna, simply connect PIN19 and PIN20;

Depending on your product structure, to achieve the best antenna effect, an additional PI is required. Connect PIN19 to PIN20 through a π -type filter circuit. Then you can use the internal high-performance antenna, as shown in Figure 3.1. The communication distance in open areas is 5 to 10 meters.

It is important to note that no devices should be placed near the antenna, no wires should be routed, no devices should be placed on the back of the module, and copper should avoid the area of the onboard antenna. (Except for the antenna part) the copper on the back of the module should be large enough for the GND, and the antenna should be given as much clearance as possible.

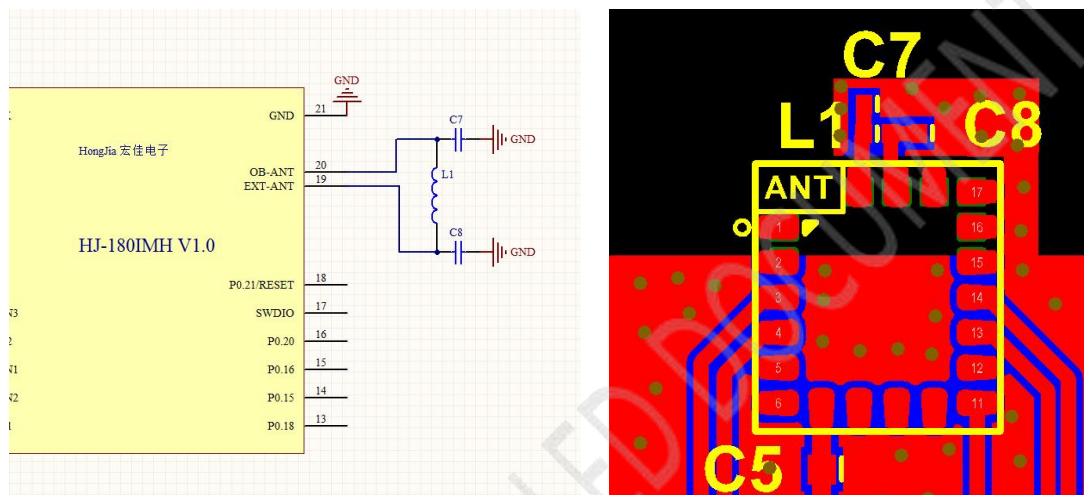


Figure 3.1: Use the module's internal antenna

3.2.2 Use the external PCB antenna wiring diagram

The PIN20 is suspended, and the PIN19 is connected to the PCB antenna through a π filter circuit, as shown in Figure 3.2 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.

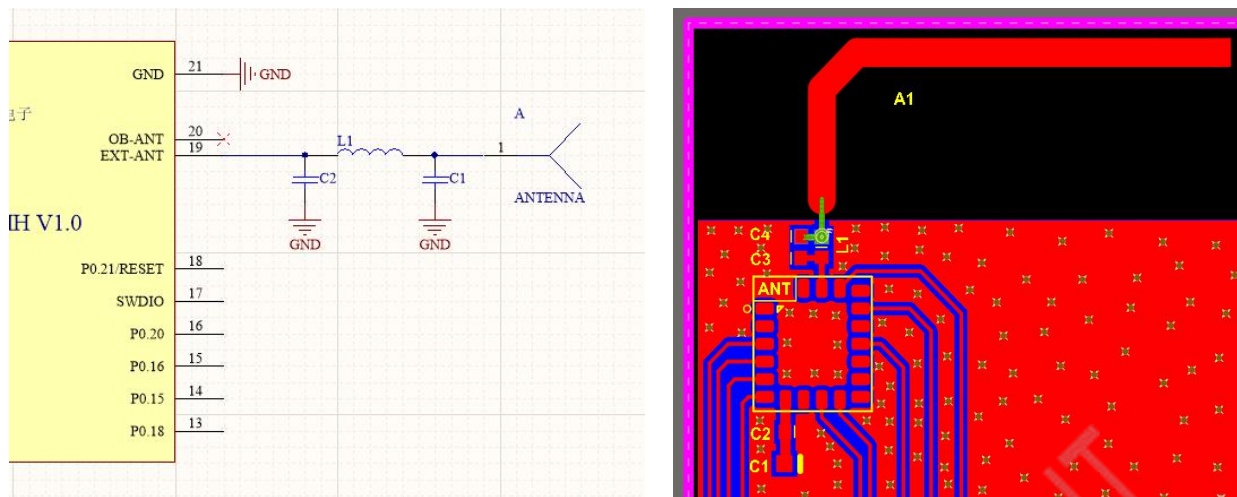


Figure 3.2: Use the external antenna

3.3 RF Features

Table 3-1: RF features

Attribute	Value	Remarks
Wireless modulation mode	(G)FSK	/
Frequency range	2.402 ~ 2.480GHz	bandwidth: 2MHz
Number of channels	40	/
Air speed	1Mbps、2Mbps、125kbps、500kbps	/
Rf port impedance	50Ω	/
Transmission power	Max. +4dBm	/
TX peak current	TYP. 4.6mA@0dBm	DC3V
RX peak current	TYP. 4.6mA	DC3V,1Mbps
Sensitivity	TYP. -97dBm @1 Mbps TYP. -104dBm @125 kbps	/
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
VCC	1.7	3.9	V
V _{I/O}	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
VCC	1.7	3.3	3.6	V

V _{I/O}	0	3.3	VCC	V
Sleep current	/	<2	/	μA
Maximum working current	/	5	/	mA
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

5 Notices for Hardware Design

- All IO ports can be led out for use. Please pay attention to the pin diagram for all pins. For the IO connected to them, please pay attention to the IO mode and status.
- Not battery-powered, powered by a reduced-voltage supply from the mains power. It is recommended to use 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 a capacitor-powered system or there is limited space, they can be removed. The module already has filter capacitors inside.
- When using an external PCB antenna, please contact us to verify whether your design of the external PCB antenna is reasonable.
- The module should not be placed in a shell made of metal. If a metal shell must be used, the antenna must be led out.
- Each layer of the circuit board is fully copper-covered and connected to GND. The copper-covered area should be large enough (excluding the antenna part) and properly grounded.
- some metal material components, such as screws and inductors, should be kept as far away as possible from the radio frequency antenna part of the wireless module.
- Near and behind the antenna of the Bluetooth module, try not to place other components and do not run wires. If devices or wires are placed, it will affect the performance of Bluetooth.
- The module antenna 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 in the corner of the circuit board.
- Through holes need to be drilled in the entire copper-clad area of the circuit board, especially in the copper-clad areas near the module and antenna, as many through holes as possible should be drilled.
- If there are high-power devices or high-voltage conversion circuits on the circuit board, the

GND copper cladding of the module needs to be isolated from the GND copper cladding of other parts, connected by single-point grounding, and as many vias as possible should be drilled to reduce the interference to the RF signal.

- Unnecessary pins can be left suspended.

6 Mechanical specifications

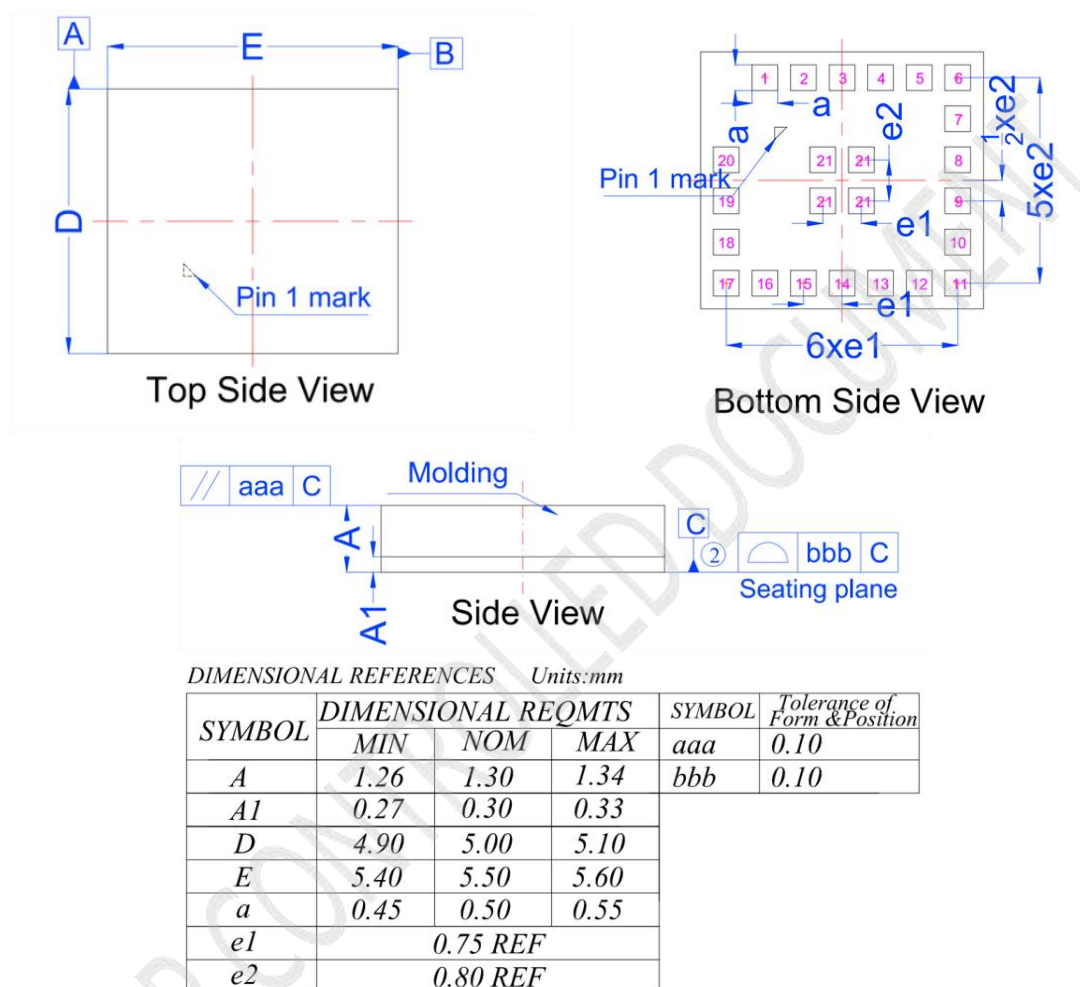


Figure 6.1: HJ-180IMH-11 dimension

7 SMT production

7.1 Production Guide

The module is recommended to be soldered using reflow soldering.

The packaging tape of this module has a maximum temperature resistance of 50°C. Do not with the tape for high-temperature baking.

If the unboxing time exceeds 3 months, special attention should be paid to whether the product is damp. Due to the PCB gold plating process, if it exceeds 3 months, it may cause oxidation of the

solder pads, and during the soldering process, it may lead to short circuits or incomplete soldering problems.

To ensure the qualified rate of reflow soldering, it is recommended to randomly select 10% of the products for visual inspection and AOI testing for the first time to ensure the rationality of the furnace temperature control, the device adsorption method, and the placement method.

During the entire production process, the operators at each workstation must wear electrostatic gloves or wristbands.

7.2 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.

7.3 Soldering Recommendations

HJ-180IMH-11 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 followed.

Table 7-1: Reflow soldering parameters

Parameter	Value
Features	Lead-free process
Average ramp up rate($T_{S\max}$ to T_p)	max3°C/sec. max
Temperature Min($T_{S\min}$)	150°C
Temperature Max($T_{S\max}$)	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

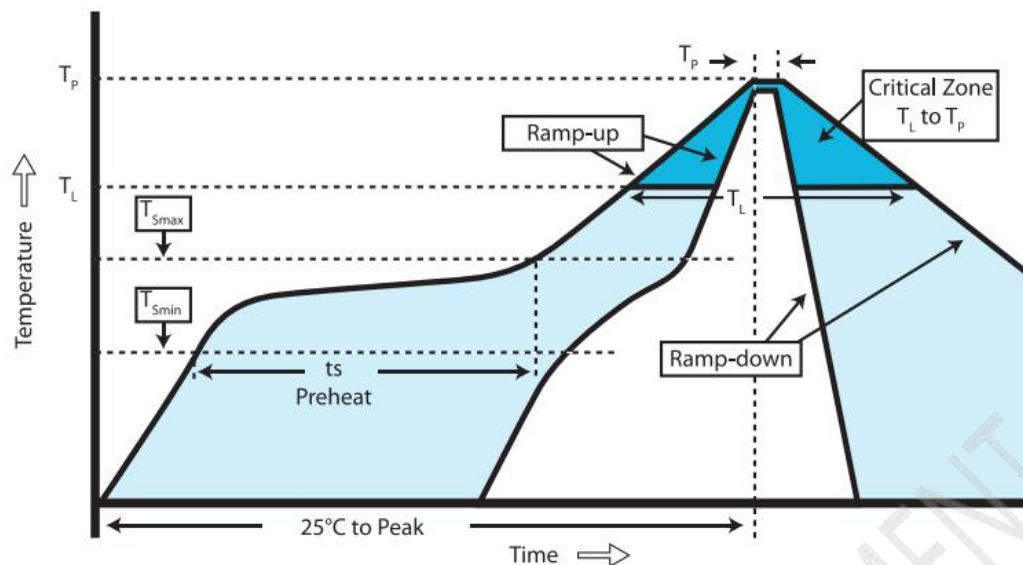


Figure 7.1: Temperature Curve of Reflow Welding

7.4 Humidity sensing properties

The HJ-180IMH-11 module has a humidity sensitivity of level 3.

If any of the following two conditions are met, the HJ-180IMH-11 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.

8 Packaging

8.1 Packaging method

Table 8-1: Packaging method

Type	Packaging method	Minimum packing quantity(PCS)
HJ-180IMH-11	Roll tape	4000

After being wrapped in a roll, the product is sealed with a chip-level anti-static aluminum foil bag. Each bag is filled with desiccant and then vacuumed using an industrial-grade vacuum pump. The protection level is IP65. The actual packaging is shown in Figure 9.1.



Figure 8.1: package figure

8.2 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 8.2: Product label drawing

Table 8-2: 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