HJSIP®

HJ-131IMH_Hardware Design Manual

Based on DA14531

Chip-level ultra-low power BLE 5.4 module

Version：V2.2

Date：2025/04/29

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Preface

Thanks for using the Bluetooth module provided by HJSIP. HJ-131IMH series standard Bluetooth module, is a high-performance iot Bluetooth transceiver. The module adopts LGA17 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	2019/10/17	Initial Version	LMY	LJH
V1.1	2019/11/01	Update the package	LMY	LJH
V1.3	2020/01/01	Update parameters	LMY	ZYP
V1.5	2020/01/18	Redefine the pin function	LMY	ZYP
V1.7	2020/02/28	update	LMY	ZYP
V1.8	2020/08/05	Fix the incorrect marking of the reference circuit diagram	LMY	ZYP
V1.9	2023/02/23	Format adjustment, update feature parameters, and add hardware precautions	FJW	LMY
V2.0	2023/07/27	Change "output antenna" to "external connect antenna"	FJW	LMY
V2.1	2025/01/10	1) Unify the document format; 2) Add "3 Description of Working Characteristics"; Add "4 Application Interface Descriptions"; Adjust the "9 SMT production content "; 3) Adjust the "10.2 Tag Information "; 4) Adjust the BLE standard from 5.1 to 5.4.	WYW	LMY
V2.2	2025/04/29	1）When using the internal antenna, a PI circuit must also be added. Please refer to 3.2.1. 2）Add a description of the core chip; 3）When using an external PCB antenna, the PCBA board needs to be sent to our company for PI circuit matching. Please refer to 3.2.2. 4）Table 2-2: Additional note: The RST pin must be connected to I/O. If not connected, a 1K pull-down resistor must be added.	WYW	LMY

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Applicable module selection

No.	Module model	Type	Description
1	HJ-131IMH	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-131IMH_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-131IMH_EMP	Customer development version	Provide standard SDK to facilitate customers' secondary development of OPEN CPU.

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1 Introduction

HJ-131IMH series standard Bluetooth module, is a high-performance iot Bluetooth transceiver. The module is packaged in LGA17 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.

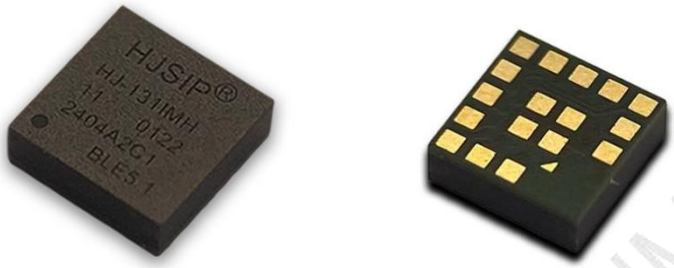

Figure 1.1：HJ-131IMH Top and bottom view

2 Product overview

2.1 Key features

Table 2-1：HJ-131IMH key characteristics

Characteristic	Description
Function	- Supports BLE 5.4, embedded low-power Bluetooth protocol stack and GATT service - Supports BLE master-slave integration (supports 1-slave 1-master or 3-slave, master and slave work simultaneously without affecting each other) - The built-in standard firmware supports transparent transmission of basic functions, or there is no program module for customers to develop their own firmware
Receiving sensitivity	-94dBm
Size	4mm*4mm*1.3mm（Regular version） 4mm*4mm*1mm（Ultra-thin version）（L*W*H，With antenna）
Packaging and weight	LGA17,The pad spacing is 0.8mm；0.1g；
supply voltage	High voltage mode：1.8V～3.3V，TYP 3V； Low voltage mode：1.1V～1.65V，TYP 1.5V； It can be powered by a single AA battery or a 1.5V zinc-air battery. It can also be powered by two AA batteries or lithium batteries after voltage stabilization.
Peak current for transmission	3.5mA@0dBm DC3V
Peak current for reception	2.2mA@DC3V
Dormant current	＜2uA
Operation Temperature	-40 ～ +85℃
Storage Temperature	-40 ～ +85℃
Working frequency band	2.402～2.480GHz(2.4GHz ISM Band)

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Transmission power	-19.5dBm～+2.5dBm
GPIO Port	6（Max）
Memory and ROM	- Built-in 32KB OTP - Built-in 48KB RAM - Built-in 4KB EEPROM - An external 512Kb EEPROM can be expanded to store user programs, or an external 1Mb EEPROM can be expanded to store user programs and for OTA use.
Transmission distance	The wireless transmission distance of the built-in antenna in open areas: 5 to 10 meters； External antenna：30～120m
Product Certification	BQB FCC CE SRRC ROHS 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

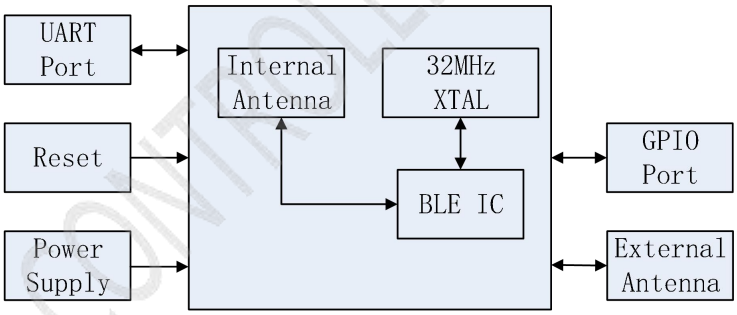

Figure 2.1：HJ-131IMH functional block diagram

2.4 Pins distribution diagram

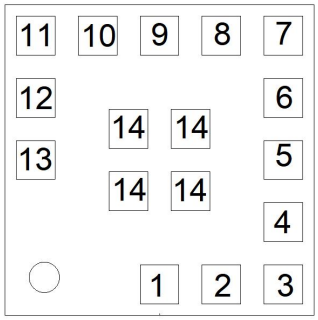

Figure 2.2：HJ-131IMH Pins distribution diagram(front view)

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2.5 Pins description table

Table 2-2：HJ-131IMH Pins definition table

PIN	Name	Type	Description	(Customization/transparent transmission) function
1	VCC_LOW	Low Power In	Low-voltage power supply input	1.1V-1.65V
2	VCC_HIGH	High Power In	High-voltage power supply input	1.8V-3.3V
3	*EEPROM_VCC*	*HongJia Reserve*	*Internal EEPROM power supply pin*	*The power supply range is 1.7-3.6V. If needed, please connect to VCC_HIGH*
4	*EEPROM_SDA*	*HongJia Reserve*	*The SDA data pin of the internal EEPROM*	*If you need to use it, please connect to P03*
5	P03	IO	GPIO	If you need to use the internal EEPROM, please connect it to EEPROM_SDA
6	*EEPROM_SCL*	*HongJia Reserve*	*The SCL data pin of the internal EEPROM*	*If needed, please connect to P04*
7	P04	IO	GPIO	If you need to use the internal EEPROM, please connect it to EEPROM_SCL
8	P05/SWDIO	UART TX	UART Pin	BLE UART TX
9	P02/SCLK	WAKEUP/UART RX	Wake-up pin /UART pin	Wake up and BLE serial port RX (At low power consumption, the pin is by default the wake-up pin. Pulling the external high level up by more than 1ms can wake up BLE. After waking up, this pin becomes the serial port RX function and can perform normal data transmission and reception.)
10	P00/H_Reset	I/RST	Reset	High level 1 reset，the duration of the high level should be more than 1 second; Suspended or low level 0 normal operation. *Note： The RST pin must be connected to I/O. If not, a 1K strong pull-down resistor must be added.*
11	P01	O	Connect status pin	Connect status （connect=1;disconnect=0;）
12	ANT_OUT	RF OUT	RF output	RF output，connect external antenna
13	BOARD_ANT	Onboard ANT	Built-in antenna input	If you want to use the built-in antenna, just connect pins12 and 13 through the PI circuit
14	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

Connect PIN12 to PIN13 through a π-type filter circuit to enable the internal high-performance antenna,as shown in Figure 3.1 below.The communication distance in the open area is 5 to 10 meters.

It should be noted that no devices or traces should be placed near the antenna, and no devices should be placed on the back of the module. The copper coating should avoid the internal antenna area，(Except for the antenna part)the copper coating on the module's GND should be large enough, and the antenna should have as much clear space as possible.

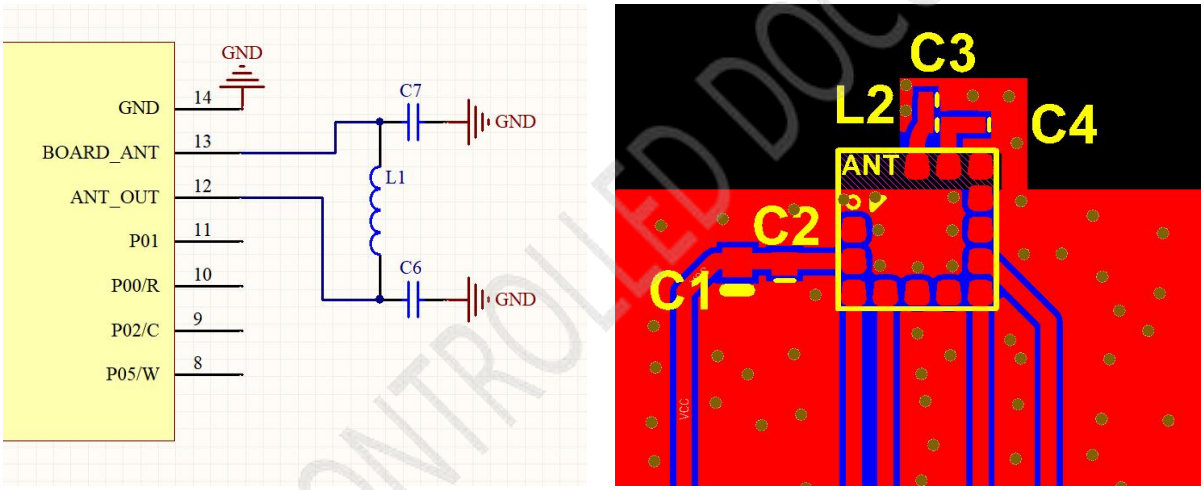

Figure 3.1：Use the module's built-in antenna

3.2.2 Use the external antenna wiring diagram

The PIN13 is suspended, and the PIN12 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.

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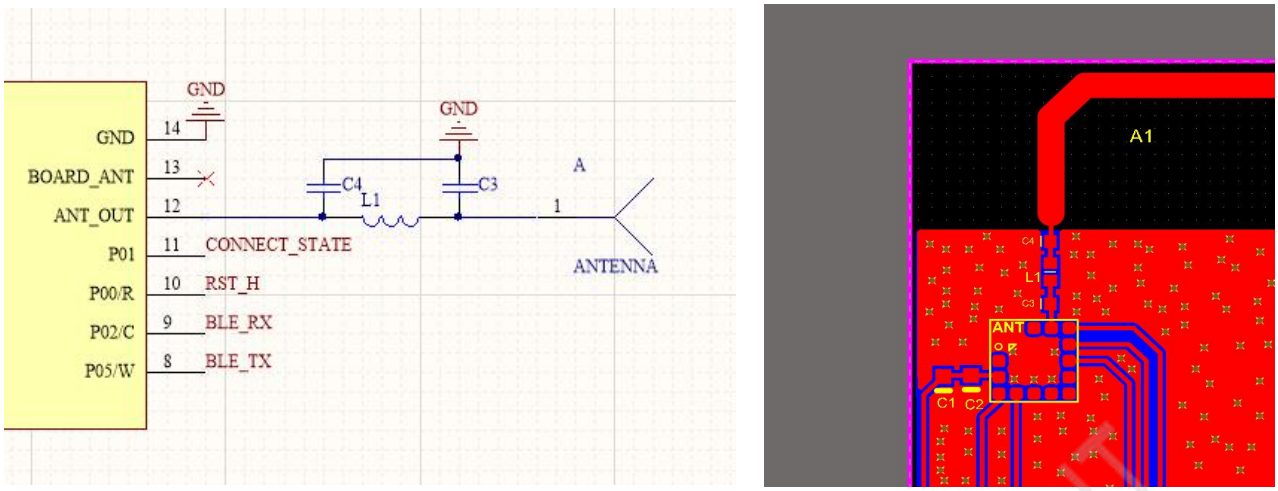

Figure 3.2：Use an external antenna

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	/
Rf port impedance	50Ω	/
Transmission power	MAX： +2.5dBm	/
Emission current	3.5mA@0dBm	DC3V
Receive current	2.2mA	DC3V
Receiving sensitivity	-94dBm	/
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	1.1	3.6	V
IO Supply Voltage	0	VCC	V
Operating Temperature	-40	+85	℃
Storage Temperature	-40	+85	℃

4.2 DC Characteristics

Table 4-2：Recommended Operating Conditions

Parameter	MIN	TYP	MAX	Unit
Supply voltage VCC	1.1	3(1.5)	3.3	V
IO Supply Voltage	0	3(1.5)	VCC	V
Dormant working current	/	<2	/	μA

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Maximum Operating Current(Average value）	/	0.4	/	mA
Operating Temperature	-40	+25	+85	℃

Table 4-3：Dc features of I/O ports

IO Pin	Drive capability	Min	Max	Unit
Input low level	/	0	0.4	V
Input high level	/	0.7	VCC	V
Output low level	5mA	0	0.6	V
Output high level	5mA	3.3	VCC	V

Table 4-4：Electricity consumption

Test condition	TYP	Unit
sleep mode	＜2	μA
Broadcast at 20ms interval in slave mode	180	μA
Broadcast in slave mode with 1S gap	7.0	μA
Maintain the connection in slave mode with a 20ms connection gap	65	μA
The connection is maintained with a 7.5ms connection gap in slave mode	110	μA
Scan in host mode	2.3	mA
In host mode, the connection is maintained at a 20ms interval	78	μA

5 Reference Design

5.1 Low voltage mode

It can be powered by a single AA battery, with a range of 1.1V-1.65V.

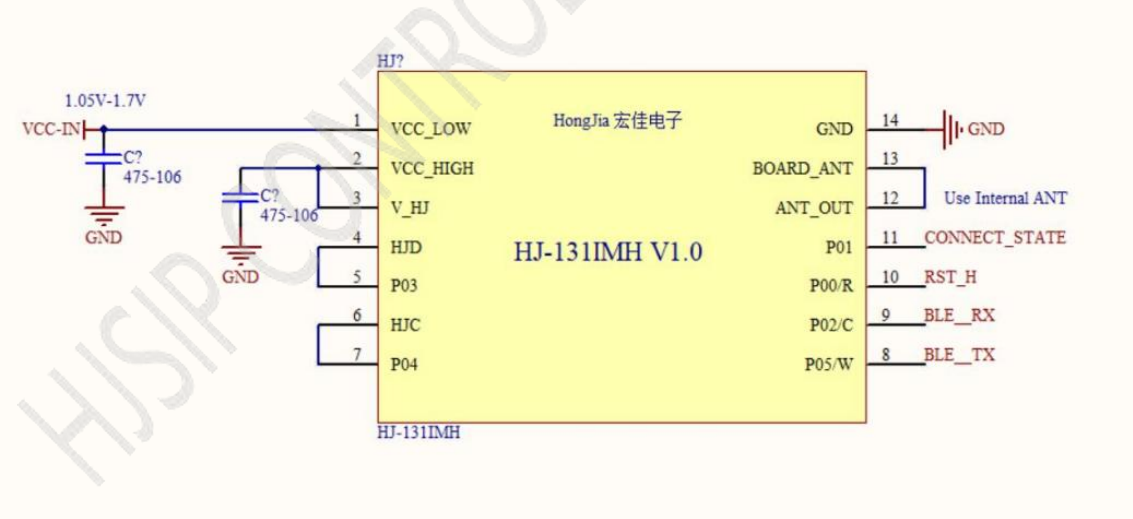

Figure 5.1：Low voltage mode

Note

For the above circuit, if space is limited, capacitors do not need to be connected to the VCC_LOW and VCC_HIGH pins.

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5.2 High voltage mode

Range：1.8V-3.3V

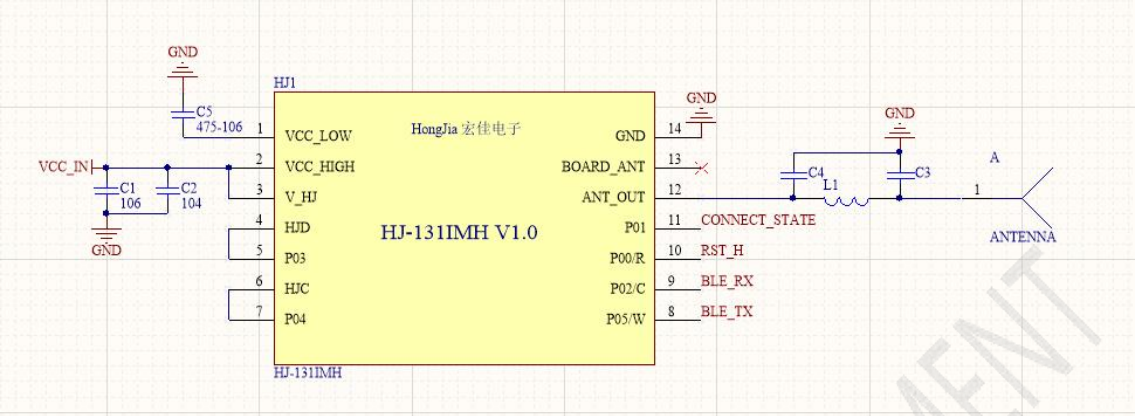

Figure 5.2：High voltage mode

Note

For the above circuit, if space is limited, capacitors do not need to be connected to the VCC_LOW and VCC_HIGH pins.

5.3 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.
- The filter capacitor at the power supply should be placed as close as possible to the power input pin of the module. If it is powered by a capacitor or space is limited, the filter capacitor at the power input can be removed. The module already has 0.1uF+2.2uF filter capacitors inside.
- Each layer of the circuit board is fully copper-clad and connected to GND, and it is necessary to ensure that the copper-clad area is large enough (except for the antenna part) and is well grounded.
- When using an external antenna, be sure to contact our company and let us confirm whether the PCB design of your external PCB antenna or lead-out 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.
- 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

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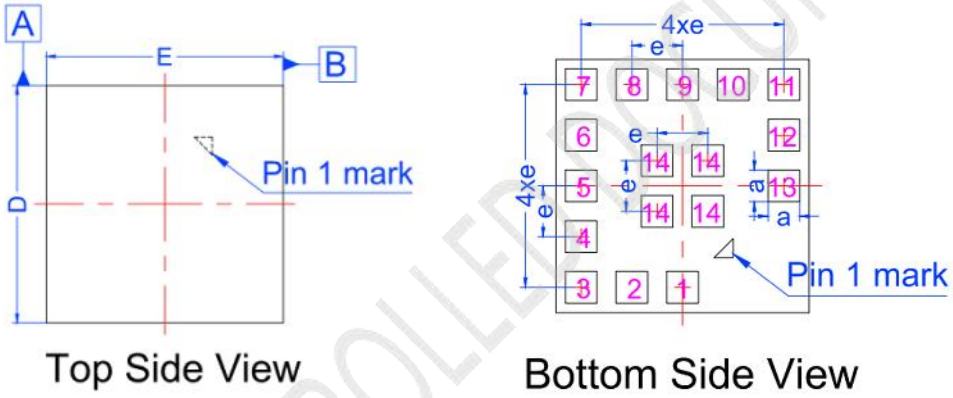
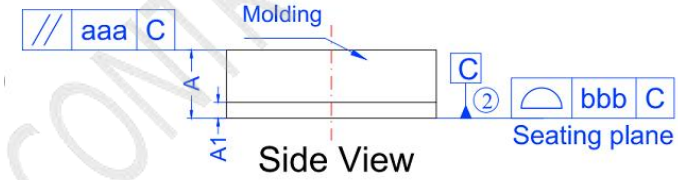
should be close to the edge or corner of the main board. It is best to place the module in the corner of the circuit board.

- 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 Machine Dimension





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	3.90	4.00	4.10		
E	3.90	4.00	4.10		
a	0.45	0.50	0.55		
e	0.80 REF				

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

Note: The normal value of the ultra-thin model A is 1mm, and other parameters are the same as those of the regular model

Figure 6.1：HJ-131IMH dimension

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7 SMT production

7.1 Precautions for ultrasonic welding

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.

7.2 Soldering Recommendations

HJ-131IMH 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 9-1.

Table 7-1：Reflow soldering parameters

Parameter	Value
Features	Lead-free process
Average ramp up rate(T_{SMAX} to Tp)	max3℃/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

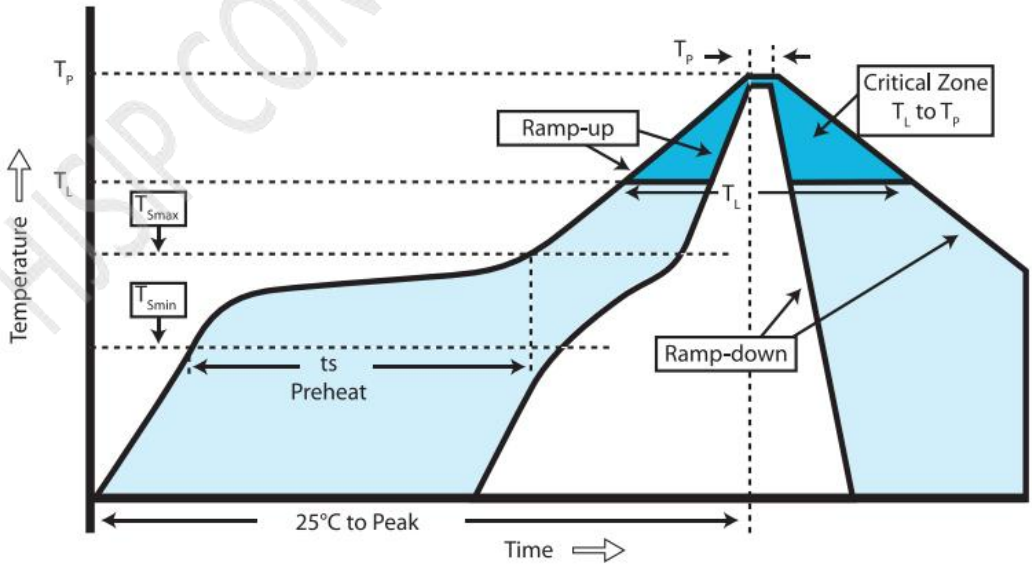

Figure 7.1：Temperature Curve of Reflow Welding

7.3 Humidity sensing properties

The HJ-131IMH module has a humidity sensitivity of level 3.

If any of the following two conditions are met, the HJ-131IMH 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-131IMH_XX	Roll tape	4000

Use chip-grade anti-static aluminum foil bags to seal and pack with braid. 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 8.1.

Figure 8.1：package figure

8.2 Label information

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

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【A】Tangshan Hongjia electronic Technology Co., LTD
【B】HJ-XXX-XXX
【C】Pb Free Reflow(260℃)
【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

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