

(Integrated master-slave support for OTA upgrades) **HJ-180-15OTA**

Ultra-small Chip (5mm\*5.5mm), ultra-low power

Bluetooth 5.1 module

**DataSheet version: V2.2**



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## 1 Overview

### 1.1 Characteristic Parameter

- Power supply: 1.7V~3.6V
- GPIO maximum number: 10
- SIP module built-in antenna(External antenna can also be used)
- Function
  - Support BLE 5.1, embedded Bluetooth low energy protocol stack and GATT service
  - Supporting BLE master-slave integration (supporting 1 slave and 1 master, master-slave working simultaneously without affecting each other)
  - Supports transparent transmission, WeChat, Xiaomi MiSDK, or no program module for customers to develop firmware themselves
- 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 ~ 80 meters
- Low Power Dissipation
  - Dormant current < 2μA
  - Broadcast current at 1s intervals: 12.2μA(0dBm)or 15.5μA(+4dBm)
  - Broadcast current at 2s intervals: 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°C
- RoHS compliant

## 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	°C
Storage Temperature	-40	+125	°C

### •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	°C

### •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	
RX Current consumption	TYP: 4.6mA	
Receive sensitivity	TYP: -94dBm, MAX: -96dBm	
Antenna	Internal Antenna	External antenna can be used

## 2 Hardware specification

### 2.1 Package and dimensions

The package 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.

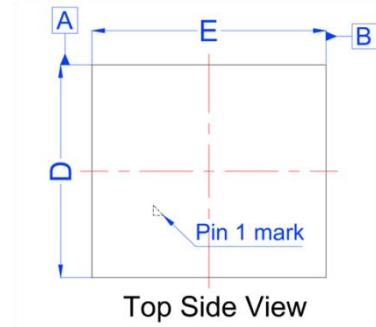


Figure 2-1 Top view

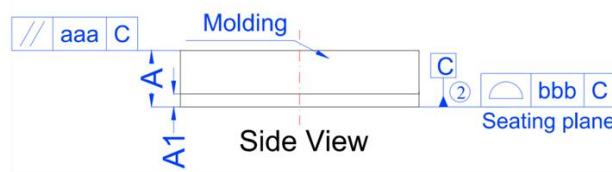


Figure 2-2 Side view

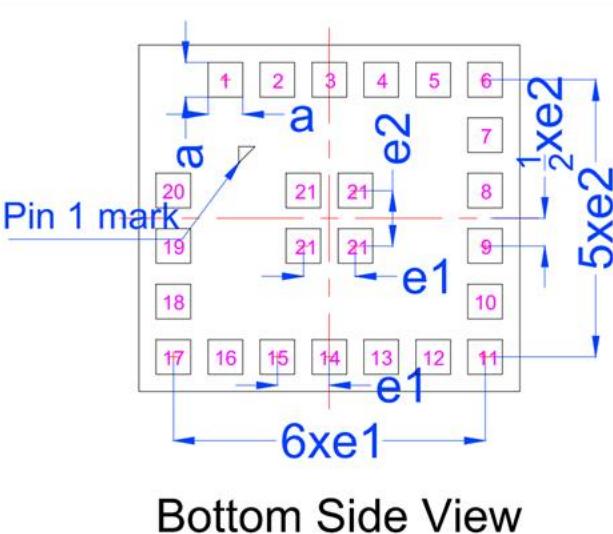


Figure 2-3 Bottom view

SYMBOL	DIMENSIONAL REQMTS			SYMBOL	Tolerance of Form & Position
	MIN	NOM	MAX		
A	1.26	1.30	1.34	aaa	0.10
A1	0.27	0.30	0.33	bbb	0.10
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

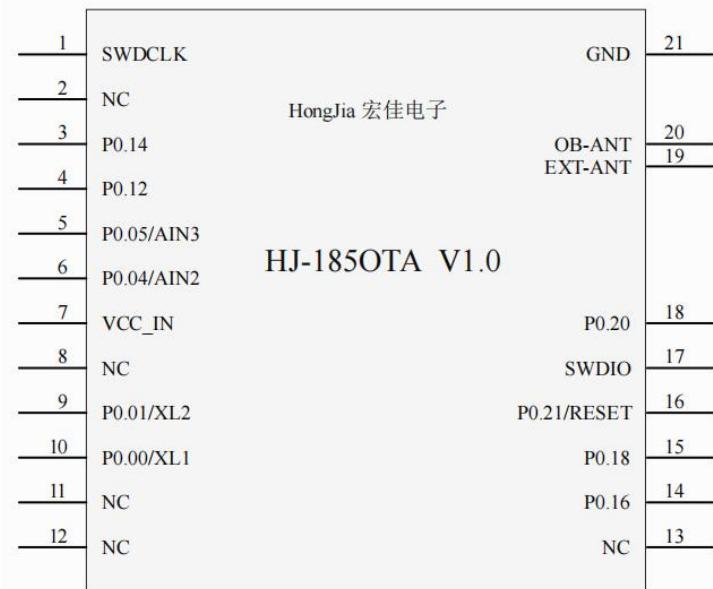


Figure 2-5 Pin diagram

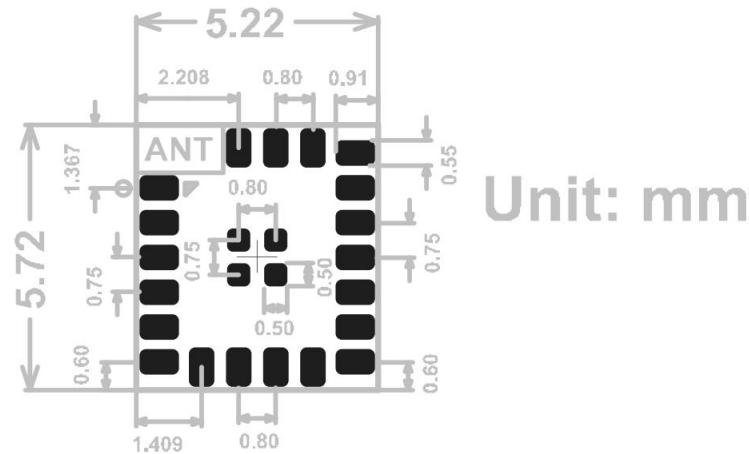


Table 2-6 Recommended packaging size diagram

Table 2-1 Pin Definition Table

Pin	Name	Type	Description	Functions of transparent transmission mode
1	SWDCLK	INPUT	Clock Line of SWD Interface	No need to use, can hover
2	NC		Empty pin	This pin can be suspended
3	P0.14	OUTPUT	Output, default output low level	<b>Host Connection Status Indicator Pin</b> (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.)
4	P0.12	OUTPUT	Output,BLE UART-TX	<b>BLE-TX Pin</b> (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	P0.05/AIN3	INPUT	Input,BLE UART-RX	<b>BLE-RX Pin</b> (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	P0.04/AIN2	OUTPUT	Output, default output low level	<b>Slave Connection Status Indicator Pin</b> (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 voltage: DC1.7V ~ 3.6V	Module power input pin
8	NC		Empty pin	This pin can be suspended
9	P0.01	INPUT	Input, default input pull-up	<b>Serial Port Receiving Function Enabling Pin (Can Be Set, The Default Is Active Low)</b> 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	P0.00	OUTPUT	Output, default output low level	<b>APP Receiving Data Indicator Pin</b> 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.
11	NC		Empty pin	This pin can be suspended
12	NC		Empty pin	This pin can be suspended
13	NC		Empty pin	This pin can be suspended
14	P0.16	INPUT	Input, default input pulldown	<b>App's Configuration Function Enable Pin</b> 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.
15	P0.18	IO	general purposed io port	It can be configured for other functions and can be kept in the air for now
16	nRESET	Reset Pin	general purposed io port/External reset pin(Active low)	<b>External reset pin(Active low)</b> If reset is required, this pin needs to be kept at least 10 ms low.
17	SWDIO	Debug Port	Simulation debugging download data	This pin can be suspended
18	P0.20	IO	general purposed io port	It can be configured for other functions and can be kept in the air for now
19	EXT-ANT	EXT ANT RF OUTPUT	External antenna pin output	If there is enough space for the RF output pins of the module, it is best to add a $\pi$ - type filtering circuit to connect to the external antenna.

20	OB-ANT	Onboard ANT	Built in antenna input	If you want to use a built-in antenna, Short-circuit the Pin19 and Pin20.
21	GND	Ground	power ground	The module power supply ground needs to ensure good connection to the GND network, and the module GND copper coverage area is large enough

## 2.3 Internal Structure

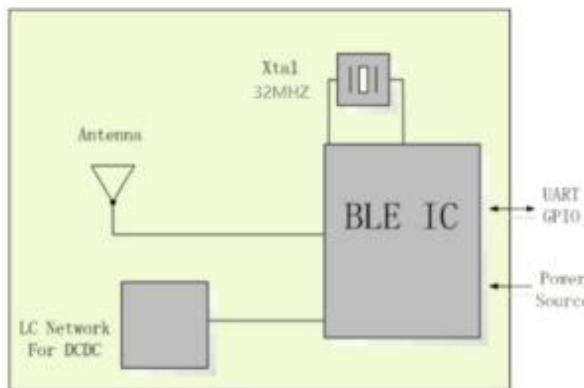


Figure 2-7 HJ-180-15OTA internal structure frame

## 2.4 Reference Design

### 2.4.1 Using the internal built-in antenna connection method

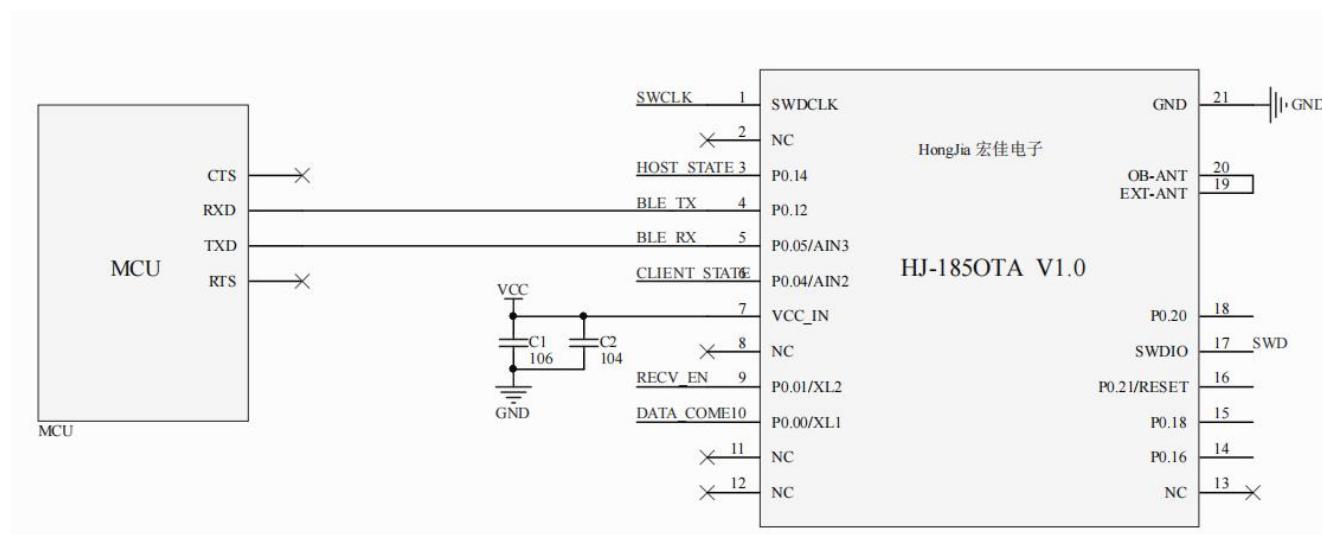


Figure 2-8 Internal antenna connection diagram

## 2.4.2 Using external antenna connection method

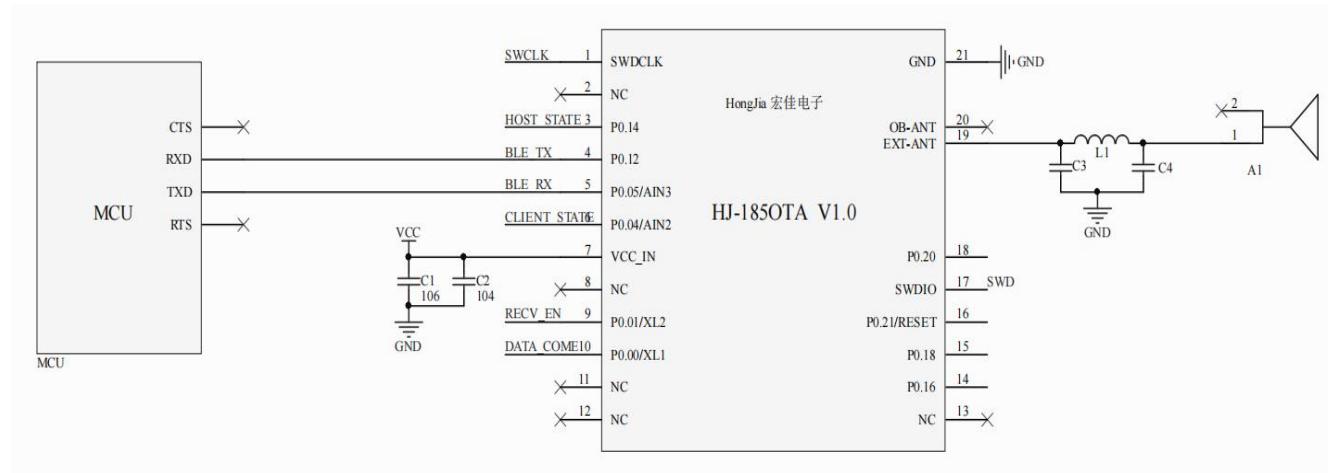


Figure 2-9 External antenna connection diagram

## 2.4.3 Antenna design reference

**1.Using internal high-performance antennas.**Simply short connect PIN19 with PIN20 to enable the internal high-performance antenna, as shown in Figure 2-10 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.

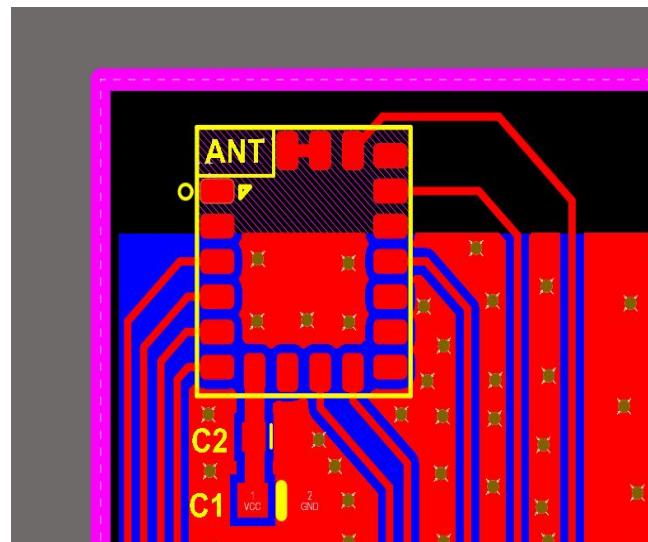


Figure 2-10 Internal antenna circuit design

**2. Using external high-performance antennas.** The pin of PIN20 is suspended, and the pin of PIN19 is connected to the PCB antenna through a  $\pi$ -shaped filter circuit, as shown in Figure 2-11 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, avoid the PCB antenna.

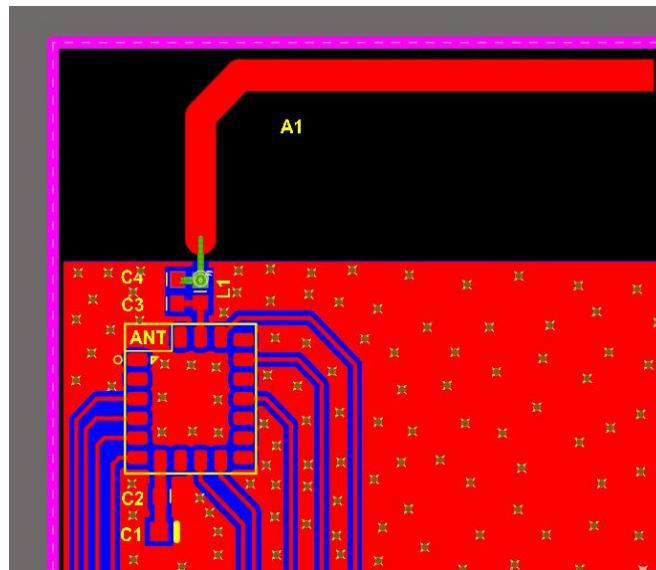


Figure 2-11 External PCB antenna circuit design

### 3 Announcements

#### 3.1 Notices for Hardware Design

1. The module antenna should be placed around the edges of the circuit board, with the antenna part close to the edge or corner of the motherboard. It is best to place the module in the corner of the circuit board.
2. Try to avoid placing other components near and on the back of the Bluetooth module antenna, and avoid wiring. If devices or cables are placed, it will affect Bluetooth performance.
3. Each layer of the circuit board should be covered with copper and connected to GND, and it is necessary to ensure that the module, especially the antenna part, has a sufficiently large copper coverage area and is well grounded.
4. It is necessary to drill through holes in the copper covered area of the entire circuit board, especially in the copper covered areas near modules and antennas. As many through holes as possible should be drilled.
5. If there are high-power devices or high-voltage conversion circuits on the circuit board, it is necessary to isolate the GND copper plating of the module from the GND copper plating of other parts, connect them with a single point grounding method, and drill as many through holes as possible to reduce interference with the RF signal.
6. The module should not be placed in a metal shell. If a metal shell must be used, the antenna must be led out.
7. In products that require the installation of this Bluetooth module, some metal components such as screws, inductors, etc. should be kept as far away as possible from the RF antenna part of the Bluetooth module.
8. Filter capacitors C1 and C2 should be placed as close as possible to the power input pins of the module.
9. Please pay attention to the pin diagram for all pins, and pay attention to the IO mode and status when connected to them.
10. GND must be well grounded.
11. It is recommended to perform magnetic bead or inductive filtering on the input power supply.
12. Unneeded pins can be suspended for processing.

## 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-180-15OTA 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 4-1.

Table 4-1 Reflow soldering parameters

Parameter	Value
Features	Lead-free process
Average ramp up rate( $T_{SMAX}$ to $T_p$ )	3°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

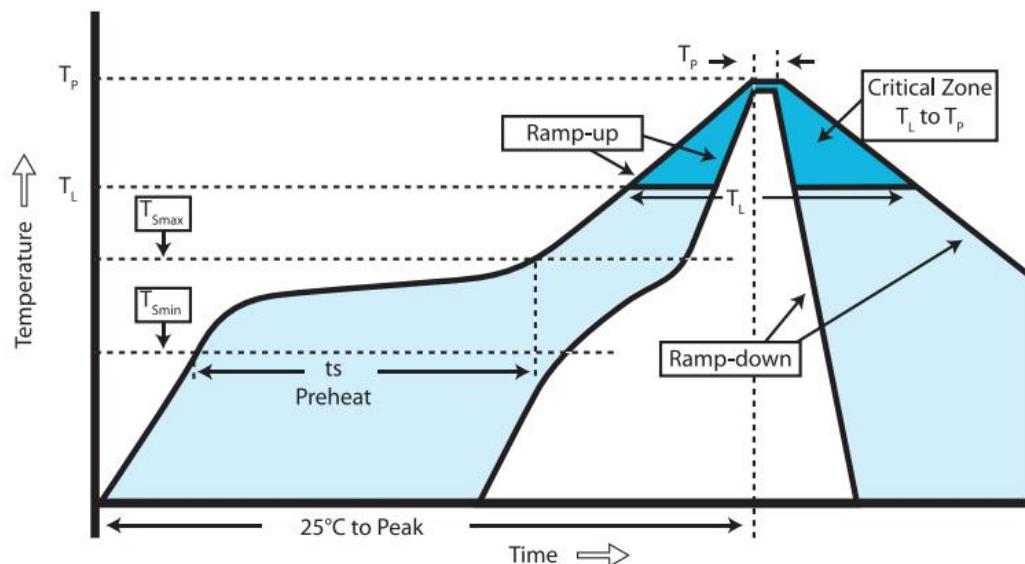


Figure 4-1 Temperature Curve of Reflow Welding

## 5 Supply Information

### 5.1 Model Definition

Table 5-1 Model Definition

Type	Model	Description
Standard Edition	HJ-180-15OTA_SPPv2	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.

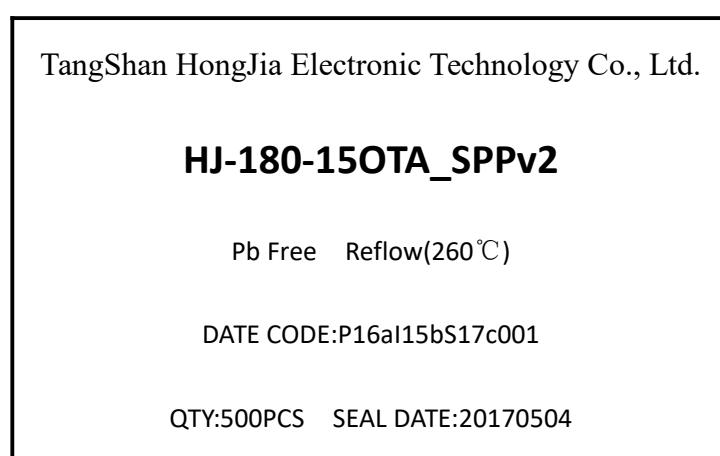
### 5.2 Packaging method

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.



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	V1.0	20220212	LMY	LJH	First edition
2	V2.0	20220221	LMY	LJH	Add configuration pins
3	V2.1	20231017	FJW	LMY	Format adjustment, module name change
4	V2.2	20231215	FJW	LMY	Pin definition update