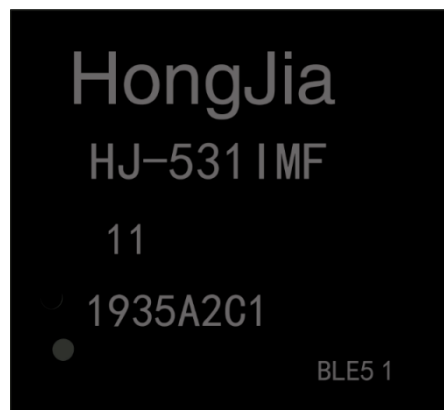# HJ-531IMF Ultra-small Chip (5mmx4.75mm,including ANT,1Mb Flash) ultra-low power Bluetooth 5.1 module Datasheet Data Sheet

DataSheet version:V1.5

TangShan HongJia Electronic Technology Co., Ltd.

CATALOG

TangShan HongJia Electronic Technology Co., Ltd.

1 Version History

Table 1-1 Revision History

No.	Version Number	Release Time	Reviser	Checker	Description
1	V1.0	20200310	LMY	LJH	First edition
2	V1.2	20200512	LMY	ZYP	Update datasheet

2　Overview

2.1 Features

●Power supply voltage range: 1.8V ~ 3.6V in high voltage mode; 1.1V ~ 1.65V in low voltage mode;

●Can be powered by a single AA battery or a zinc air battery at 1.5V; can also be powered by two AA batteries or a lithium battery after voltage stabilization；

●GPIO maximum number:12

●Size: 5mm*4.75mm (Includes built-in high-performance ANT and 1Mb flash.External ANT can be expanded)

●Memory and ROM

　- Built-in 32KB OTP

　- Built-in 48KB of RAM

　- Includes 1Mb (P25Q10) [Partly 4Mb(PQ25Q40)]of FLASH to user code for OTA .

●Function

　- Support BLE 5.1, embedded Bluetooth low energy protocol stack and GATT service

　- BLE supported master-slave integration(Support 1 host-slave or 3 slave. Host and slave work at the same time without affecting each other)

●RF Features

　- Operating Frequency: 2.4GHz, Support ISM free Frequency band

　- Transmit Power：-19.5dBm ~ +2.5dBm (Adjustable)

　- High Receive sensitivity：-94dBm

　- TX peak current < 3.5mA；RX peak current <2.2mA；

　-When using the On-board antenna in an open area, the transmission distance of wireless signal can spread more than 5 metres and less than 10 metres.

　-When using an external antenna in an open area, the transmission distance of wireless signal can spread more than 40 metres and less than 80 metres.

●Low Power Dissipation

- Dormancy current < 2μA

- Current at 1s broadcast interval: 7 μA(0dBm)

- Current at 2s broadcast interval:3.8 μA(0dBm)

- Current at 20ms connection gap: 65uA(0dBm)

- Current at 1000ms connection gap: 6.8uA(0dBm)

●Applications

   -Tiny medical applications

   -Beacons

   -Smart toys

   -Smar locks

   -Remote controls

   -Industrial smart devices

●Package：LGA25；pad spacing：0.6mm；pad size：0.3mm*0.5mm

●Size：5mm*4.75mm*1.3mm (Built-in antenna inside)

●Weigh：1.5g

●Operating temperature range:：-40℃ ~ +85℃（Maximum temperate up +120℃）

●BQB FCC CE KC SRRC REACH RoHS compliant

3 Hardware specification

3.1 Package and dimensions

Package: LGA25，pad spacing: 0.6mm.The detailed dimensions are shown in Figure 3-1, Figure 3-2, Figure 3-3 and Figure 3-4.

Top Side View
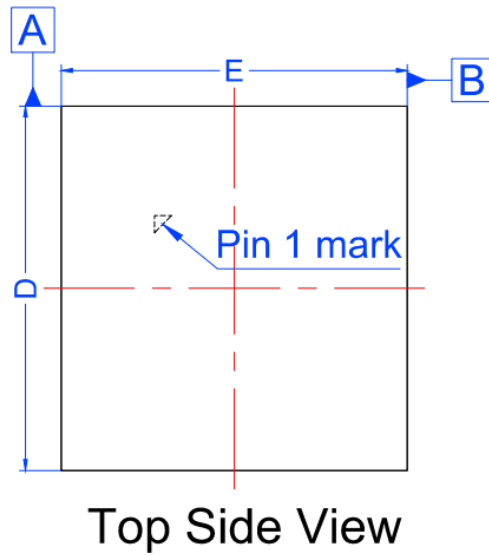
Figure 3-1 Top view
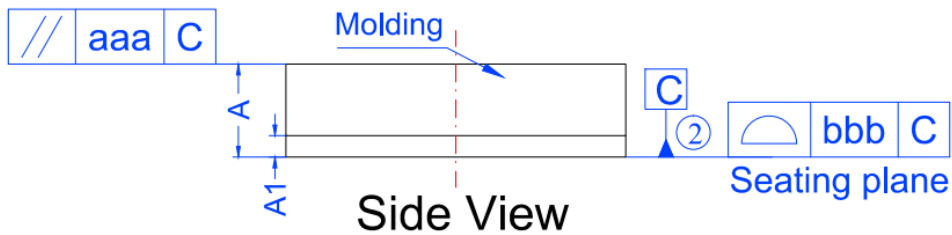
Side View

Figure 3-2 Side view
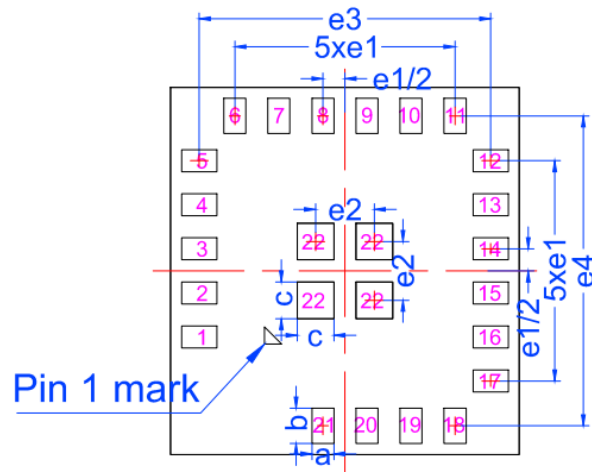
Bottom Side View

Figure 3-3 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	4.65	4.75	4.85		
a	0.25	0.30	0.35		
b	0.43	0.48	0.53		
c	0.45	0.50	0.55		
e1	0.60 REF				
e2	0.80 REF				
e3	3.97 REF				
e4	4.22 REF				

Note:

1. All dimensions are in mm

② Datum 'C' is the mounting surface, with which the package is in contact

Figure 3-4 Dimensions

3.2 Pin Definition

Table 3-1 Pin definition table

Pin	Name	Type	Description	Function
1	P0.9 (Connection Status)	GPIO (OUTPUT)	General I/O	Connection status (connection = 1; disconnect = 0)
2	P0.7 (APP data coming point)	GPIO	General I/O	Whether the module is a host or slave, this pin is raised during 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. 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.
3	P0.5	GPIO	General I/O	BLE UART TX pin

	(UART TX)			
4	P0.8 (UART receive enable interrupt/UART RX)	GPIO	General I/O	UART receive enable interrupt/ function and BLE serial RX (Under low power consumption, the pin defaults to the UART receive enable interrupt pin. If the external high level is increased for more than 1ms, UART receive will enable . After UART receive enable, this pin becomes the UART RX function, which can perform normal data transmission and reception;)
5	P0.2/C	GPIO/Debugger	General I/O	
6	P0.6	GPIO	General I/O	
7	P0.11	GPIO	General I/O	
8	P0.10/W	GPIO/Debugger	General IO/Data port of debug	
9	VCC_LOW	Low Power In	Low voltage power input pin	Low voltage mode input range：1.1V-1.65V
10	VCC_HIGH	High Power In	High voltage power input pin	High voltage power input range：1.8V-3.6V
11	*Flash_vcc*	*Flash power In*	*Internal Flash power supply pin*	*Power supply range 1.65-3.6V, please connect with VCC_HIGH if needed*
12	*Flash_sck*	*Flash Sck*	*Internal Flash clock pin*	*If needed, please connect with P0.4*
13	P0.4/RCM	GPIO	General I/O	
14	P0.3/RCP	GPIO	General I/O	
15	*Flash_so*	*Flash So*	*Internal Flash data output pin*	*If needed, please connect with P0.3*
16	*Flash_si*	*Flash Si*	*Internal Flash data input pin*	*If needed, please connect with P0.0*
17	P00/RST	GPIO/RST	Reset pin	High-level (1) reset; floating or low-level (0) works normally
18	*Flash_cs*	*Flash Cs*	*Internal Flash Chip Select*	*If needed, please connect with P0.1*
19	P0.1	GPIO	General I/O	
20	ANT	RF OUT	RF output pin	RF output, can be external antenna

21	BOARD_ANT	Onboard ANT	On-board antenna input pin	The internal matching circuit has been integrated. If you want to use the On-board antenna, you can directly short the 20 and 21 pins.
22	GND	Ground	Power input GND pin	Power negative GND

Note: The brackets in "()" are the built-in standard UART transparent transmission firmware function. If the chip is empty, this function is not available.

3.3 Internal structure
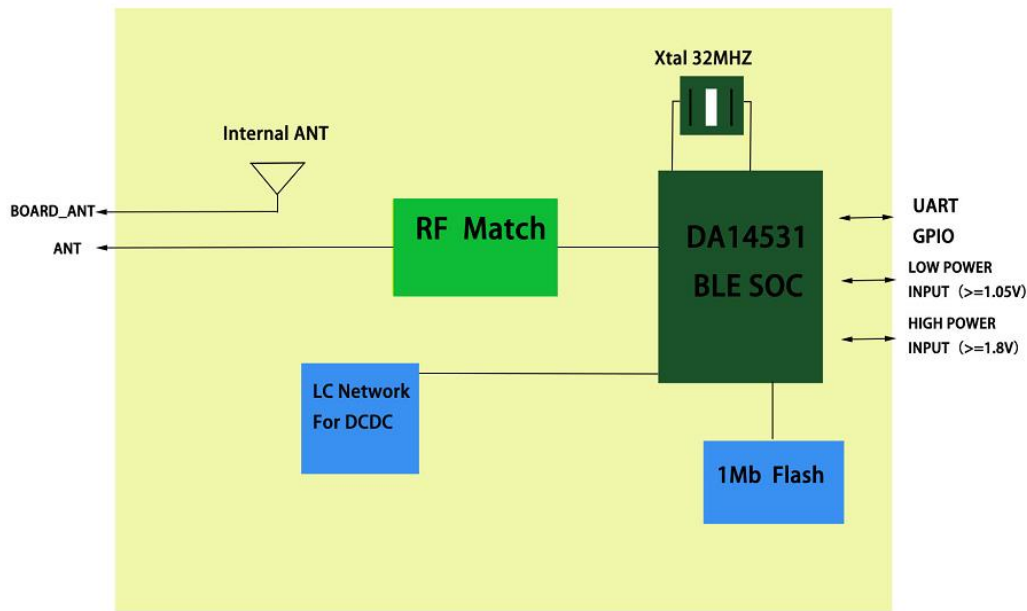
Figure 3-5   HJ-531IMF Interal Block Diagram

3.4 Reference Design

3.4.1 Low Voltage Mode (Can be powered by a single AA size battery, voltage range: 1.1-1.65V)
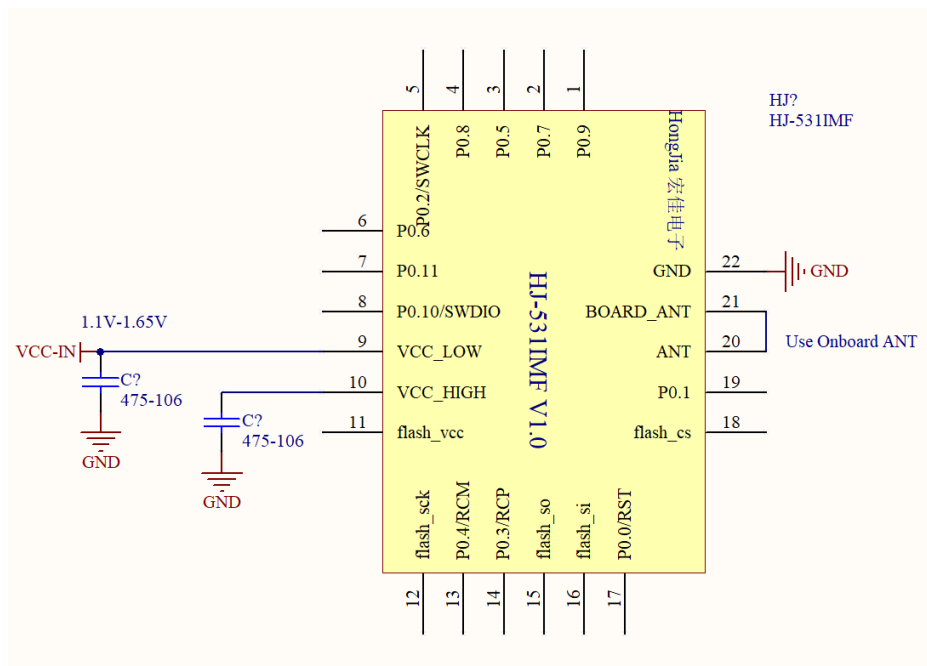

Figure 3-6 HJ-531IMF low-voltage power supply mode

3.4.2 High Voltage Mode（voltage range: 1.8V-3.6V）
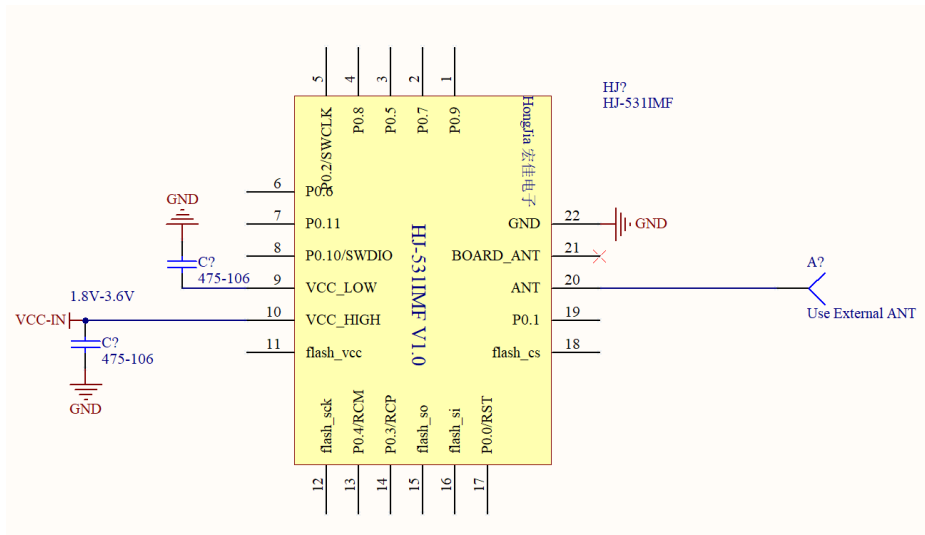
Figure 3-7 HJ-531IMF high voltage power supply mode

3.4.3 Using the built-in Flash for save user firmware and support OTA
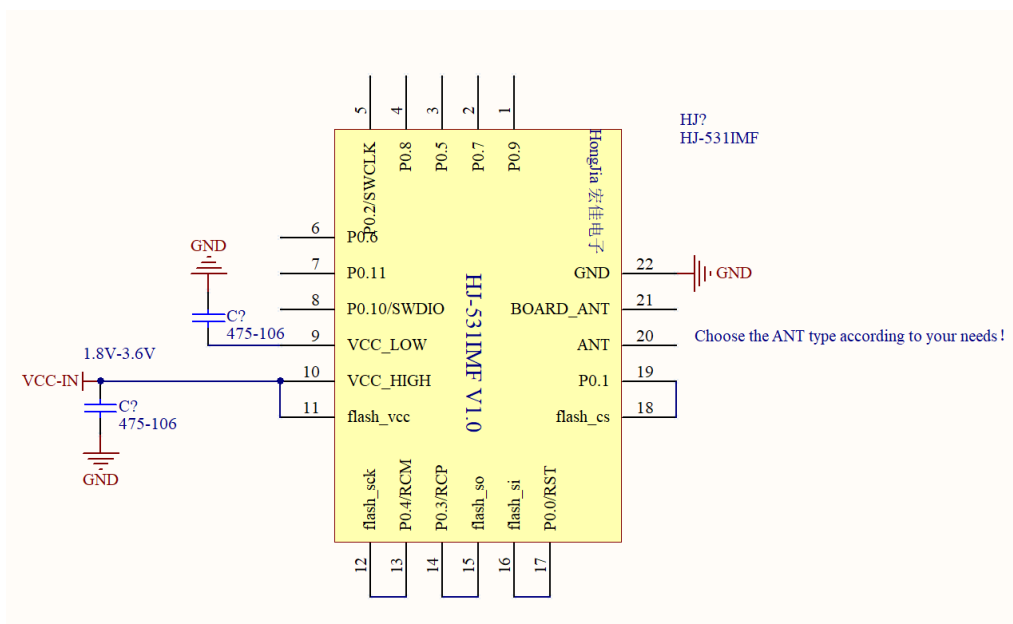
3.4.4 Using the built-in antenna of the module
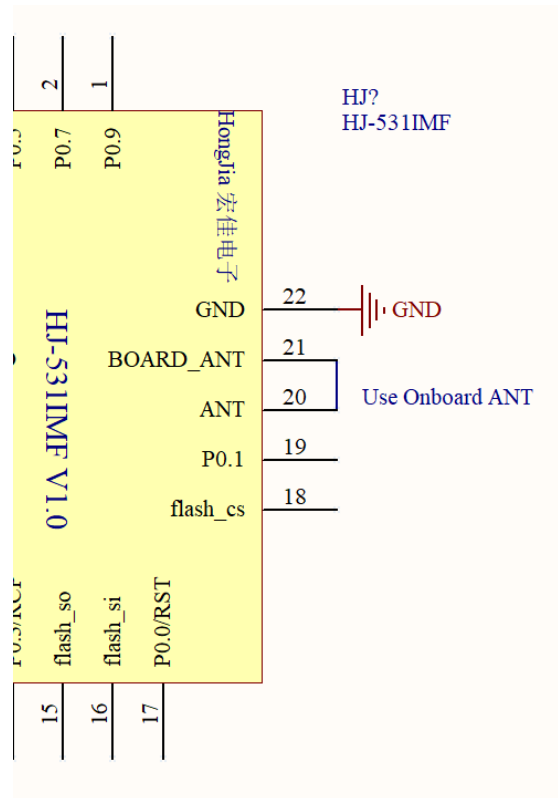
3.4.5 Notices for Hardware Design

A. All I/Os can be used.

B. If there is enough space, we recommend adding the PI filter of LC. L? can choose resistor or inductor. Of course, if the space is limited, you can not add it, instead of directly connect a 0603 or 0402 package's ceramic capacitor, capacitance value 475-106.

c、When using an external antenna, be sure to contact us to let us confirm whether your external Ceramic antenna or IPEX lead-out antenna PCB design is reasonable.

3.4.6 Matters needing attention in the use of products

A. The module should not be placed in a metal-based enclosure. If a metal enclosure is required, the antenna must be lead out.

B. Among the products that need to install this wireless module, some metal materials such as screws, inductors, etc. should be kept away from the RF antenna part of the wireless module.

C. On the wireless module antenna, Do not place other components. Because other components can degrade wireless performance.

D. The wireless module should be placed on the four sides of the motherboard as much as possible. The antenna part should be close to the side or corner of the motherboard. The motherboard PCB under the module antenna should be hollowed out with the keepout layer. If hollowing is prohibited, copper or wiring is not allowed under the antenna. Otherwise it will affect RF performance.

E. Please pay attention to the pin diagram for all pins. Please pay attention to the IO mode and status of the IO connected to it.

F. GND must be sound grounding.

G. It is recommended that magnetic beads or inductance filters be applied to the input power supply.

4   Electrical Parameters

4.1 Absolute Maximum Ratings

Table 4-1 Absolute maximum ratings

Parameter	MIN	MAX	Unit
Power Supply Voltage (VCC)	1.05	3.8	V
IO Supply Voltage	0	VCC	V
Operating Temperature	-45	+120	℃
Storage Temperature	-55	+135	℃

4.2Recommended Operating Conditions(Low voltage mode)

Table 4-2 Recommended operating conditions

Parameter	MIN	TYP	MAX	Unit
Power Supply Voltage (VCC)	1.8(1.05)	3.3(1.5)	3.6(1.8)	V
IO Supply Voltage	0	3.3(1.8)	VCC	V
Dormant working current		<2		μA
Maximum Operating Current		0.4		mA
Operating Temperature	-40	+25	+85	℃

4.3 I/O DC Characteristics

Table 4-3 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

4.4 RF Features

Table 4-4 RF Features

Attribute	Value	Remarks
Modulation	GFSK	
Frequency range	2.402～2.480Ghz	Bandwidth：2Mhz
Number of channels	40	
Air speed	1Mbps	
RF Port Impedance	50Ω	
Transmit Power	MAX： +2.5dbm	
TX Current consumption	TYP：3.5mA	
RX Current consumption	TYP：2.2mA	
Receive sensitivity	TYP：-94dbm，MAX：-95dbm	
Antenna	Onboard ceramic Antenna	

4.5 Power Dissipation

Table 4-5 Power Dissipation

Test conditions	TYP	Unit
Dormancy mode	<2	μA
20ms Interval Broadcasting in Slave Mode	180	μA
1S Interval Broadcasting in Slave Mode	7.0	μA
20ms Connection Gap Holding Connection in Slave Mode	65	μA
7.5ms Connection Gap Holding Connection in Slave Mode	110	μA
Scanning in Host Mode	2.3	mA
20ms Connection Gap Holding Connection in Host Mode	78	μA

5 Reflow Soldering Information

Reflow soldering is recommended for welding.

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 5-1.

Table 5-1 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)	80-100 sec.
Peak Temperature (T_P)	250±5℃
Ramp-down Rate	6℃/sec. max
Time 25℃ to Peak Temp (T_P)	8min. max
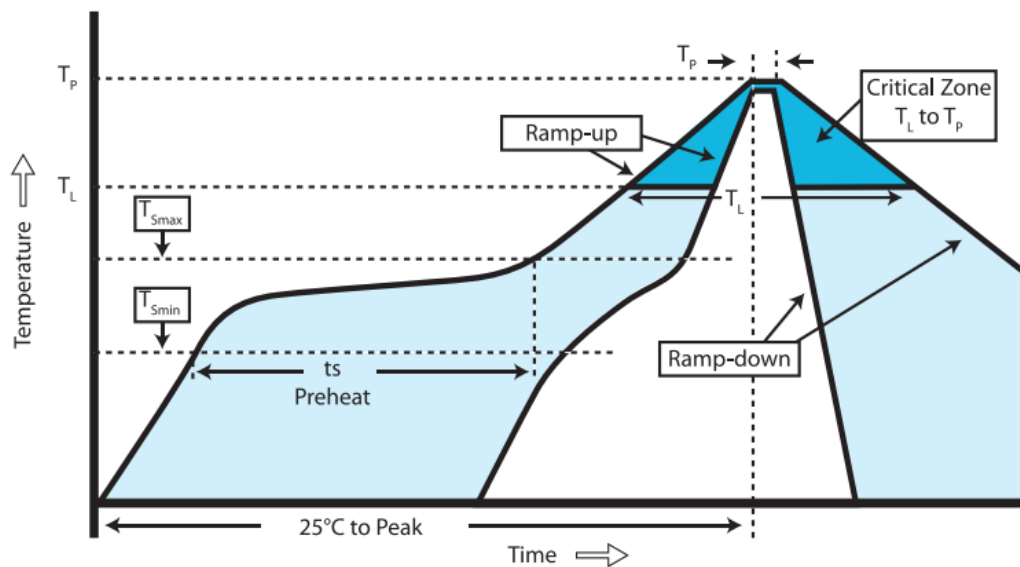
Figure 5-1 Temperature Curve of Reflow Welding

6   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.

7   Supply Information

7.1 Model Definition

Table 7-1 Model Definition

Type	Model	Description
Standard Edition of uart transparent transmission	HJ-131IMH_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.
Custom version	HJ-131IMH_CUSv2	This version supports custom firmware, the customer proposes functions according to the product requirements, and we will customize the module with the special version firmware to supply the customer.
Customer development Version	HJ-131IMH_EMP	This version of the module has no built-in firmware, customer can develop their own firmware according to the Dialog DA14531 chip datasheet and support documents.

7.2 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 7-1.

Figure 7-1 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-131IMH_SPPv2                    │
│                                              │
│         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 7-2 Label Sample Diagram

8 FCC Warning

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01

2.2 List of applicable FCC rules
FCC Part 15.247

2.3 Specific operational use conditions
his transmitter/module and its antenna(s) must not be co-located or operating in conjunction with any transmitter. This information also extends to the host manufacturer's instruction manual.

2.4 Limited module procedures
not applicable

2.5 Trace antenna designs
It is "not applicable" as trace antenna which is not used on the module.

2.6 RF exposure considerations
This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This compliance to FCC radiation exposure limits for an uncontrolled environment, and minimum of 20cm separation between antenna and body.
The host product manufacturer would provide the above information to end users in their end-product manuals.

2.7 Antennas
Ceramic antenna; 3.5dBi; 2.402 GHz～2.480GHz

2.8 Label and compliance information
The end product must carry a physical label or shall use e-labeling followed KDB784748D01 and KDB 784748 stating "Contains Transmitter Module FCC ID: 2AGPMHJ-531IMF".

2.9 Information on test modes and additional testing requirements
For more information on testing, please contact the manufacturer.

2.10 Additional testing, Part 15 Subpart B disclaimer
The modular transmitter is only FCC authorized for the specific rule parts (FCC Part 15.247) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed when contains digital circuity.

FCC/IC Statements

(OEM) Integrator has to assure compliance of the entire end-product incl. the integrated RF Module. For 15 B (§15.107 and if applicable §15.109) compliance, the host manufacturer is required to show compliance with 15 while the module is installed and operating.

Furthermore the module should be transmitting and the evaluation should confirm that the module's intentional emissions (15C) are compliant (fundamental / out-of-band). Finally the integrator has to apply the appropriate equipment authorization (e.g. Verification) for the new host device per definition in §15.101.

Integrator is reminded to assure that these installation instructions will not be made available to the end-user of the final host device.

The final host device, into which this RF Module is integrated" has to be labeled with an auxiliary label stating the FCC ID of the RF Module, such as "Contains FCC ID: 2AGPMHJ-531IMF

"This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions:
(1)this device may not cause harmful interference, and
(2)this device must accept any interference received, including interference that may cause undesired operation."

"Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment."

the Integrator will be responsible to satisfy SAR/ RF Exposure requirements, when the module integrated into the host device.

RF Exposure Warning Statements:
This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.
This equipment shall be installed and operated with minimum distance 20cm between the radiator & body.

The final host device, into which this RF Module is integrated" has to be labeled with an auxiliary label stating the IC of the RF Module, such as" Contains transmitter module IC: 26719-HJ531IMF
Le périphérique hôte final, dans lequel ce module RF est intégré "doit être étiqueté avec une étiquette auxiliaire indiquant le CI du module RF, tel que" Contient le module émetteur IC: 26719-HJ531IMF

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

(1) This device may not cause interference.

(2) This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

(1) L' appareil ne doit pas produire de brouillage;

(2) L' appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d' en compromettre le fonctionnement.

Radio Frequency Exposure Statement for IC

The device has been evaluated to meet general RF exposure requirements. The device can be used in mobile exposure conditions. The min separation distance is 20cm.

Déclaration d'exposition aux radiofréquences pour IC

L'appareil a été évalué pour répondre aux exigences générales en matière d'exposition aux RF. L'appareil peut être utilisé dans des conditions d'exposition mobiles. La distance de séparation minimale est de 20 cm.

Module statement

The single-modular transmitter is a self-contained, physically delineated, component for which compliance can be demonstrated independent of the host operating conditions, and which complies with all eight requirements of § 15.212(a)(1) as summarized below.

1) The radio elements have the radio frequency circuitry shielded.

2) The module has buffered modulation/data inputs to ensure that the device will comply with Part 15 requirements with any type of input signal.

3) The module contains power supply regulation on the module.

4) The module contains a permanently attached antenna.

5) The module demonstrates compliance in a stand-alone configuration.

6) The module is labeled with its permanently affixed FCC ID label.

7) The module complies with all specific rules applicable to the transmitter, including all the conditions provided in the integration instructions by the grantee.

8) The module complies with RF exposure requirements.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
-Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
-Consult the dealer or an experienced radio/TV technician for help

Co-location Warning:
This equipment could not be co-located or operating in conjunction with any other antenna or transmitter except in accordance with the FCC multi-transmitter product procedures.