

BLE 5.3 Module Hardware Specification

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HY-234004PC

Bluetooth Module Hardware Specification

Version: V1.0

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1. Module Overview

1.1. Description

HY-234004P is based on TI (Texas Instruments) CC2340 as the core design of a SimpleLink 2.4 GHz wireless module, Supports Bluetooth®5.3 Low Energy, Zigbee®, IEEE 802.15.4g, TI 15.4-Stack (2.4 GHz) and proprietary protocols. Integrated high-performance ARM Cortex-M0+ processor with 512 KB Flash, 36 KB ultra-low leakage SRAM, and on-board industrial-grade 48 MHz crystal. The module supports high-speed mode (2Mbps PHY), long-distance broadcasting (LE Coded 125kbps and 500kbps PHY), and backward compatibility with key features of BLE 4.2 and earlier BLE specifications.

HY-234004P BLE module provides Bluetooth low power features: radio, Bluetooth protocol stack, profile and required space for customer applications. The module also provides a flexible hardware interface for connecting sensors. It can be powered directly using a standard 3V button battery or a pair of AAA batteries, and in the lowest power off mode, it consumes only 0.15uA and wakes up in a few microseconds. The transmission distance will vary according to the structure of the whole product, the material of the parts, the layout, the type of antenna, the placement position, and the surrounding environment. Bluetooth IC: CC2340R5 4*4*0.9mm QFN24.

1.2. Applications

- **Medical**

- Home healthcare – blood glucose monitors, blood pressure monitor, CPAP machine, electronic thermometer
- Patient monitoring & diagnostics – medical sensor patches
- Personal care & Fitness – electric toothbrush, wearable fitness & activity monitor

- **Building automation**

- Building security systems – motion detector, electronic smart lock, door and window sensor, garage door system, gateway
- HVAC – thermostat, wireless environmental sensor
- Fire safety system – smoke and heat detector
- Video surveillance – IP network camera

- **Lighting**

- LED luminaire
- Lighting Control – daylight sensor, lighting sensor, wireless control

- **Factory automation and control**

- **Retail automation & payment**

- Electronic shelf label

- **Communication equipment**

- Wired networking
- wireless LAN or Wi-Fi access points, edge router

- **Personal electronics**

- Connected peripherals – consumer wireless module, pointing devices, keyboards and keypads, electronic and robotic toys

– Wearables (non-medical) – smart trackers, smart clothing

1.3. Key Features

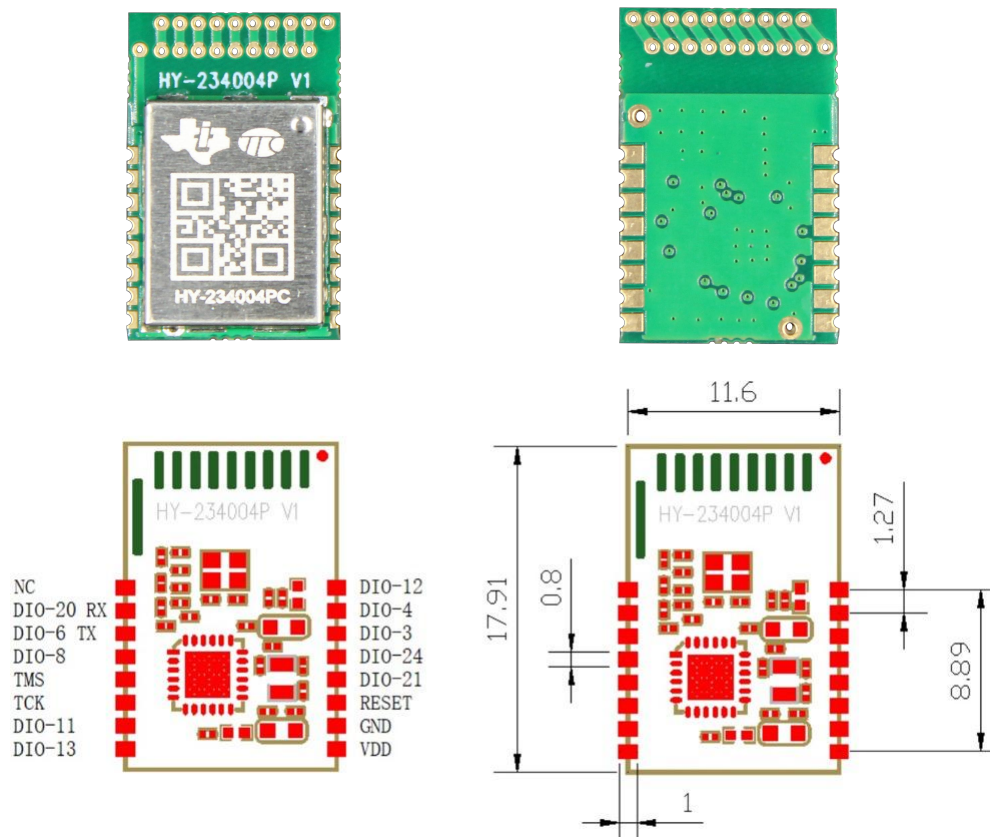
- Bluetooth 5.3, single-mode compatible.
- Support master mode, slave mode, master-slave mode.
- Integrated Bluetooth low power stack.
- GAP, GATT, L2CAP, SMP Bluetooth low power profile.
- Ultra-low current power consumption.
- Standby state : 0.7uA(RTC running and RAM/CPU holding,LFXT DCDC charging current setting: ipeak=7).
- Shutdown status: 150nA (no clock running, no retention).
- Programmable ARM Cortex-M0+ processor for embedding complete applications.

2. Hardware Description

Part number (P/N)	Hardware model	Instructions
WMD234004SR6PC	HY-234004P	PCB antenna

2.1. PCBA Dimension Size and Picture

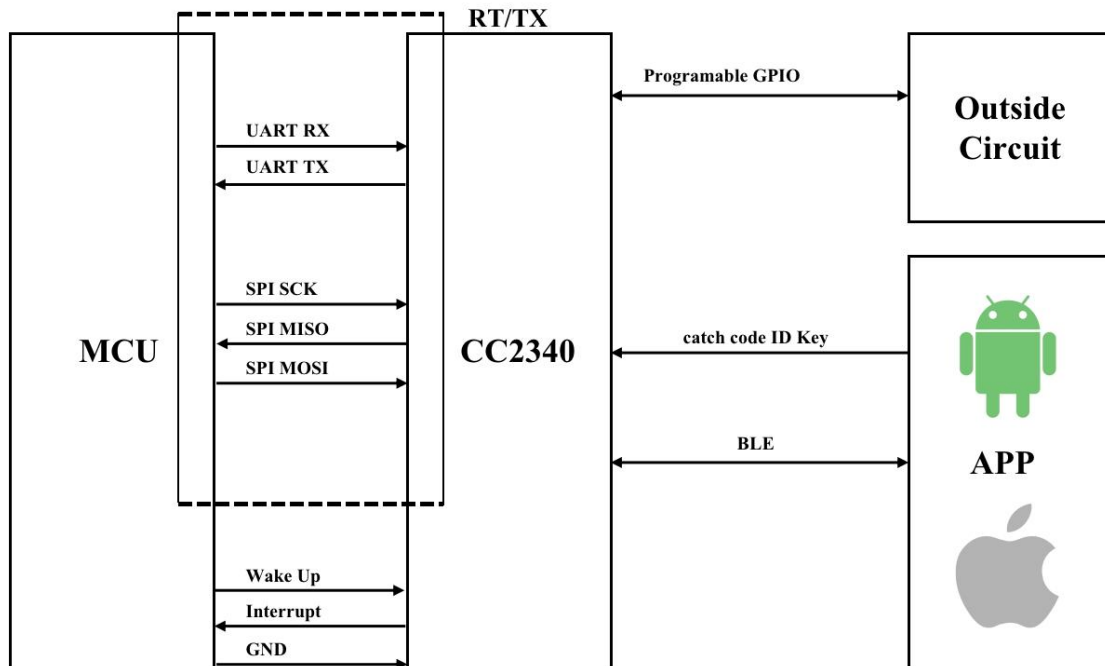
HY-234004P Size(17.91*11.6*2.2/2.7 mm±0.2mm)



2.2. Pin Definition

No.	Name	Type	Function description
1	NC	NC	Not connect
2	DIO_20	Digital or Analog I/O	GPIO, analog capability
3	DIO_6	Digital or Analog	GPIO, analog capability
4	DIO_8	Digital I/O	GPIO
5	DIO16_SW DIO JTAG TMS	Digital I/O	GPIO, SWD interface: mode select or SWDIO, high-drive capability
6	DIO17_SWDC K JTAG TCKC	Digital I/O	GPIO, SWD interface: clock, high-drive capability
7	DIO_11	Digital I/O	GPIO
8	DIO_13	Digital I/O	GPIO
9	VDD	Power supply	+1.8V to +3.8V (Recommended 2.7~3.3V)
10	GND	Power GND	Ground
11	RESET_N	Digital input	Reset, active-low. Module have pull up.
12	DIO_21	Digital or Analog	GPIO, analog capability
13	DIO_24	Digital or Analog	GPIO, Analog capability, high-drive capability
14	DIO_3	Digital or Analog	GPIO, 32-kHz crystal oscillator pin 1, Optional TCXO input
15	DIO_4	Digital or Analog	GPIO, 32-kHz crystal oscillator pin 2
16	DIO_12	Digital	GPIO, high-drive capability

2.3. Working Mode Schematic



3. Electrical Characteristic

(Test conditions: $T_a = 25\text{ }^{\circ}\text{C}$, $V_{DD} = 3.0\text{V}$ internal DC-DC regulator, test standard :1Mbps GFSK modulation, $\text{FRF} = 2440\text{MHz}$ BLE mode.)

3.1. Radio Characteristics And Current Consumption:

- Modulation mode: GFSK.
- Frequency range: 2400 ~ 2483.5MHz (2.4G ISM Frequency band).
- IC Transmitting power range : -21 ~ +8dBm typical (Controlled by software programming).
- RF transmit power at antenna feed: +6 dBm typical.: +6 dBm typical. (RF TX Set at +8dBm maximum feature).
- RF receiving sensitivity of antenna feeder: -93dBm typical (In PER <30.8% characteristic).
- Frequency offset : RF $\pm 60\text{ppm}$, MCU clock 32.768KHz $\pm 350\text{ppm}$ (using crystal mode).
- Ultra-low current consumption:
 - RF TX Current: 5mA (0dBm).
 - RF TX current: <12mA (8dBm).
 - RF RX current: 5.3mA.
 - Idle state current: 56uA (support system and RAM power supply).
 - Standby state current: 0.7uA (RTC run and RAM/CPU hold).
 - Shutdown state current: 150nA (no clock running, no storage).

3.2. Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted)

Rated value	MIN	MAX	Unit
VDDS	-0.3	4.1	V
Other terminal voltage	VSS-0.3	VDDS+0.3	V
Storage temperature	-40	+150	°C

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

(2) All voltage values are with respect to ground, unless otherwise noted.

3.3. ESD Ratings

			Ratting	Unit
V _{ESD} Electrostatic discharge	Human body model (HBM) , BasisANSI/ESDA/JEDEC/JS001	ALL PIN	±2000	V
		RF PIN	±500	
	Charging device mode, Basis JESD22-C101	NOT RF PIN	±500	

3.4. Recommended Operating Conditions

Power supply voltage noise should be less than 10mV_{pp}, too large power supply noise, will reduce the RF performance.

Rated value	MIN	MAX	Unit
VDD(Bluetooth operating time)	2.2	3.8	V
VDD (Flash memory burning program firmware)	2.4	3.6	V
Operating temperature	-40	+125	°C

Notes:

(1).VDD DC power supply recommended voltage: 2.7~3.3V DC.

(2).When the module flash memory is burning the program firmware, the VDDS DC power supply voltage should be between 2.4 and 3.6V to avoid incomplete or abnormal conditions when burning.

(3).In the worst case, the battery equivalent source resistance will cause a power supply voltage drop, and the VDDS must use a 22μF input capacitor to strengthen the power supply capacity to ensure that the conversion rate (3-6 timing requirements) is met.

3.5. GPIO Characteristics

Parameter	Test Condition	Typical value	Unit
GPIO VOH at 10 mA load	high-drive GPIOs only, max drive setting	2.85	V
PIO VOL at 10 mA load	high-drive GPIOs only, max drive setting	0.15	V
GPIO VOH at 2 mA load	standard drive GPIOs	2.9	V
GPIO VOL at 2 mA load	standard drive GPIOs	0.1	V

3.6. Timing Requirement

State	MIN	Standard	MAX	Unit
Characteristics of the input control				
Reset Duration for which RESET_N remains low	1			μs

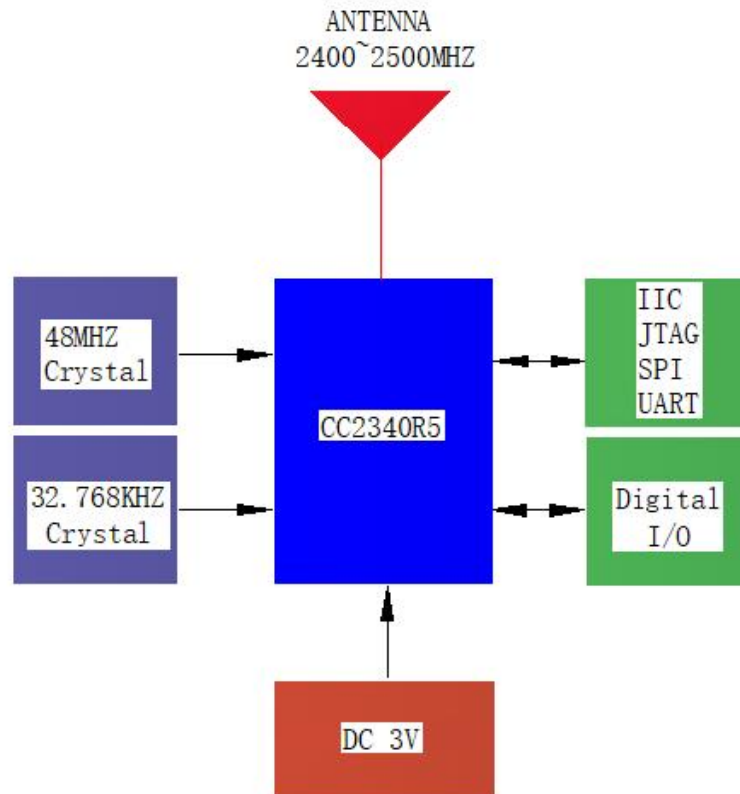
- (1) In the worst case, the battery equivalent source resistance will cause a power supply voltage drop, and the VDDS must use a 22μF input capacitor to strengthen the power supply capacity to ensure that the conversion rate (3-6 timing requirements) is met.
- (2) The application of RCOSC_LF as a sleep timer must consider the frequency drift caused by temperature changes.

3.7. Switching Characteristics

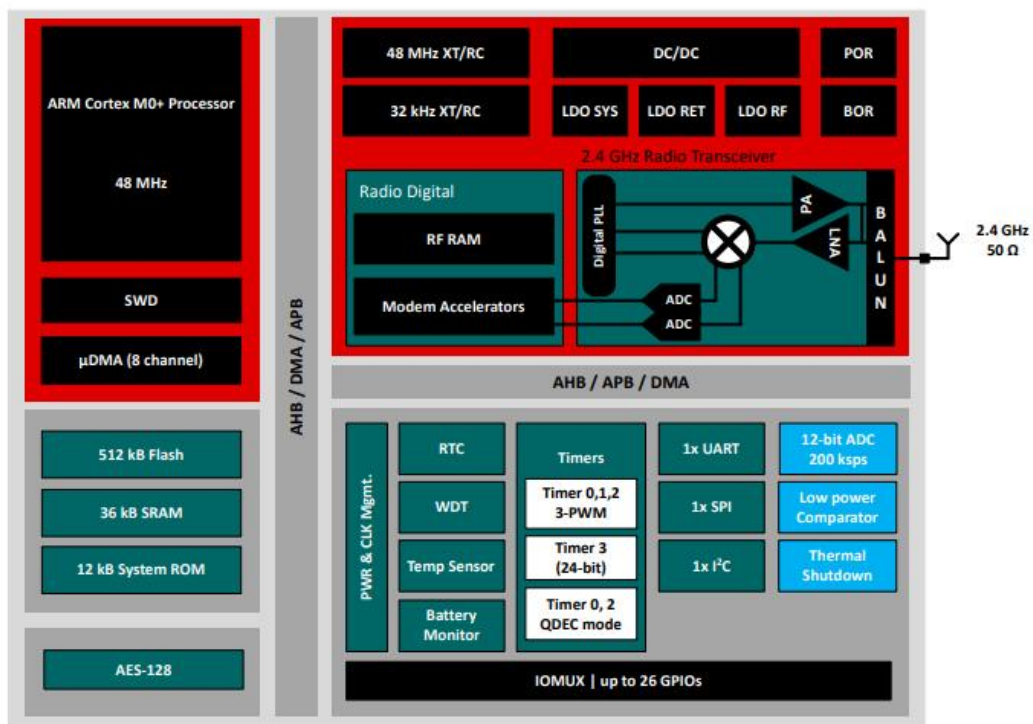
Measurement conditions Tc = 25°C, VDDS = 3.0 V, unless otherwise stated

Parameter	Test Condition	MIN	Type	MAX	Unit
Wake and Time Sequential					
Idle → Active	Flash disabled in idle mode		10		μs
Standby → Active	GLDO ON, min recharge current configuration		200		μs
Shutdown → Active	GLDO default charge current setting, VDDR capacitor fully discharged		2000		μs

4. Block Diagram



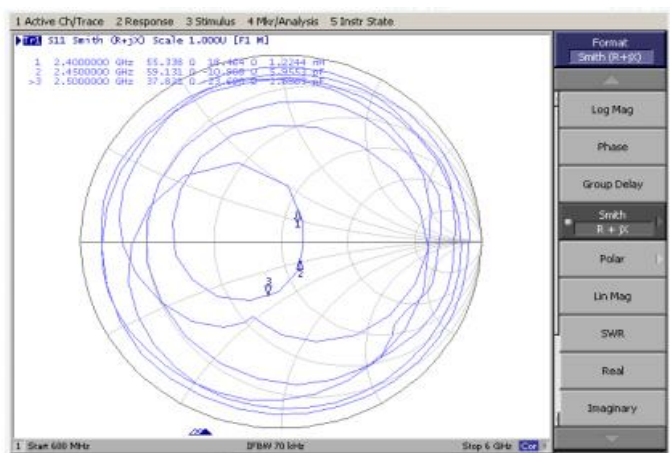
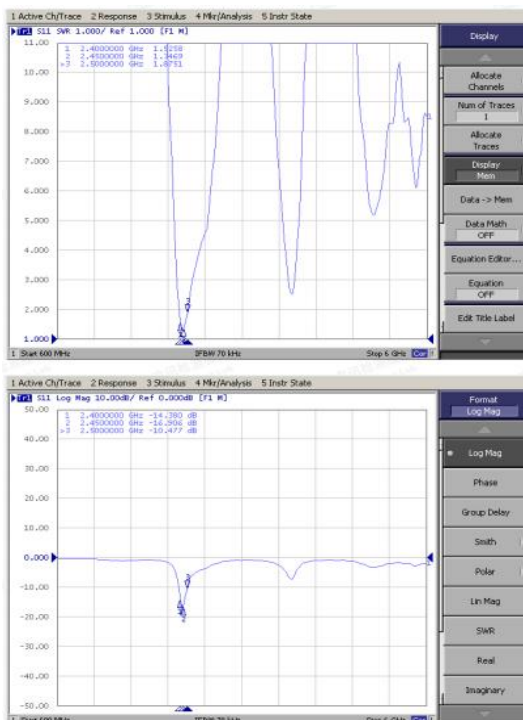
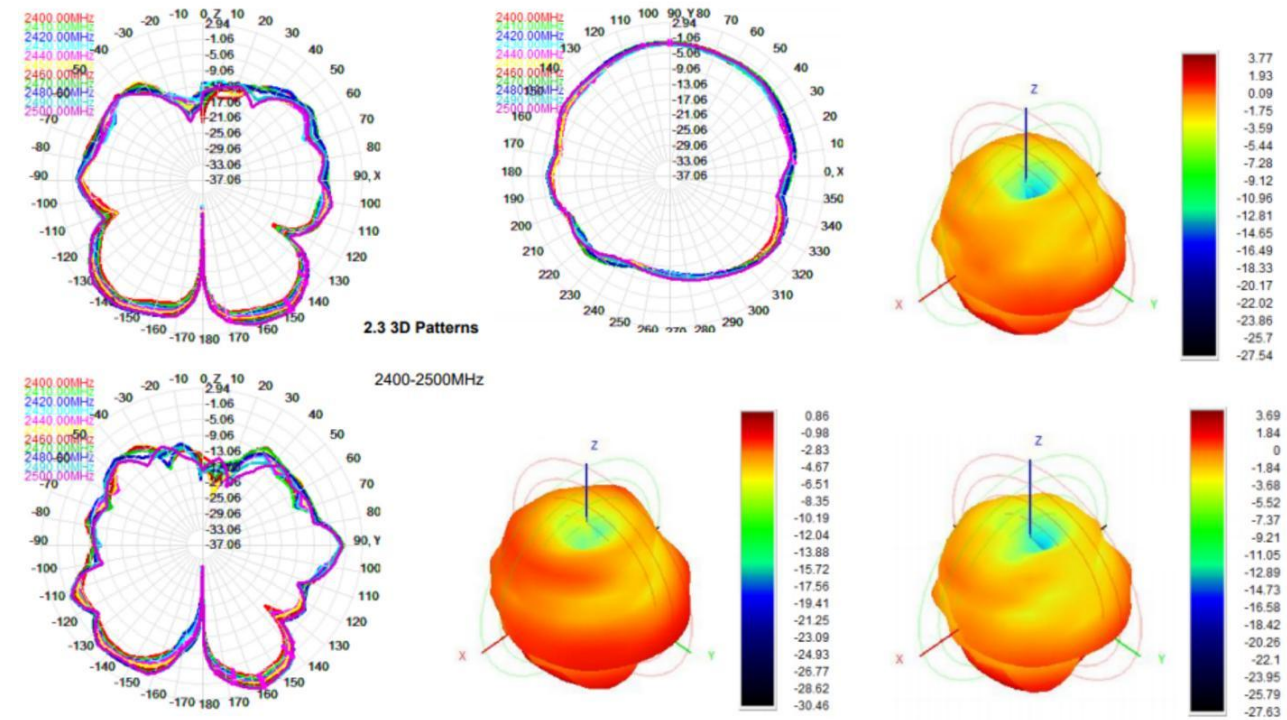
5. Functional Block Diagram



6. Antenna Radiation and Efficiency

Antenna gain and radiation patterns have a strong dependence on the size and shape of the application PCB the module is mounted on, as well as on the proximity of any mechanical design to the antenna.

Typical radiation patterns and efficiency for the on-board chip antenna under optimal operating conditions are plotted in the figures that follow:



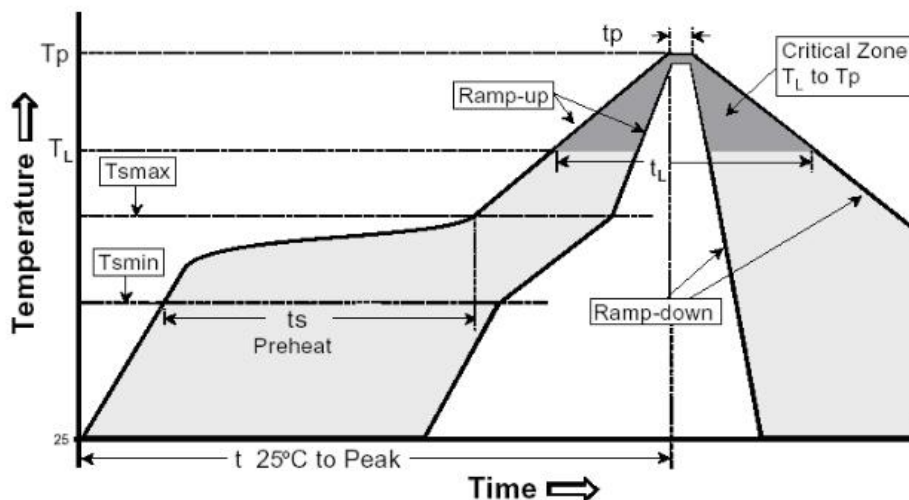
Frequency ID	1	2	3	4	5	6	7	8	9	10	11
Frequency (MHz)	2400.0	2410.0	2420.0	2430.0	2440.0	2450.0	2460.0	2470.0	2480.0	2490.0	2500.0
Efficiency (dBi)	-6.08	-5.73	-5.35	-5.00	-4.75	-4.47	-4.14	-3.93	-3.85	-3.85	-3.82
Gain (dBi)	0.86	1.45	1.98	2.20	2.31	2.77	3.37	3.59	3.77	3.76	3.69
Efficiency (%)	24.66	26.76	29.20	31.65	33.53	35.76	38.59	40.50	41.20	41.20	41.49
Directivity (dB)	6.94	7.18	7.33	7.19	7.06	7.24	7.51	7.51	7.62	7.61	7.51
Peak Gain Position (Theta)	146.00	146.00	146.00	146.00	146.00	146.00	146.00	146.00	146.00	146.00	146.00
Peak Gain Position (Phi)	146.00	146.00	135.00	146.00	146.00	146.00	146.00	135.00	135.00	135.00	135.00
Efficiency ThetaPol (%)	17.72	18.99	20.51	21.85	22.96	24.30	26.17	27.23	27.60	27.55	27.59
Efficiency PhiPol (%)	6.94	7.77	8.70	9.80	10.57	11.46	12.43	13.27	13.60	13.65	13.90
Upper Hem. Efficiency (%)	7.60	7.49	7.84	7.95	8.25	8.61	8.95	9.21	8.96	8.31	8.19
Lower Hem. Efficiency (%)	17.06	19.27	21.37	23.70	25.28	27.14	29.64	31.30	32.24	32.90	33.29

7. Recommended Reflow Curve

Profile Feature	Pb-Free Assembly	
	Large Body	Small Body
Average ramp-up rate(T_L to T_P)	3°C/second max	
Preheat -Temperature Min (T_{smin}) -Temperature Max (T_{smax}) -Time (min to max)(t_s)	150°C 200°C 60-180 seconds	
T_{smax} to T_L -Ramp-up Rate	3°C/second max	
Time maintained above -Temperature (T_L)-Time (t_L)	217°C 60-150 seconds	
Peak Temperature (T_P)	245 +0/-5°C	250 +0/-5°C
Time within 5°C of actual Peak Temperature (t_p)	10-30 seconds	20-40 seconds
Ramp-down Rate	6°C/second max	
Time 25°C to Peak Temperature	8 minutes max	

Notes:

- 1、lead-free solder paste: Sn 96.5%, Ag 3%, Cu 0.5%);
- 2、The furnace temperature curve is for reference only, please adjust according to the actual effect;

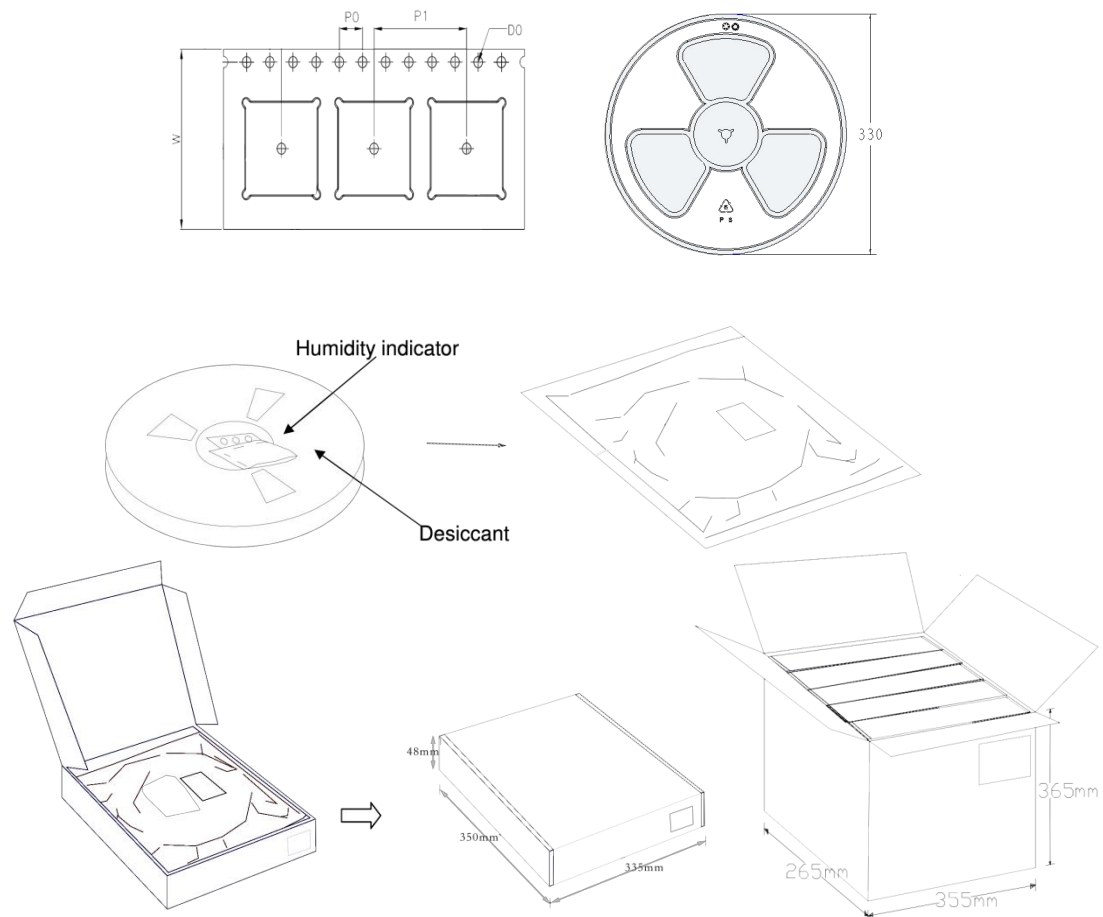


8. Packing Information

There are two types of module packaging, namely taping and tray. The details are as follows:

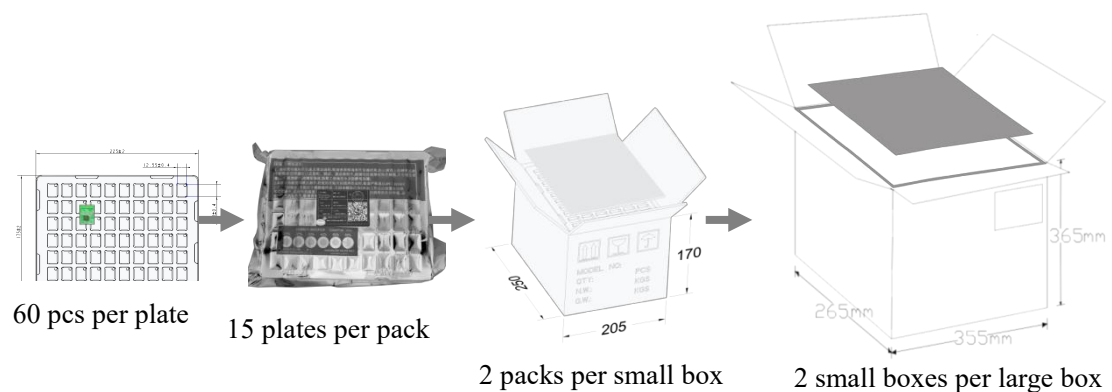
8.1. Tape Packing

The module is delivered to the customer in tape packing(1200pcs/package), packing method and size are as follows:



8.2. Reel Packing

The module is delivered to the customer in reel packing(1800pcs/ package), packing method and size are as follows:

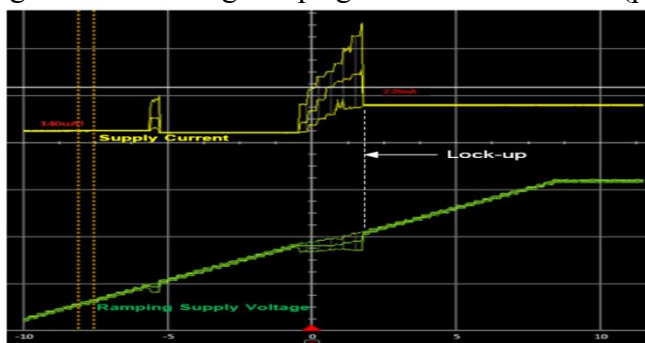


8.3. Humidity Sensitivity Level

Modules are delivered in packing that conforms to moisture sensitivity level 3 (MSL3) requirements.

9. Application Precautions

- Pay attention to electrostatic protection: During the operation, ensure that the instrument and equipment are completely grounded. Prevent poor grounding of the soldering iron and various equipment; avoid static electricity generated by packaging materials and human body contact, which will damage the IC or the program will be blown away; when manually soldering the module, pay attention to the temperature of the soldering iron to avoid peeling off of the PCB copper skin; The power supply damages the module; the operator must install the anti-static ring and implement the static protection inspection to prevent human contact from damaging the IC and the program. Good contact to avoid oxidation and poor contact; the electrostatic voltage of the environment and personnel is within $0\pm 100V$. Anti-static signs should be made in the work area.
- Pay attention to avoid program runaway or IC damage caused by abnormal voltage of the Bluetooth chip due to poor power supply circuit of the motherboard, soldering short circuit connection/open circuit.
- When burning the program firmware in the module flash memory, the VDDSDC power supply voltage must be between 2.4~3.3V.
- Avoid multiple occurrences of the power supply voltage falling within the range of the electrical detection threshold (1.76 V ~ 1.78 V) within the BOD Brown-Out Detect range, the below picture shows the power-off lock area, the firmware may be locked causing the boot code to pause and unable to connect to the JTAG protocol. In this state, the reset pin action can be used to eliminate this phenomenon below 1.0 V; the rechargeable battery is in the state of charging and discharging; while applying it, ensure the voltage setting of the protection system, and pay attention to the internal resistance and line impedance voltage drop caused by power supply; ensure The device operates from 2.0 V to 3.6 V with a guaranteed voltage slope greater than 0.5 V/ms (passing the BOD threshold).

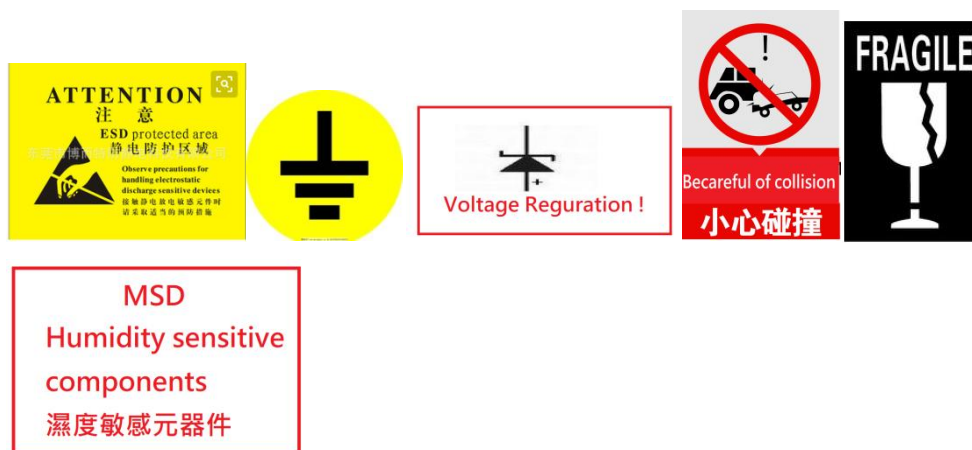


- During the production and transportation process, please take good measures to

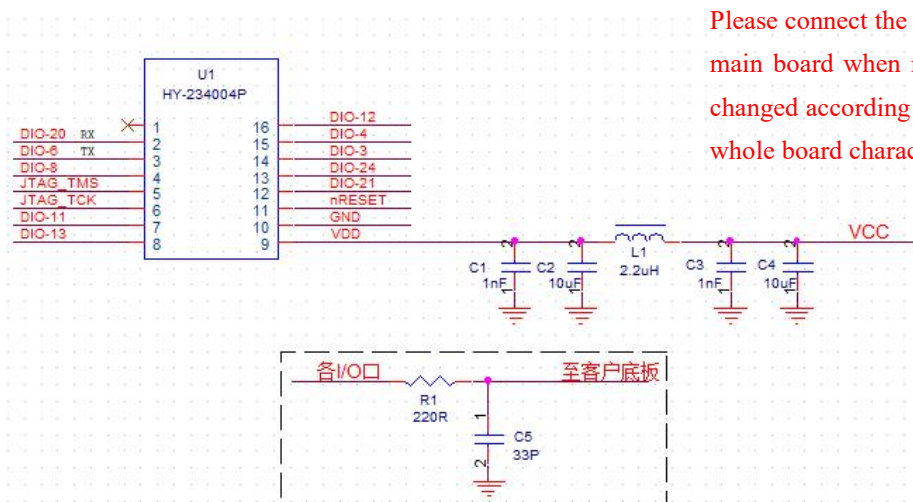
protect the module parts to prevent the precision parts on the module from being damaged (reflow furnace outlet and assembly, testing, and transportation processes, it is recommended to use anti-collision materials for buffering, and do not collide with each other.

- This module is a humidity-sensitive component. If it is used in SMD reflow soldering operations, please strictly follow the regulations of IPC/JEDECJ-STD-020, and do a good job of drying and dehumidification first, and because this module has been placed after 2 processing operations In the functional test environment, the humidity inside the chip cannot be guaranteed at a certain ratio, please understand;

The above precautions are as follows:



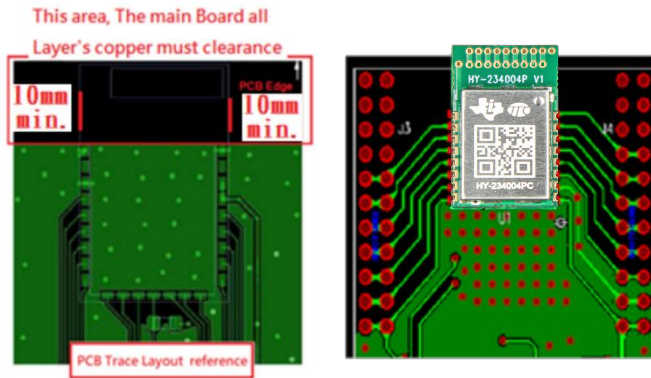
- The external filter parts on the module application schematic diagram should be connected to the main board when needed, and the values can be changed according to the actual needs of the whole board characteristics;



Please connect the external filter parts to the main board when needed, the value can be changed according to the actual needs of the whole board characteristics

- Installation Suggestion 1: The PCB copper skin around the module antenna and under the RF circuit must be clear, and the module must be placed on the edge of the motherboard. There should be no metal parts or substances that hinder electromagnetic radiation near the antenna, which will affect the control distance.

- Installation suggestion 2: The layout of signal lines and power lines, do not cross the lines, avoid crosstalk, and affect the receiving sensitivity, as shown in the following schematic diagram:



10. Document Revision History

Version	Date	reviser	auditor	Revised content
V1.0	2023/07/25	YDQ	LYC	First release

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