TTCIOTSDK
昇 润 科 技

BLE5.2+ZigBee3.0 Module Hardware Specification
HY-52P101P

2023.07.25

Version：V1.0

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

CONTENTS

1. Module Overview

1.1 Description

HY-52P101P is a SimpleLink multi-protocol 2.4 GHz high transmit power (+20 dBm) wireless module developed by Shengrun Technology based on TI CC2652P1 solution. It integrates a powerful 48MHz Arm® Cortex®-M4F processor with parity correction. Function-tested 80KB ultra-low leakage SRAM, 352KB flash program memory, 256KB ROM (for protocol and library functions), and 8KB cache SRAM for highly reliable operation.

Supported protocols: Thread, Zigbee®, Matter, Bluetooth® 5.2 Low Energy, IEEE 802.15.4, Smart Objects for IPv6 (6LoWPAN), TI 15.4.Stack (2.4GHz) and via Dynamic Multiprotocol Manager (DMM) The driver implements concurrent multi-protocols and supports over-the-air upgrades (OTA).

1.2 Applications

1. Building security systems – motion detectors, electronic smart locks, door and window sensors, garage door systems, gateways

2.HVAC – Thermostats, Wireless Environmental Sensors, HVAC System Controllers, Gateways

3. Fire safety systems – smoke and heat detectors, fire alarm control panels (FACP)

4. Lifts and escalators – Elevator main control boards for lifts and escalators

5. Industrial Transportation – Asset Tracking

6. Factory automation and control

7.Medical

8. Electronic Point of Sale (EPOS) – Electronic Shelf Label (ESL)

9. Communications equipment – wired networks – wireless LAN or Wi-Fi access points, edge routers, small business routers

10. Personal electronics – Home theater and entertainment – Smart speakers, smart displays, set-top boxes – Wearable devices (non-medical) – Smart trackers, smart clothing.

2. Hardware Description

2.1. Antenna Selection

| Part number (P/N)	Hardware model	Instructions
WMD52P101021A0	HY-52P101PC	PCB antenna with shielding cover
WMD52P101031A0	HY-52P101PC	IPEX seat with shielding cover

2.2 Module Dimension and Picture

HY-52P101PC (PCB antenna, with shielding cover)

Size: 28.7*17.5*2.7mm ±0.2MM
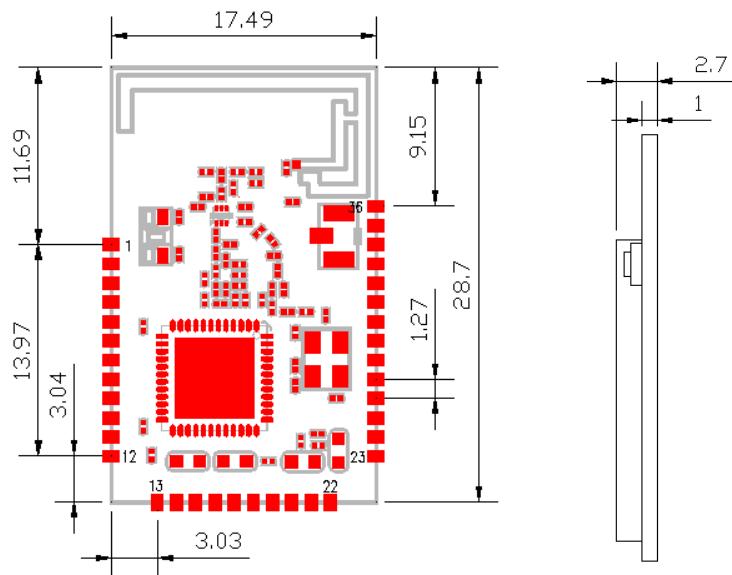
3. Application Precautions

- 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±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 VDDS DC 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 Decect 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).
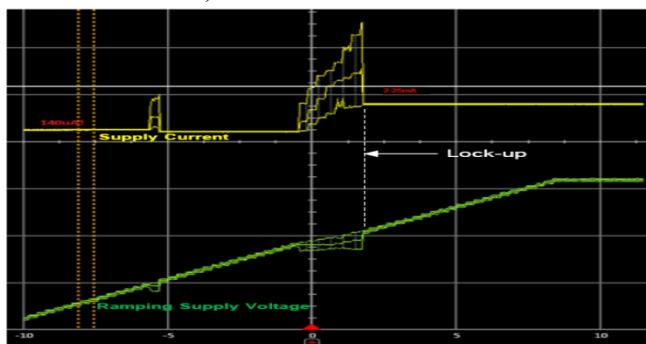
- During the production and transportation process, please take good measures to protect the module parts to prevent the precision parts on the module from being damaged (reflow furnace outlet and assembly, testing, and transportation processes, it is recommended to use anti-collision materials for buffering, 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. 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;

(The picture below is for reference only, the actual circuit depends on the customer's application.)
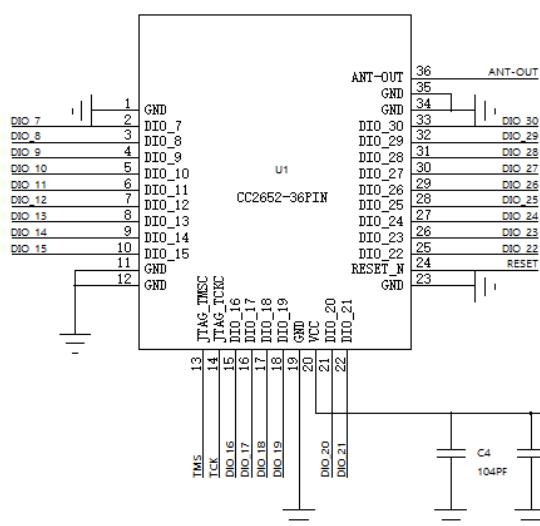
Please connect the external filter parts to the main board when needed, the value can be changed according to the actual needs of the whole board characteristics

V1.0   www.ttcble.com
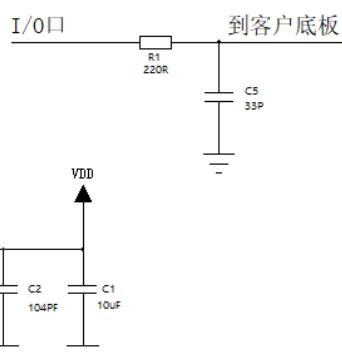
- Installation Suggestion 1: The PCB copper skin around the module antenna and under the RF circuit must be clear, and the module must be placed on the edge of the motherboard. There should be no metal parts or substances that hinder electromagnetic radiation near the antenna, which will affect the control 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:
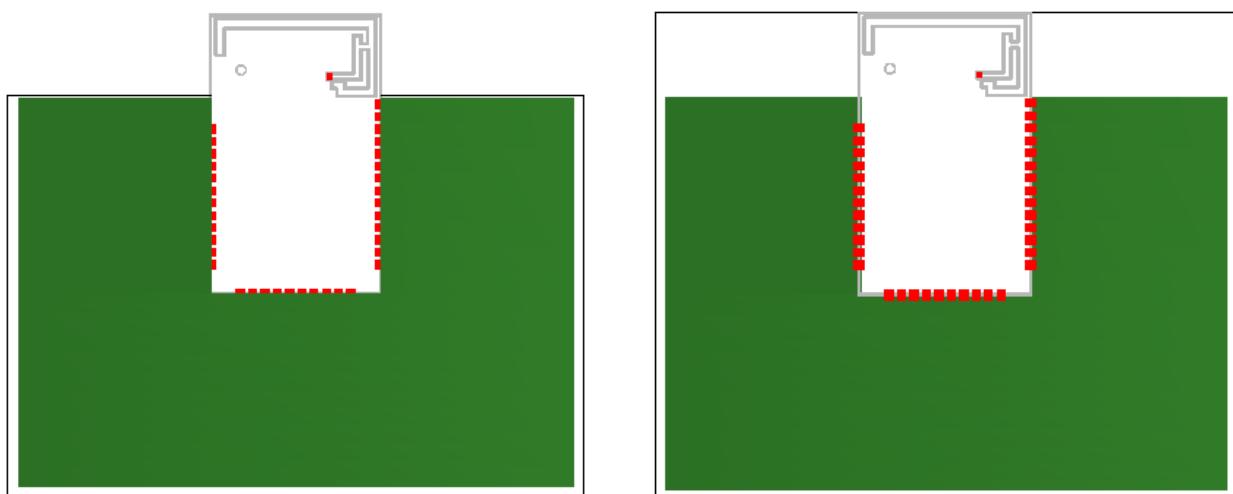
4. Pinout And GPIO Function
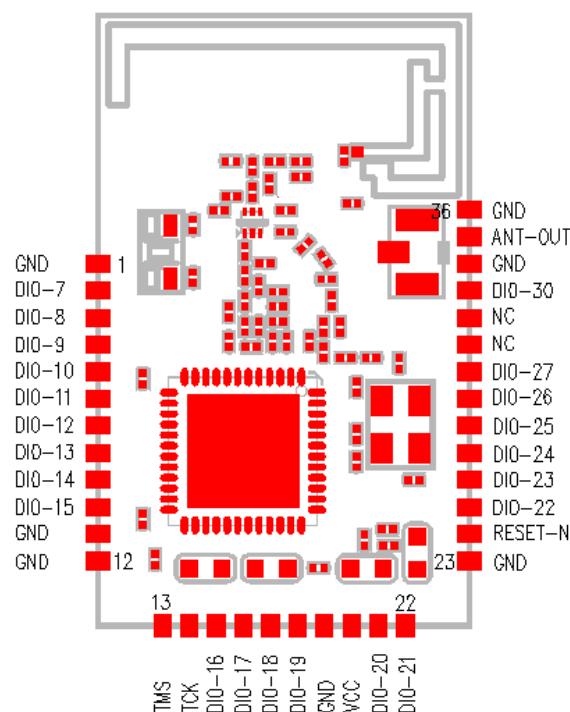
No.	Name	Type	Function description
1	GND	Power GND	Ground
2	DIO_7	Digital I/O	GPIO, high-drive capability
3	DIO_8	Digital I/O	GPIO
4	DIO_9	Digital I/O	GPIO
5	DIO_10	Digital I/O	GPIO
6	DIO_11	Digital I/O	GPIO
7	DIO_12	Digital I/O	GPIO
8	DIO_13	Digital I/O	GPIO
9	DIO_14	Digital I/O	GPIO
10	DIO_15	Digital I/O	GPIO
11	GND	Power GND	Ground
12	GND	Power GND	Ground
13	TMS	I/O	JTAG_TMSC, high-drive capability
14	TCK	I	JTAG-TCKC
15	DIO_16	Digital I/O	GPIO, JTAG_TDO, high-drive capability
16	DIO_17	Digital I/O	GPIO, JTAG_TDI, high-drive capability
17	DIO_18	Digital I/O	GPIO
18	DIO_19	Digital I/O	GPIO
19	GND	Power GND	Ground
20	VCC	Power	1.8.V to 3.8.V main chip supply
21	DIO_20	Digital I/O	GPIO
22	DIO_21	Digital I/O	GPIO
23	GND	Power GND	Ground
24	RESET-N	Digital I	Reset, active low. internal pullup resistor
25	DIO_22	Digital I/O	GPIO
26	DIO_23	Digital or Analog I/O	GPIO, analog capability
27	DIO_24	Digital or Analog I/O	GPIO, analog capability
28	DIO_25	Digital or Analog I/O	GPIO, analog capability
29	DIO_26	Digital or Analog I/O	GPIO, analog capability
30	DIO_27	Digital or Analog I/O	GPIO, analog capability
31	DIO_28	NC	NC
32	DIO_29	NC	NC

33	DIO_30	Digital or Analog I/O	GPIO, analog capability
34	GND	Power GND	Ground
35	GND	Power GND	Ground
36	ANT-OUT	RF OUT	RF POWER OUT

5. Electrical Characteristic

Test conditions: Ta = 25 ℃, VDD =3.0V with internal DC-DC regulator, FRF = 2440MHz

5.1 Radio Characteristics And Current Consumption

➢ Modulation method: OQPSK

➢ Frequency range: 2360~2500MHz (2.4G ISM band)

➢ IC RF TX power range can be set through software programming: -20~+20dBm

➢ Antenna feed end RF transmit power: +18dBm typical. (RF TX is set at +20dBm maximum characteristic)

➢ RX sensitivity: -104dBm typical (at PER <30.8% characteristics)

➢ Frequency offset: RF ± 60ppm, MCU clock 32.768KHz ± 350ppm (using crystal oscillator mode)

➢ Comply with: FCC, IC (Canada), CE RED, BQB and other global RF regulations.

➢ Ultra-low current power consumption

1. Transmit: 22mA (typical) (TX transmit power is set to: 10dBm)

2. Transmit: 85mA (typical) (TX transmit power setting: 20dBm)

3. Receive (high gain setting): 6.9mA (typical)

4. Active mode MCU 48 MHz (Core Mark): 3.39 mA

5. Standby state: 1uA (RTC running and RAM/CPU maintained)

6. Shutdown state: 0.15uA (no clock operation, no storage, wake-up must be triggered externally)

5.2 Absolute Maximum Ratings

Note: These are absolute maximum ratings. Beyond these ratings, the module may be permanently damaged. These are not maximum operating conditions. See 6.4 for maximum recommended operating conditions.

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

5.3 ESD Ratings

			Value	Unit
VESD electrostatic discharge	The human body model (HBM) according to AEC Q100-002 is as follows: (1), (2).	ALL Pin	±2000	V
	According to AEC Q100-011 charging equipment mode is as follows note (3).	XOSC pin 46,47	±250	
		Other pins	±500	

Note:

1. According to AEC Q100-002 instructions, HBM mode operates according to

ANSI/ESDA/JEDEC JS-001 specifications.

2. JEDEC document JEP155 states that the anti-static control process of the 500 V HBM safety

production standard is allowed.

3. JEDEC document JEP157 states that the anti-static control process of the 250 V CDM safety

production standard is allowed.

5.4 Recommended Operating Conditions

The power supply voltage noise should be less than 10mVpp. Excessive power supply noise will

reduce the radio frequency performance.

Rated value	MIN	MAX	Unit
VDD(Bluetooth operating time)	1.8	3.8	V
VDD（Flash memory burning program firmware	2.4	3.8	V
Operating temperature	-40	+85	°C

Note:

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

2. When burning program firmware into module flash memory, the VDDS DC power supply voltage

needs to be between 2.4~3.3V to avoid

The recording is incomplete or an abnormality occurs.

3. For button batteries, in the worst case, the equivalent source resistance of the battery will cause a power supply voltage drop. At this time, VDDSA 22μF input capacitor must be used to enhance the power supply capability to ensure compliance with this slew rate (6.6 timing requirement).

5.5 GPIO Characteristics

Parameter	Test Condition	Typical	Unit
8.mA load GPIO high level output	IOCURR = 2, high-limit driver GPIOs	1.56	V
8.mA load GPIO low level output	IOCURR = 2, high-limit driver GPIOs	0.24	V
4.mA load GPIO high level output	IOCURR = 1	1.59	V
4.mA load GPIO low output	IOCURR = 1	0.21	V

5.6 Timing Requirement

Description		Min	Standard	MAX	Unit
Rising Supply Voltage Slew Rate		0		100	mV/μs
Decreasing Supply Voltage Slew Rate		0		20	mV/μs
Decreasing Supply Voltage Slew Rate – Low Power Flash Environment [1]				3	mV/μs
Standby positive temperature gradient [2]	No limitations on negative temperature gradients or external standby mode			5	°C/s
AC Characteristics of Input Control					
Reset RESET_N remains low for the duration		1			μs

1. For button batteries, in the worst case, the equivalent source resistance of the battery will cause a power supply voltage drop. At this time, VDDS must use a 22μF input capacitor to enhance the power supply capability to ensure compliance with the conversion rate.

2.Applications that use RCOSC_LF as a sleep timer must consider frequency drift caused by temperature changes.

5.7 Switching Characteristics

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

Parameter	Test Conditions	Min	Typical	Max	Unit
Wake-up and timing					
Idle →Active			15		μs
Standby →Active			165		μs
Shutdown →Active			850~4000		μs

6. Block Diagram

V1.0   www.ttcble.com
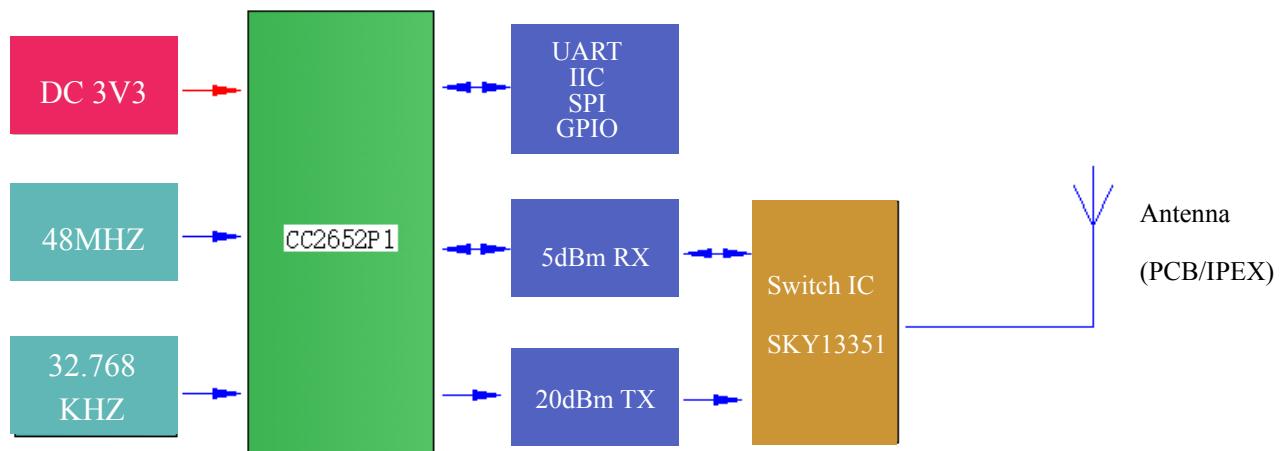
7. Functional Block Diagram

V1.0   www.ttcble.com
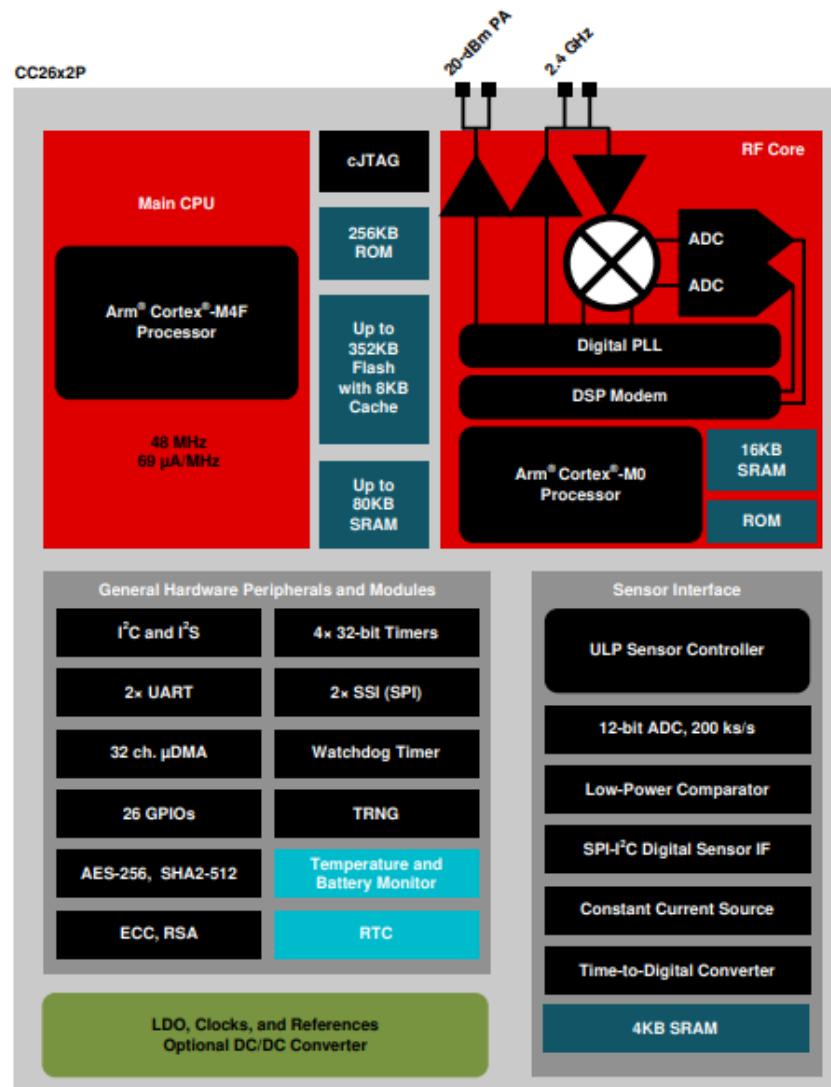
## 8. Working Mode Schematic
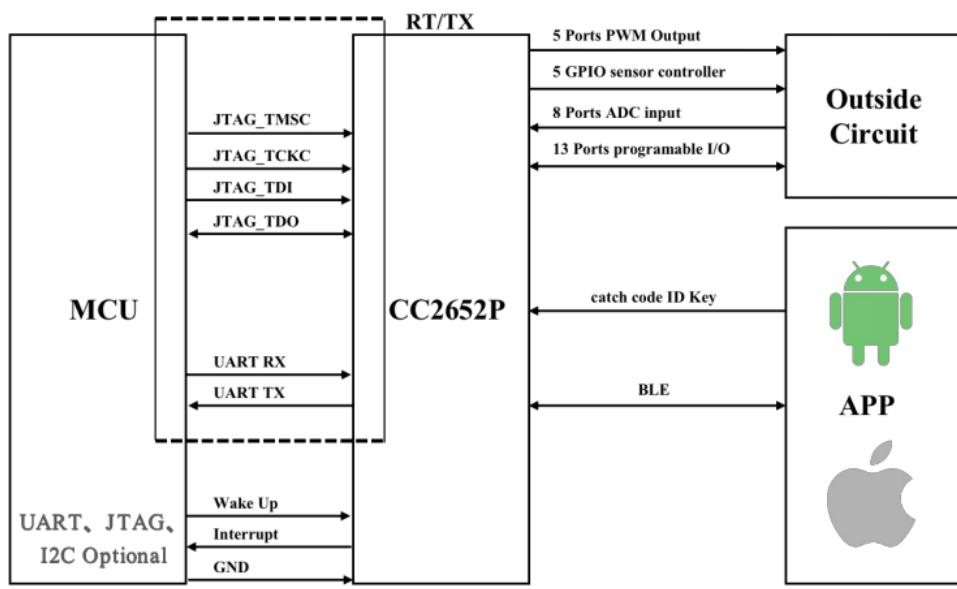
9. Packing Information

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

9.1 Tape Packing

The module is delivered to the customer in tape packing(1000pcs/package), packing method and size are as follows:

12 /13
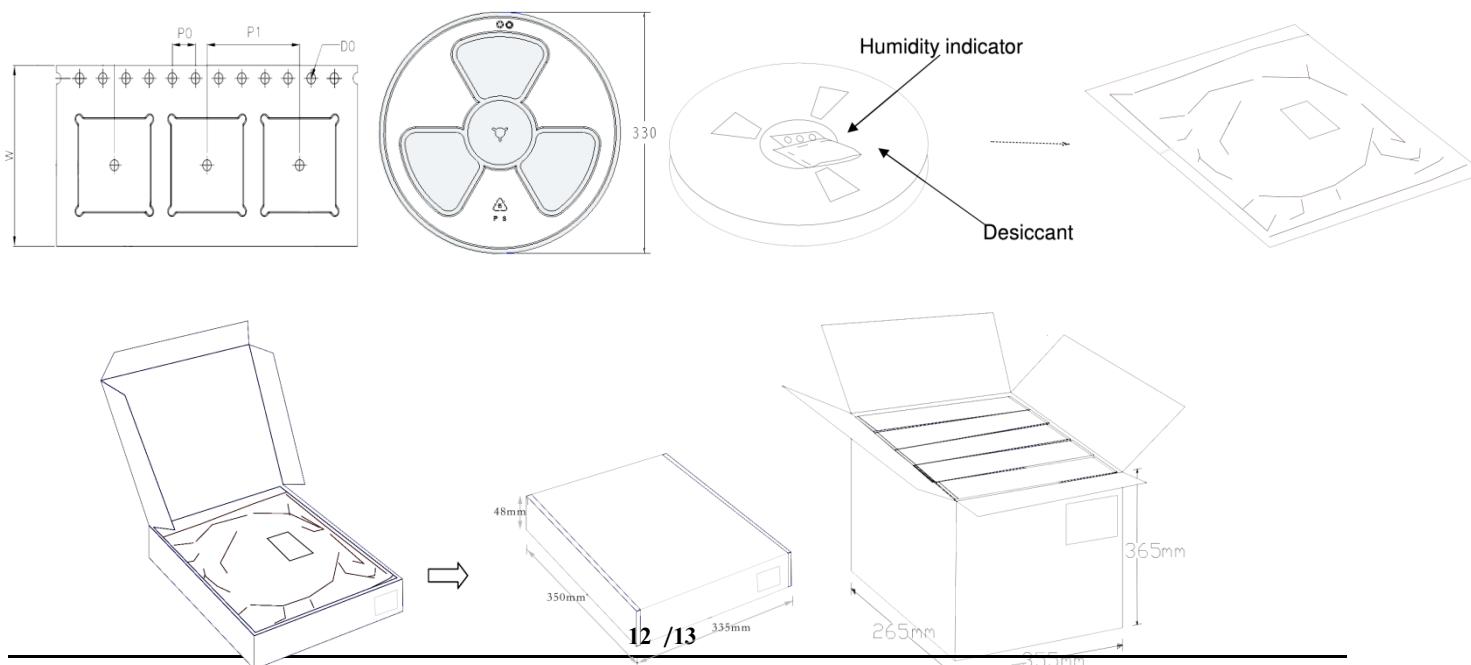
9.2 Reel Packing

The module is delivered to the customer in reel packing(1800pcs/ package), packing method and size are as follows:
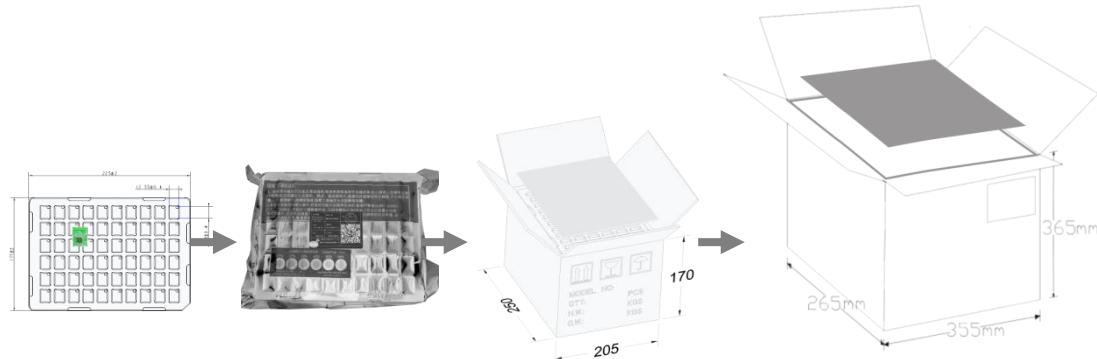
50 pcs per plate   18 plates per pack   2 packs per small box   2 small boxes per large box

9.3 Humidity Sensitivity Level

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

10. Antenna Radiation and Efficiency

10.1 Antenna peak gain: 3.6dBi at 2430MHZ

10.2 Antenna size
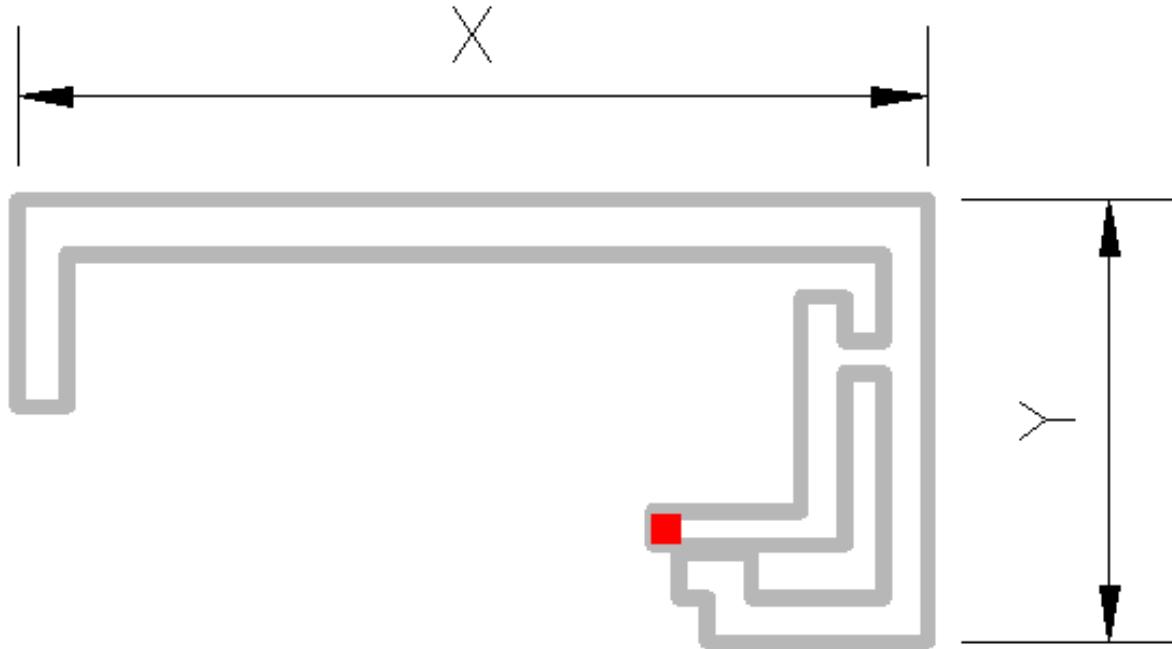
10.3 Radiation pattern and efficiency
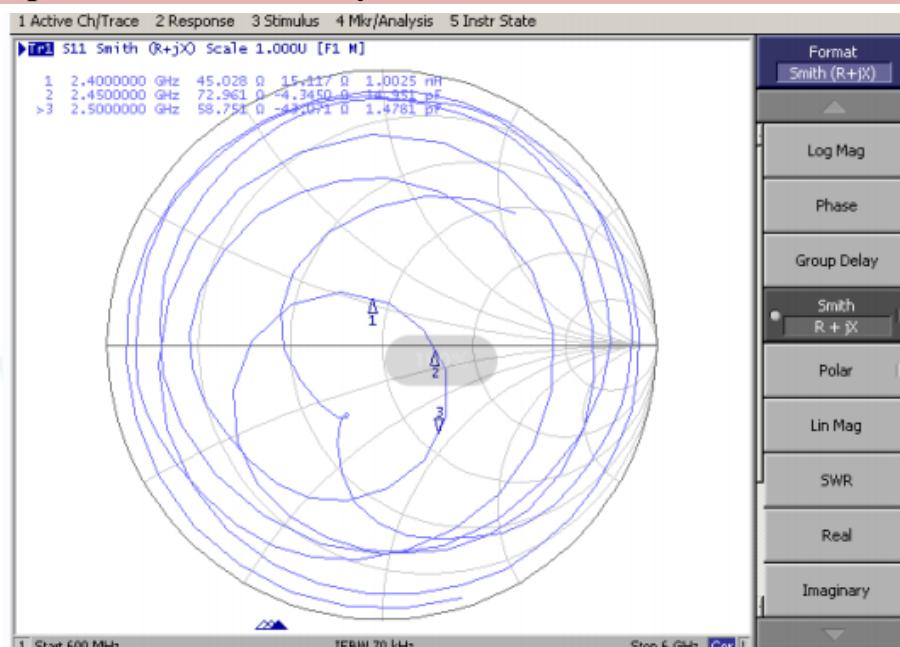
Frequency ID	1	2	3	4	5	6	7	8	9	10	11
Frequency (MHz)	2400.0	2410.0	2420.0	2430.0	2440.0	2450.0	2460.0	2470.0	2480.0	2490.0	2500.0
Efficiency (dBi)	-2.92	-2.92	-2.88	-2.77	-2.83	-2.86	-2.81	-2.82	-2.92	-3.02	-3.09
Gain (dBi)	3.68	3.70	3.63	3.60	3.36	3.25	3.49	3.69	3.74	3.46	3.34
Efficiency (%)	51.04	51.05	51.53	52.84	52.12	51.77	52.37	52.26	51.01	49.85	49.04
Directivity (dB)	6.60	6.62	6.51	6.37	6.19	6.11	6.30	6.50	6.66	6.48	6.44
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)	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00
Efficiency ThetaPol (%)	29.46	28.81	28.50	29.03	28.77	28.27	28.50	28.36	27.61	26.90	26.33
Efficiency PhiPol (%)	21.57	22.24	23.03	23.81	23.35	23.50	23.87	23.90	23.40	22.94	22.71
Upper Hem. Efficiency (%)	20.39	20.32	20.80	20.92	20.69	20.97	21.29	21.43	20.94	19.97	19.27
Lower Hem. Efficiency (%)	30.65	30.73	30.73	31.92	31.44	30.79	31.08	30.83	30.07	29.87	29.77

14 /13

2400-2500MHz
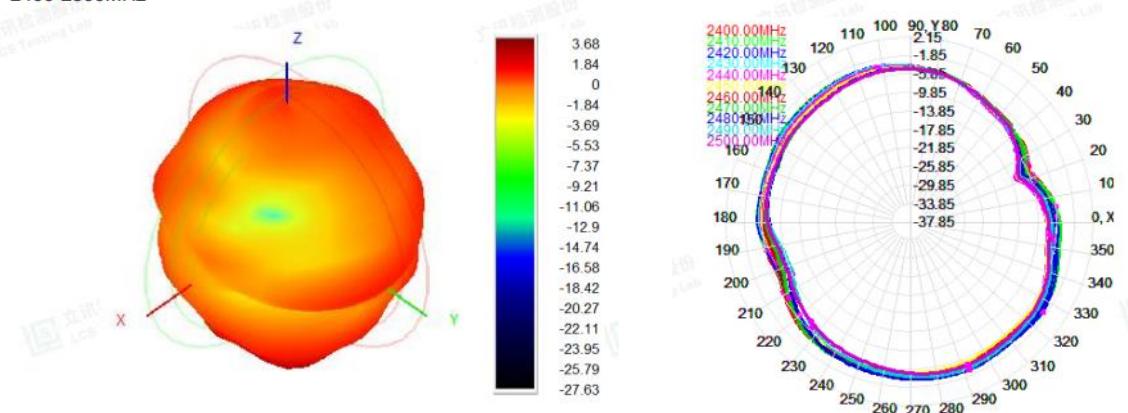
11. Recommended Reflow Curve

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 (Ts_{min})
           -Temperature Max (Ts_{max})
           -Time   (min to max)(ts)
	150°C
	200°C
	60-180 seconds	

$Ts_{max}$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 PeakTemperature	8 minutes max	
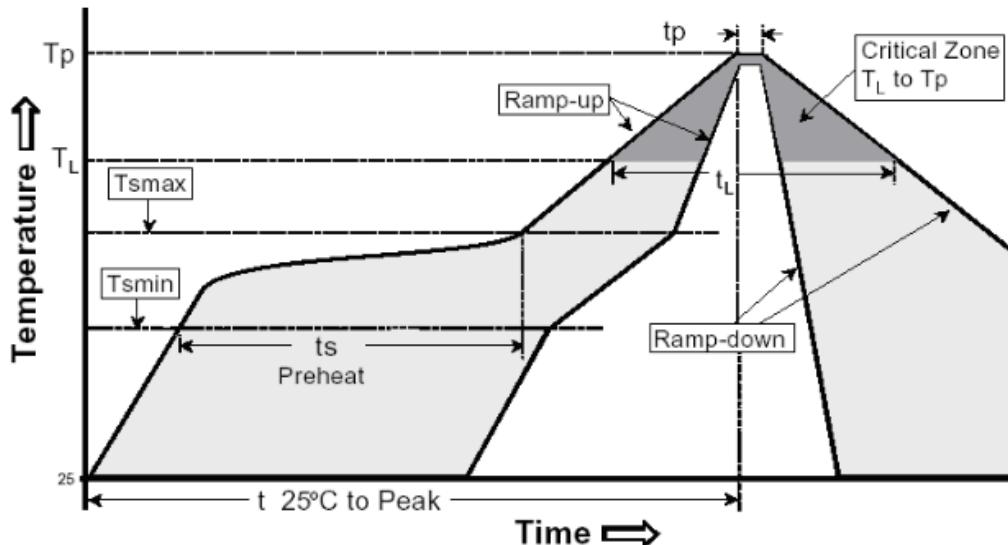
Notes：

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；

12. Contact Us

Shenzhen Shengrun Technology Co., Ltd

C505, Wisdom Home, Baolong Street, Longgang District, Shenzhen City, Guangdong, China

TEL.：+86 400-8050-562

Mail：marketing@ttcble.com

Online shop：https://tuner168.1688.com/

Chinese website：www.tuner168.com

English website：www.ttcble.com