PB-04 Specification

Version V1.0.0

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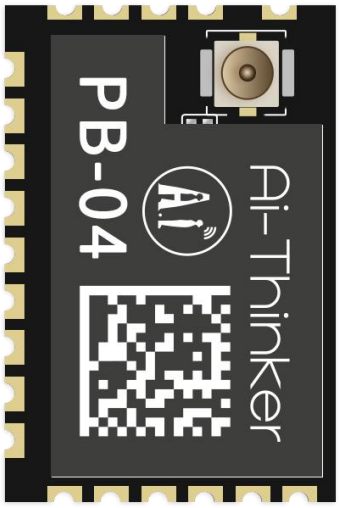

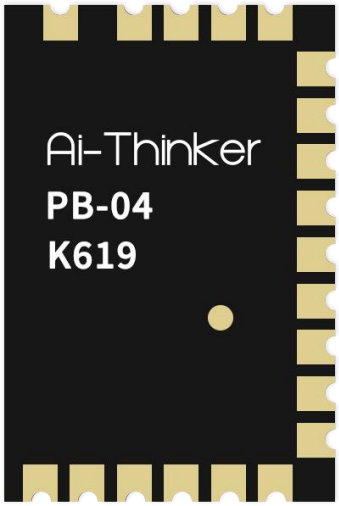

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Document Revision History

Version	Date	Created / Revised Content	Prepared by	Approved by
V1.0.0	2026-05-26	First edition	Wang Yeqing	Guan Ning

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Contents

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List of Figures

List of Tables

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1 Product Overview

PB-04 is a Bluetooth module developed by Shenzhen Ai-Thinker Technology Co., Ltd. It utilizes the PHY6222 chip as its core processor. The PHY6222 supports BLE 5.4 and is equipped with a high-performance, low-power 32-bit processor, featuring ultra-low power consumption, high performance, and multi-mode radio capability. In addition, the PHY6222 supports Bluetooth Low Energy (BLE) with security, application, and over-the-air (OTA) download update.

The PB-04 module provides a rich set of peripheral interfaces, including SPI, UART, I2C, PWM, ADC, Timer, DMIC/AMIC, GPIO, and others. It can be widely applied in fields such as the Internet of Things (IoT), mobile devices, wearable electronics, and smart home systems.

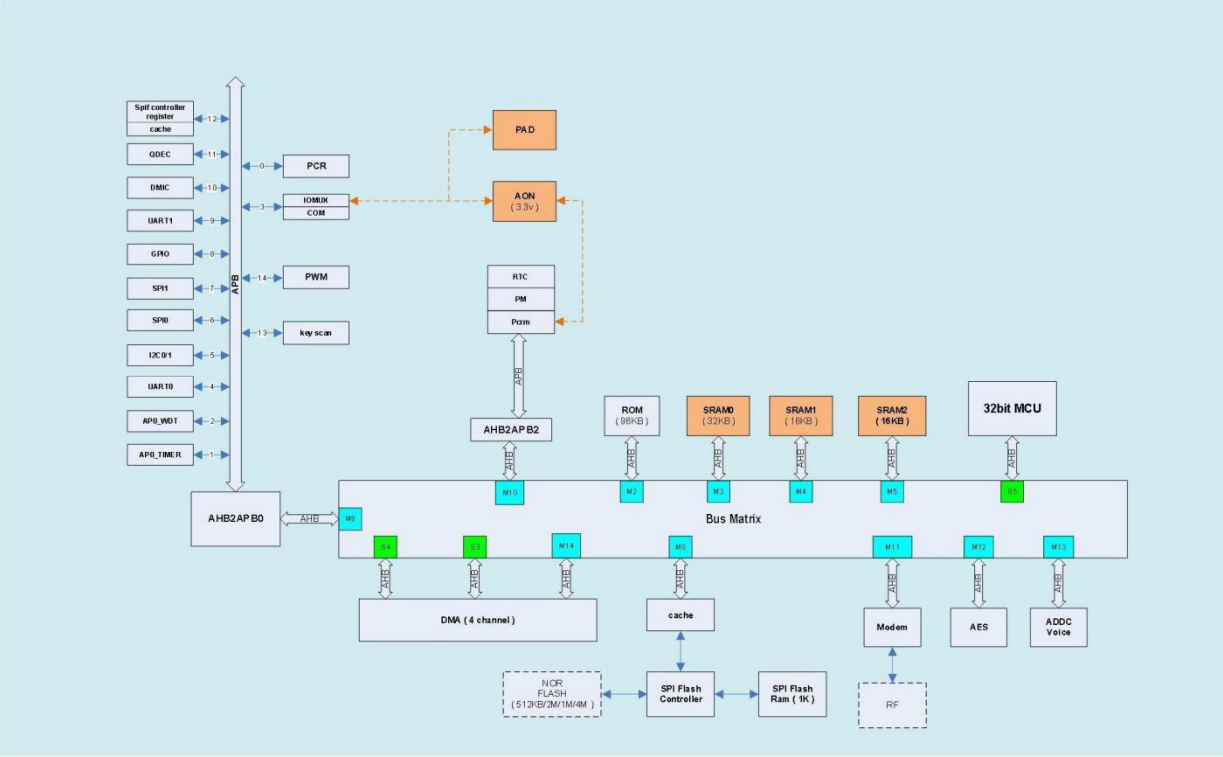

Figure 1 Main Chip Architecture Diagram

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1.1 Features

Wireless

- Supports Bluetooth BLE 5.4 link controller
- -95dBm sensitivity @ 1Mbps GFSK
- -92dBm sensitivity @ 2Mbps GFSK
- TX Power -20 to +5dBm
- RSSI (1dB resolution)

Microcontroller Subsystem

- High-performance, low-power 32-bit processor
- SWD interface

Memory

- eFuse: 256 bit
- SRAM: 64KB
- Serial Flash: 128KB–8MB
- 96KB ROM

Clock

- 16MHz & 32.768kHz external crystal oscillators
- 32MHz & 32.768kHz internal RC oscillators

Security

- Supports AES-128 bit

Software

- Compatible with Bluetooth 5.4
- Supported data rates: 1Mbps, 2Mbps (BLE)
- Supports SIG-Mesh multi-feature
- Supports OTA

Peripherals

- Supports SPI, UART, I2C, PWM, ADC, GPIO, Timer, DMIC/AMIC, etc.

Package Type

- Adopts SMD-20 package

Development Environment

- Supports secondary development; integrated Windows development environment

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1.2 Application Scenarios

- Smart Home
- Industrial Equipment Interaction
- Wearable Electronic Devices
- Internet of Things (IoT)
- Mobile Devices

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2 Key Specifications

Table 1 Key Specifications

Model	PB-04
Package	SMD-20
Dimensions	13.9*9.0*2.8 (mm)
Antenna Type	External antenna (4th Gen I-PEX connector) / Castellated antenna
Frequency Range	2400–2483.5MHz
Operating Temperature	-40–105℃
Storage Conditions	-40–125°C, <90% RH
Power Supply Range	VDD: 1.8V–3.6V, supply current ≥ 100mA
Supported Interfaces	SPI, UART, I2C, PWM, ADC, Timer, SWD, DMIC/AMIC, GPIO, etc.
Available I/Os	13 (default)
UART Baud Rate	115200bps (default)
Wi-Fi Security	AES-128 encryption hardware
Flash	512KB (default), up to 8MB

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3 Electrical Characteristics

3.1 Recommended Operating Conditions

Table 2 Recommended Operating Conditions

Symbol	Parameter	Min	Typ	Max	Unit
VDD	Supply Voltage	1.8	3.3	3.6	V
I	Supply Current	100	-	-	mA

3.2 I/O DC Electrical Characteristics

Table 3 I/O DC Electrical Characteristics

Symbol	Parameter	Min	Typ	Max	Unit
VIH	High-level Input Voltage	2.4	-	-	V
VIL	Low-level Input Voltage	-	-	0.5	V
VOH	High-level Output Voltage	2.5	-	-	V
VOL	Low-level Output Voltage	-	-	0.5	V
Imax	I/O Maximum Operating Current	-	-	10	mA

3.3 Electrostatic Discharge

The PB-04 is an ESD-sensitive device and requires special precautions during handling.

Figure 2 ESD Protection Symbol

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3.4 BLE RF Performance

Table 4 BLE RF Performance

Description	Typ			Unit
Frequency Range	2400–2483.5			MHz
Output Power				
Data Rate Mode	**Min**	**Typ**	**Max**	**Unit**
1Mbps	-	5	-	dBm
2Mbps	-	5	-	dBm
Receiver Sensitivity				
Data Rate Mode	**Min**	**Typ**	**Max**	**Unit**
1Mbps Sensitivity @ 30.8% PER	-	-95	-	dBm
2Mbps Sensitivity @ 30.8% PER	-	-92	-	dBm

3.5 Power Consumption

The following power consumption data are measured based on a 3.3V power supply and an ambient temperature of 25℃.

- The POUT power for all transmit modes is measured at the antenna interface.
- All transmission data are measured at 100% duty cycle in continuous transmit mode.

Table 5 Power Consumption

Mode	Min	Avg	Max	Unit
TX PHY=1M, PRBS9, Pout = 5dBm	-	9	-	mA
TX PHY=2M, PRBS9, Pout = 5dBm	-	6	-	mA
RX PHY= 1M, Packet Length 1024 bytes	-	6	-	mA
RX PHY= 2M, Packet Length 1024 bytes	-	6	-	mA

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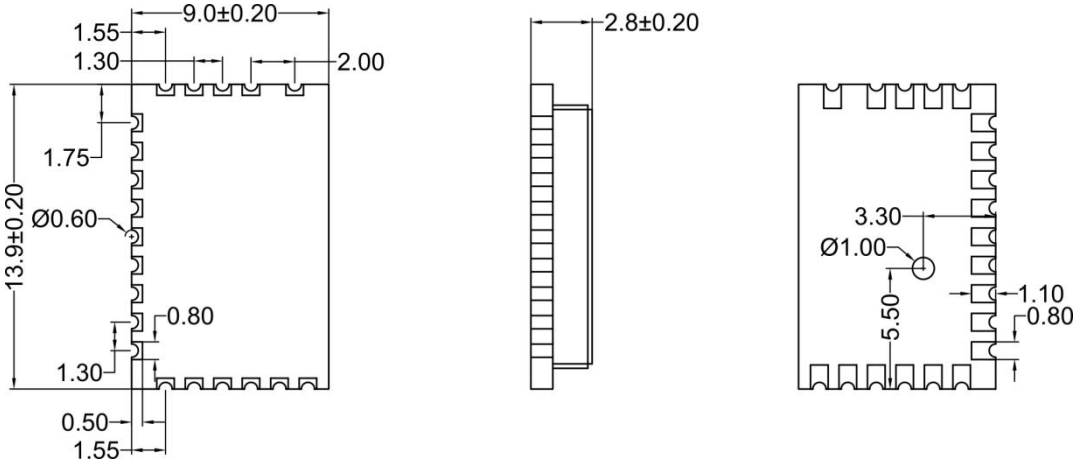
4 Mechanical Specifications

4.1 Module Dimensions



Top View Side View Bottom View

Figure 3 Module Dimensions (Unit: mm)

4.2 External Antenna Connector Dimensions

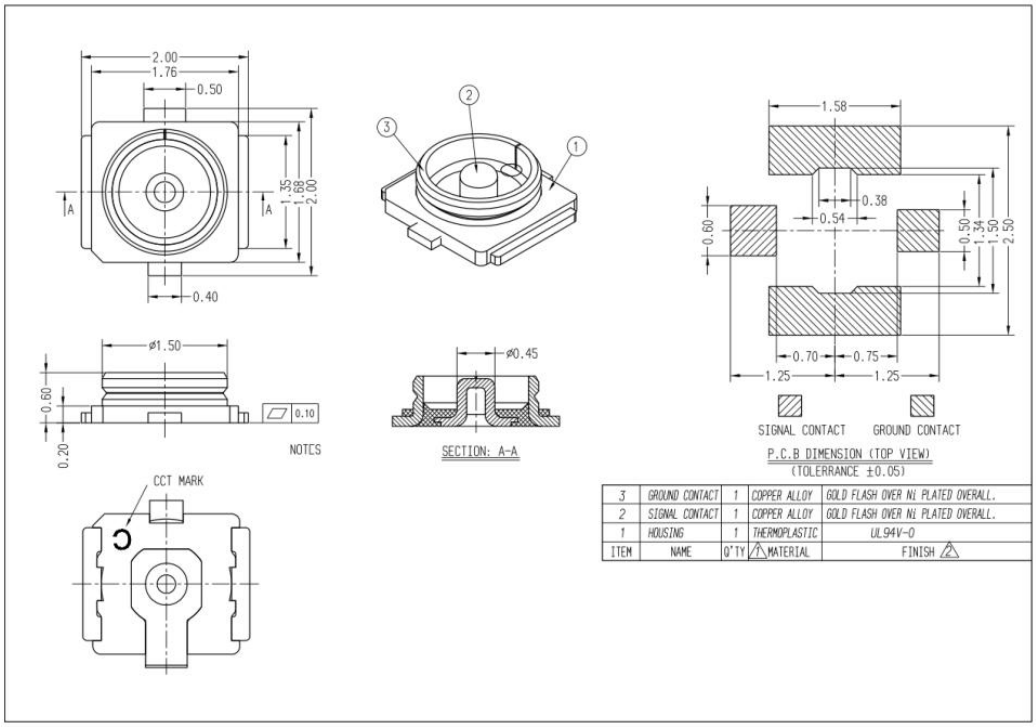


Figure 4 External Antenna Connector Dimensions (Unit: mm)

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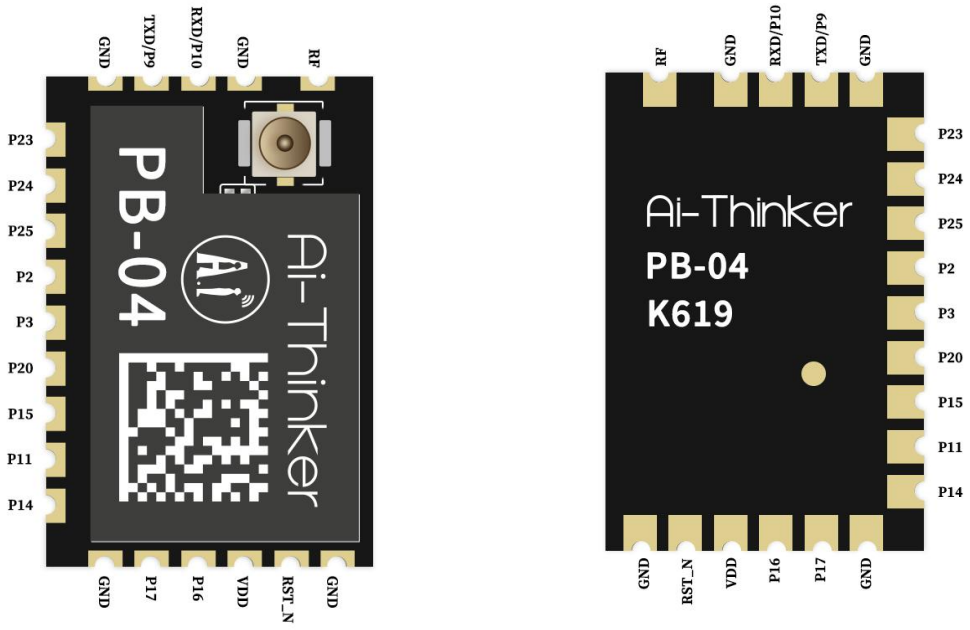
5 Pin Definition

The PB-04 module exposes a total of 20 pins, as shown in the pin diagram. The pin function definition table provides the detailed interface specifications.



Top View Bottom View

Figure 5 Pin Diagram

Table 6 Pin Function Definition

No.	Name	Function
1	GND	Ground
2	RXD / P10	RXD / GPIO 10
3	TXD / P9	TXD / GPIO 9
4	GND	Ground
5	P23	GPIO 23 / ADC input 1 / Micbias output reference
6	P24	GPIO 24 / ADC input 2
7	P25	GPIO 25 / ADC Input 8
8	P2	GPIO 2 / SWD debug data input / output port
9	P3	GPIO 3 / SWD debug clock port
10	P20	GPIO 20 / ADC input 9 / PGA positive input
11	P15	GPIO 15 / ADC input 4 / Micbias output

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12	P11	GPIO 11 / ADC input 0
13	P14	GPIO 14 / ADC input 3
14	GND	Ground
15	P17	GPIO17 / 32.768kHz crystal output
16	P16	GPIO16 / 32.768kHz crystal input
17	VDD	3.3V power supply
18	RST_N	Reset, active low
19	GND	Ground
20	RF	RF antenna
-	TM	Test mode enable

Note: 1. The bottom test point is the TM pin, which serves as Test Mode Enable. When TM is pulled high and RST_N is reset, the module enters download mode. If TM is high at the moment of power-on, the module enters programming mode; if TM is low at the moment of power-on, the module boots normally.

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6 Schematic

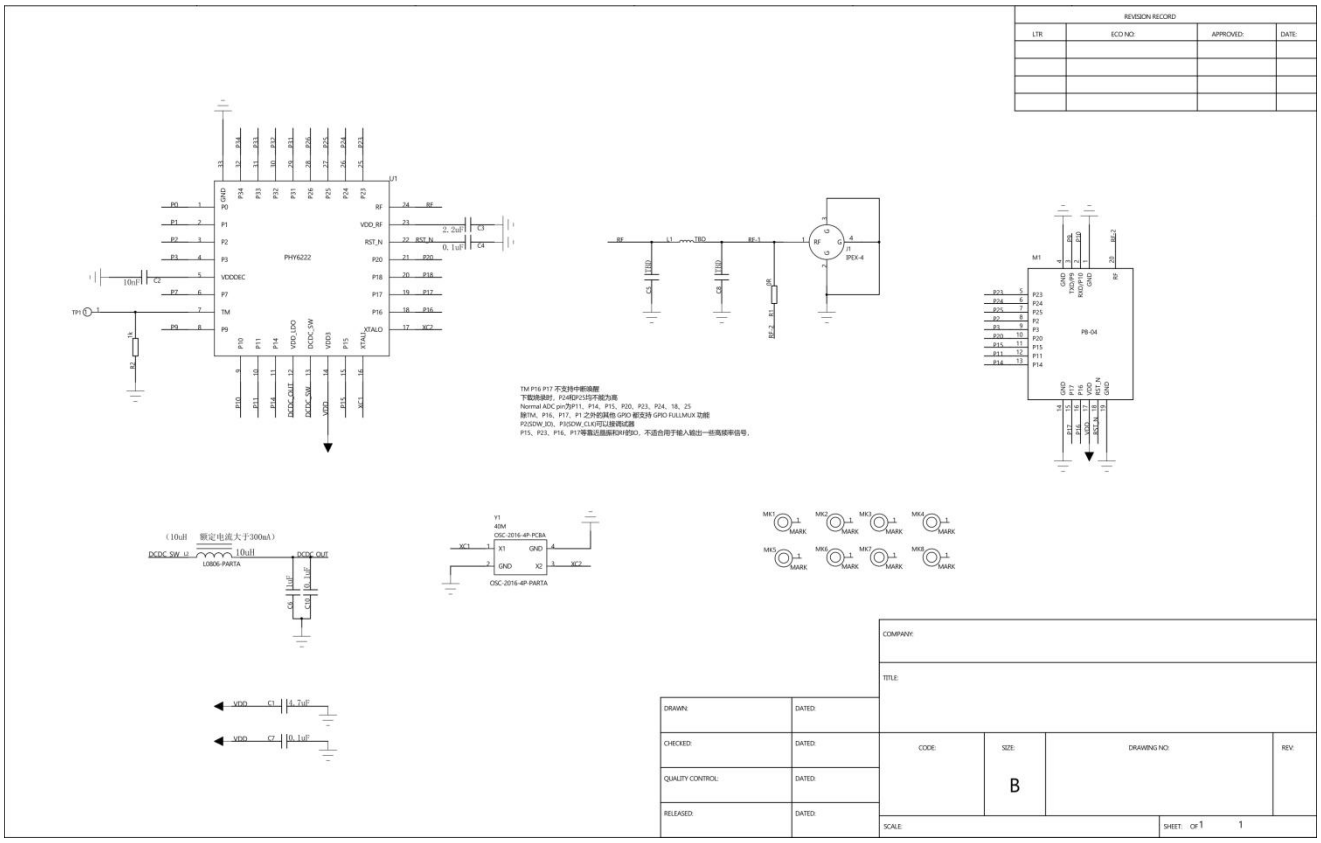

Figure 6 Schematic

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7 Design Guide

7.1 Application Reference Circuit

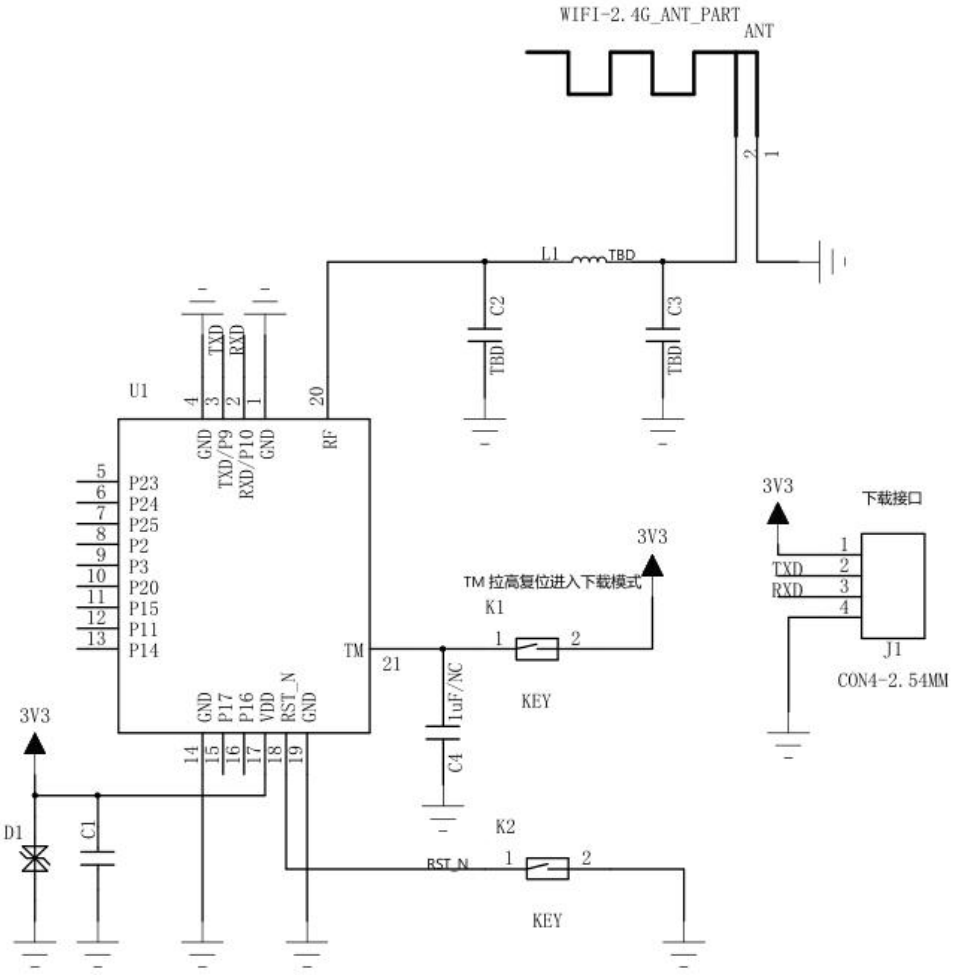

Figure 7 Application Reference Circuit

- The RF port on the mainboard shall reserve a π-type matching circuit.
- The bottom test point is the TM pin, which serves as Test Mode Enable. When TM is pulled high and RST_N is reset, the module enters download mode. If TM is high at the moment of power-on, the module enters programming mode; if TM is low at the moment of power-on, the module boots normally.
- TXD and RXD are the module download ports.
- VDD supply voltage: 1.8–3.6V. The external power supply output current is recommended to be above 100mA.

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7.2 Recommended PCB Footprint Dimensions

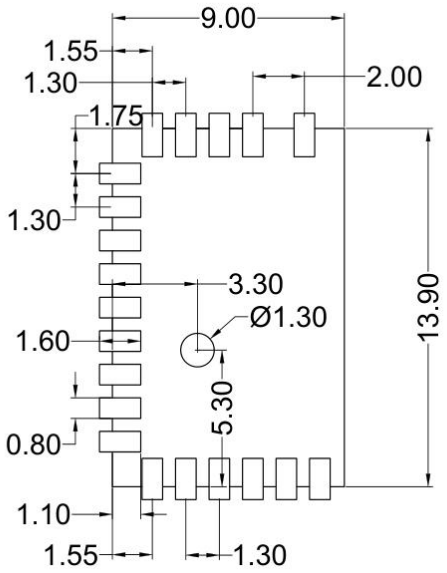

Figure 8 Recommended PCB Footprint Dimensions (Unit: mm)

7.3 Antenna Layout Requirements

- For the installation position on the mainboard, the following 2 options are recommended.

Option 1: Place the module at the mainboard edge, with the antenna area extending beyond it.

Option 2: Place the module at the mainboard edge, with a clearance cutout at the antenna position.

- To ensure optimal antenna performance, metal components should be kept away from the antenna area, and the antenna should be placed as far as possible from high-frequency devices.

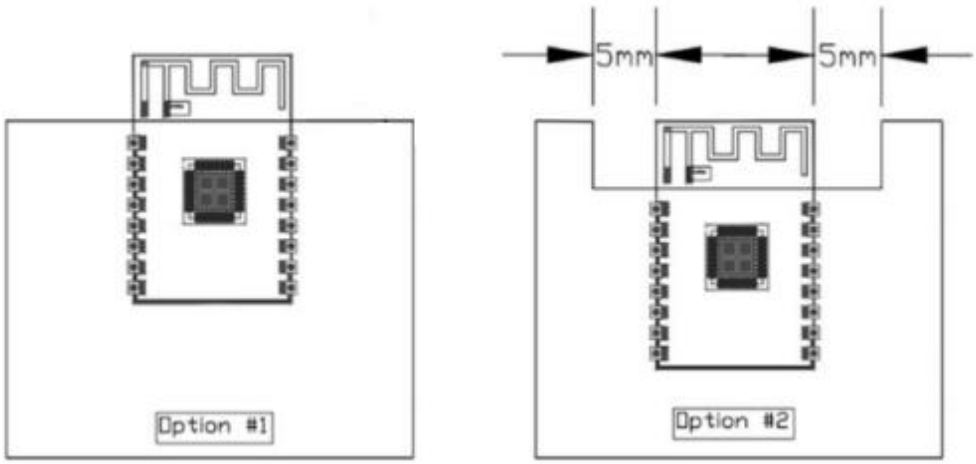

Figure 9 Antenna Layout Diagram

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7.4 Power Supply

- VDD is recommended as 3.3V, with a peak current above 100mA.
- An LDO is recommended for power supply; if using DC-DC, the ripple should be controlled within 30mV.
- For the DC-DC power supply circuit, it is recommended to reserve space for dynamic response capacitors to optimize output ripple under large load transients.
- It is recommended to add ESD protection devices to the power interface.

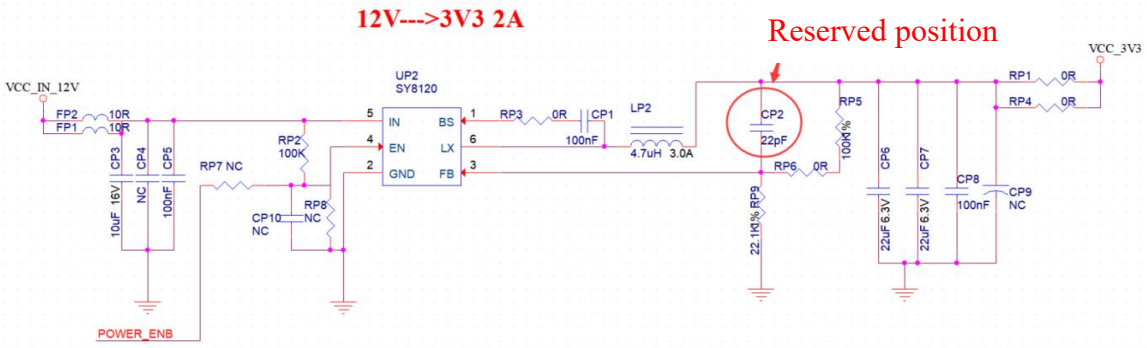

Figure 10 DC-DC Buck Circuit

7.5 GPIO

- Some I/O pins are exposed on the module periphery. To use these I/O pins, it is recommended to connect a 10-100Ω resistor in series with each I/O pin. This helps suppress overshoot, stabilize signal levels, and benefits both EMI and ESD protection.
- The pull-up or pull-down configuration for special I/O pins must follow the guidelines in the specification, as it affects the module's boot configuration.
- The module's I/O pins operate at 3.3V. If the I/O voltage level of the main controller and the module do not match, a level-shifting circuit must be added.
- If an I/O pin is directly connected to a peripheral interface or pin headers, it is recommended to reserve space for an ESD protection device near the connector on the I/O trace.

Figure 11 Level-shifting Circuit

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8 Storage Conditions

Products sealed in moisture barrier bags should be stored in a non-condensing atmosphere at < 40℃ and < 90% RH.

The moisture sensitivity level (MSL) of the module is level 3.

The module must be used within 168 hours after vacuum bag removal under conditions of 25±5℃ and 60% RH. Otherwise, the module requires baking before being returned to production.

9 Reflow Soldering Profile

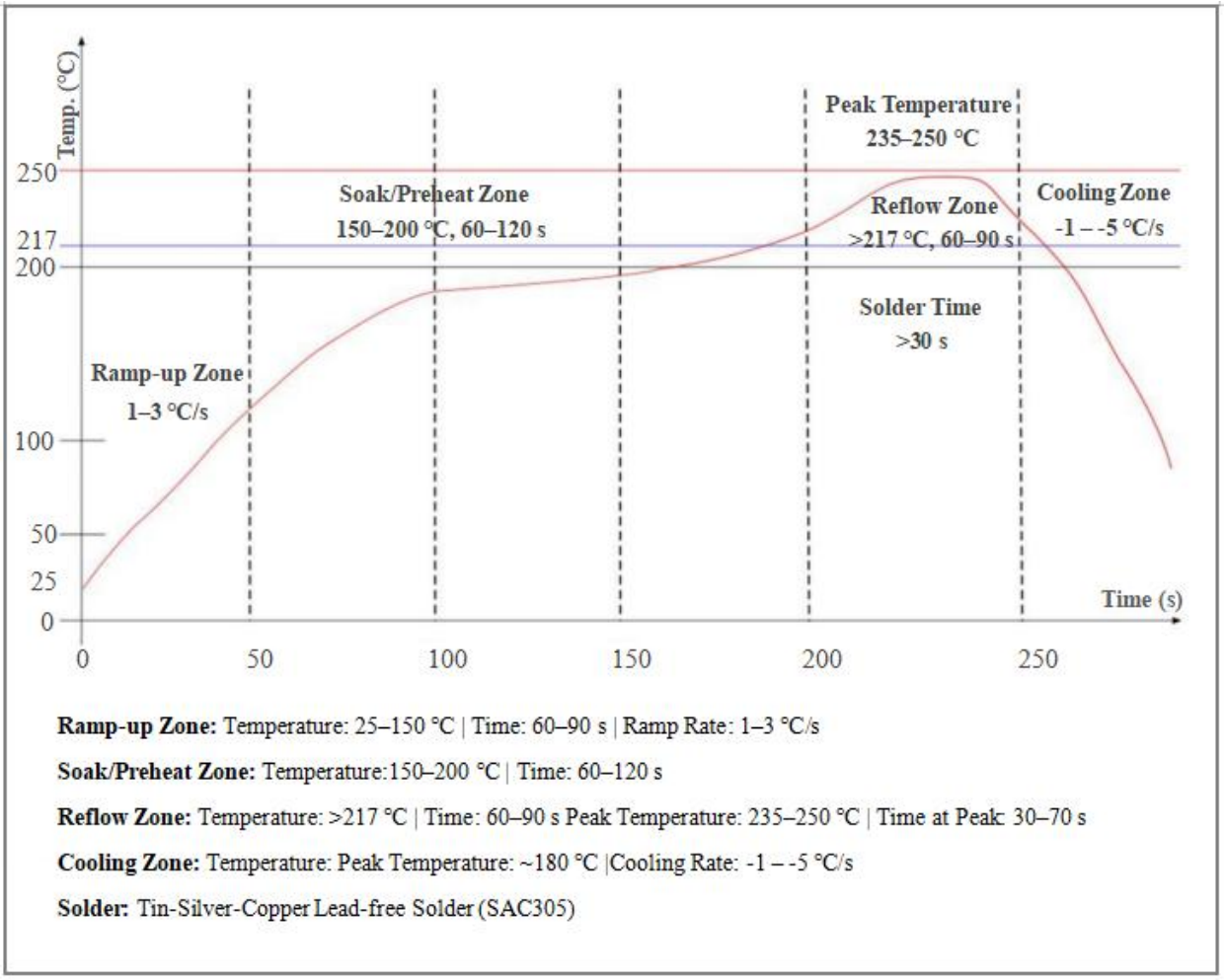

Figure 12 Reflow Soldering Profile

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10 Packaging Information

The PB-04 module is packaged in tape-and-reel, 1200 pcs/reel.

Figure 13 Tape and Reel Packaging Diagram

11 Contact Information

Official Website | Official Forum | Development DOCS | LinkedIn

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Oversea Business Cooperation: overseas@aithinker.com

Company Address: Room 403–405, 408–410, Building C, Huafeng Smart Innovation Port, Gushu, Xixiang, Bao'an District, Shenzhen, Guangdong, China

Contact Hotline: 0755-29162996

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