PB-03 Specification

Version V1.0.0

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Document resume

Version	Date	Develop/revise content	Edition	Approve
V1.0.0	2021.11.23	First Edition	Nannan Yuan	Ning Guan

Content

1. Product Overview

PB-03 is a BLE module developed by Shenzhen Ai-Thinker Technology Co.,Ltd.The core processor chip PHY6252(SSOP24)of this module is a BLE SoC with high integration and low power consumption,which is specially designed for various applications such as IoT,mobile devices,wearable electronic devices and smart homes.

PHY6252(SSOP24)chip has industry-leading low power consumption performance and RF performance,it supports BLE 5.2.The chip built in 64 KB SRAM,256KB flash,96 KB ROM,256bit efuse.The chip supports a variety of low-power working states and can meet the power consumption requirements of various application scenarios.RF output power can be adjusted to achieve the best balance among communication distance,communication rate and power consumption.

PB-03 module provide rich peripheral interfaces,including UART,PWM,ADC,I2C,SPI,PDM,DMA and up to 19 IOs.

PB-03 module has many unique hardware security mechanisms.Hardware encryption accelerator supports AES algorithm.

PB-03 module supports BLE with low power consumption:BLE 5.2 and BLE mesh.Bluetooth rate support:125Kbps,500Kbps,1Mbps,2Mbps.Support broadcast expansion,multi-broadcast,channel selection.
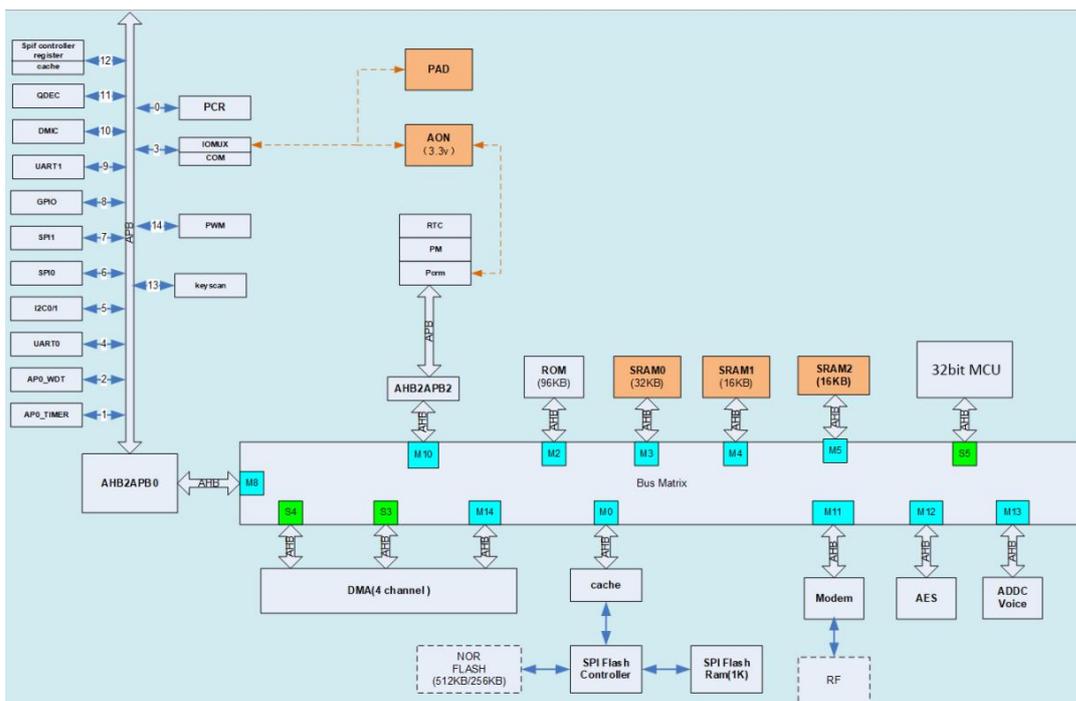

Figure 1 Main chip architecture diagram

1.1. Characteristic

■ Support BLE5.2,rate support:125Kbps,500Kbps,1Mbps,2Mbps

■ Own 64 KB SRAM，256KB flash,96 KB ROM，256bit efuse

■ Support UART/GPIO/ADC/PWM/I2C/SPI/PDM/DMA interface

■ Adopt SMD-52 package

■ Support multiple sleep modes,deep sleep current is less than 1uA

■ Support for serial local upgrade and remote Firmware upgrade(FOTA)

■ Universal AT instructions can be used easy and quickly

■ Support for secondary development,with an integrated Windows development environment

2. Main parameters

Table 1 Description of the main parameters

Model	PB-03
Package	SMD-52
Size	16.6*13.2*2.8(±0.2)mm
Antenna	On-board antenna
Frequency	2400~2483.5MHz
Operating temperature	-40℃~85℃
Storage temperature	-40℃~125℃,<90%RH
Power supply	Voltage 2.7V~3.6V,Current>200mA
Interface	UART/GPIO/ADC/PWM/I2C/I2S/SPI/PDM/DMA
IO	19
UART rate	Default 115200 bps
Bluetooth	BLE 5.2
Security	AES-128
SPI Flash	256KB

2.1. Static electricity requirements

PB-03 is an electrostatic sensitive device,and special precautions must be taken when handling it.

Figure 2 ESD anti-static diagram

2.2. Electrical characteristics

Table 2 Electrical characteristics table

Parameters		Conditions	Min.	Typical value	Max.	Unit
Power supply voltage		VDD	2.7	3.3	3.6	V
I/O	V_{IL}/V_{IH}	-	-0.3/0.75VDD	-	0.25VDD/VDD+0.3	V
	V_{OL}/V_{OH}	-	N/0.8VIO	-	0.1VIO/N	V
	I_{MAX}	-	-	-	12	mA

2.3. BLE RF performance

Table 3 BLE RF performance table

Description	Typical values			Unit
Operating frequency	2400-2483.5			MHz
Output power				
Mode	Min.	typical value	Max.	Unit
BLE 2Mbps	-20	8	10	dBm
BLE 1Mbps	-20	8	10	dBm
BLE 500Kbps	-20	8	10	dBm
BLE 125kbps	-20	8	10	dBm
Receiving sensitivity				
Mode	Min.	typical value	Max.	Unit

BLE 2Mbps	-	-93	-	dBm
BLE 1Mbps	-	-96	-	dBm
BLE 500Kbps	-	-97	-	dBm
BLE 125Kbps	-	-102	-	dBm

2.4. Power consumption

The following power consumption data are based on a 3.3V power supply,ambient temperature of 25°C and measured using an internal regulator.

- All measurements were completed without the SAW filter at the antenna interface.
- All emission data were measured based on the TX_Burst_Test&RX_Burst_Test mode

Table 4 Power consumption table

Mode	Min.	Average value	Max.	Unit
TX_Burst_Test Power output 8dBm	-	11.5	-	mA
TX_Burst_Test Power output 5dBm	-	9	-	mA
TX_Burst_Test Power output 0dBm	-	8	-	mA
RX_Burst_Test	-	9.4	-	mA
Deep Sleep(With broadcast,1 second interval)	-	50.58	-	uA
Deep Sleep(With broadcast,2 seconds interval)	-	28.25	-	uA
Deep Sleep(Without broadcast)	-	7.2	-	uA
Power Off	-	0.57	-	uA

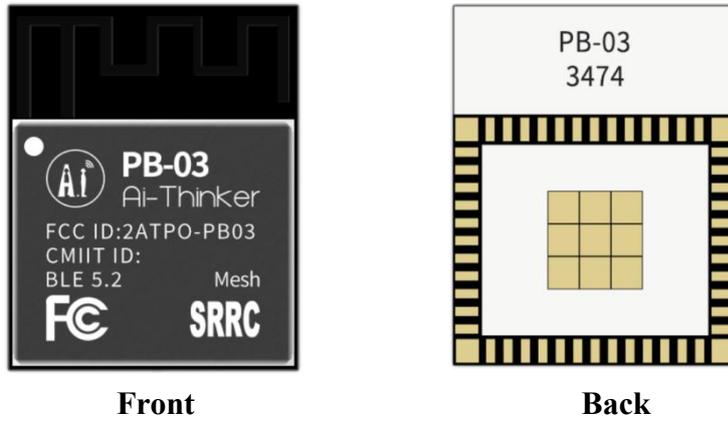## 3. Appearance dimensions

Front   Back

Figure 3 Appearance diagram pictures is for reference only,subject to physical objects)
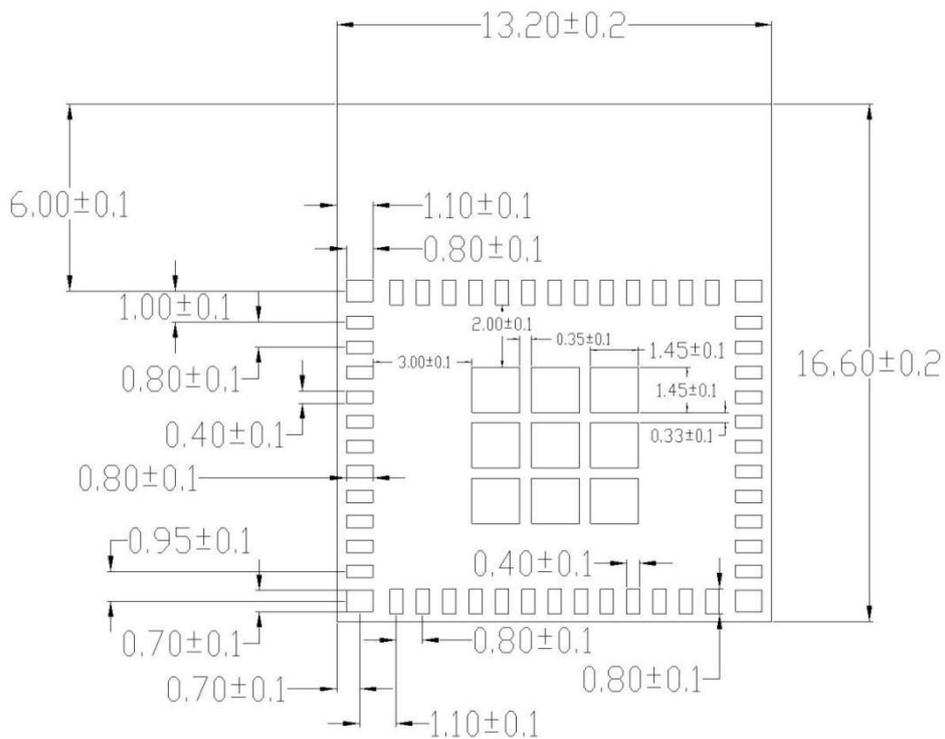

Figure 4 Module size diagram

4. Pin definition

PB-03has a total of 61 interfaces.As shown in below pin diagram,the pin function definition table is the interface definition.

Figure 5 Schematic diagram of module pins(top view)

Table 6 Pin function definition table

| No.	Name	Function
1,2,11,14, 36-48,50-53	GND	Ground(Power negative electrode)
3	3V3	Power supply positive electrode
4,7,9,10,15,17,20,21,25,34,35	NC	Empty
5	P24	GPIO24/ADC input 2
6	P7	GPIO7
8	P31	GPIO31
12	P16	GPIO16/32.768KHz crystal input
13	P17	GPIO17/32.768KHz crystal output
16	P32	GPIO32
18	P11	GPIO11/ADC input 0
19	P18	GPIO18/ADC input 7/PGA negative input
22	P2	GPIO2/SWD debug data inout
23	P3	GPIO3/SWD debug clock
24	P14	GPIO14/ADC input 3
26	P0	GPIO0
27	P34	GPIO34
28	P33	GPIO33
29	P23	GPIO23/ADC input 1/micbias reference
30	P10	RXD/GPIO10
31	P9	TXD/GPIO9
32	P20	GPIO20/ADC input 9/PGA positive input
33	P15	GPIO15/ADC input 4/micbias output

5. Schematic
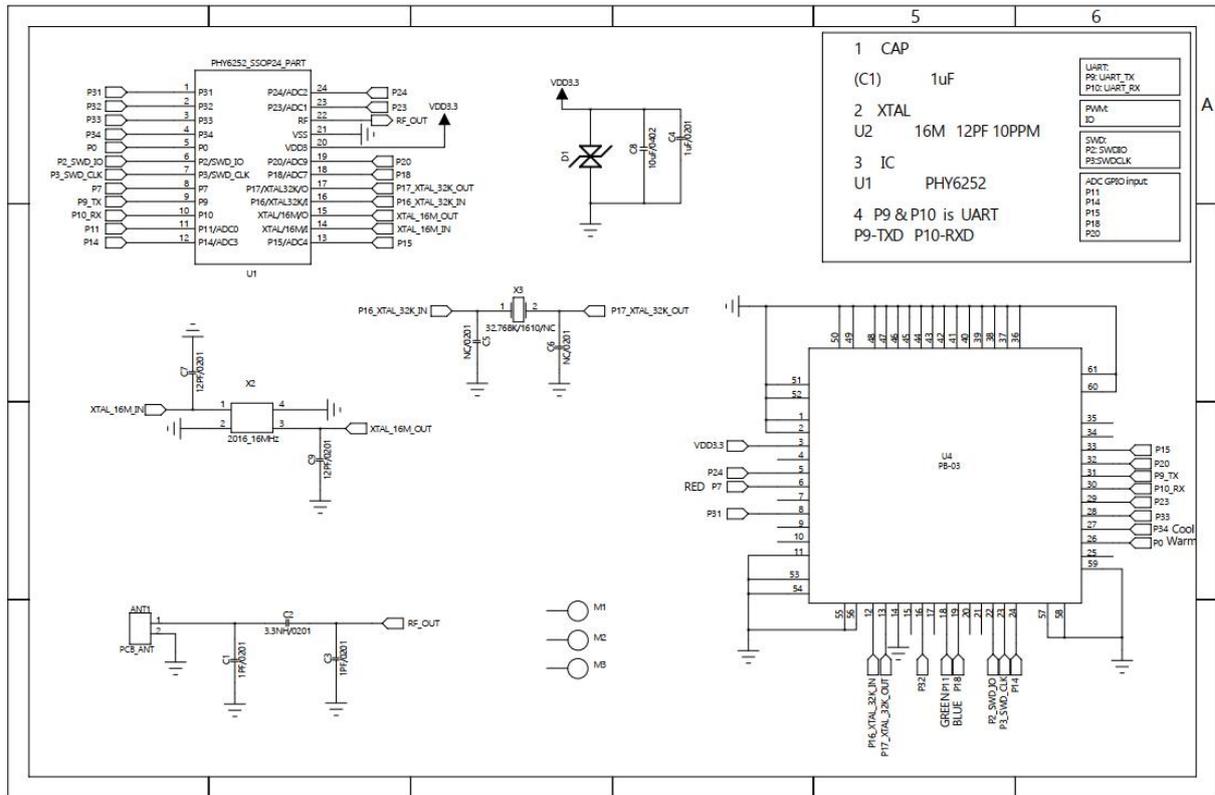
Figure 6 Module schematic

6. Antenna parameters

6.1. Test conditions for the antenna

Figure 7 Antenna test conditions
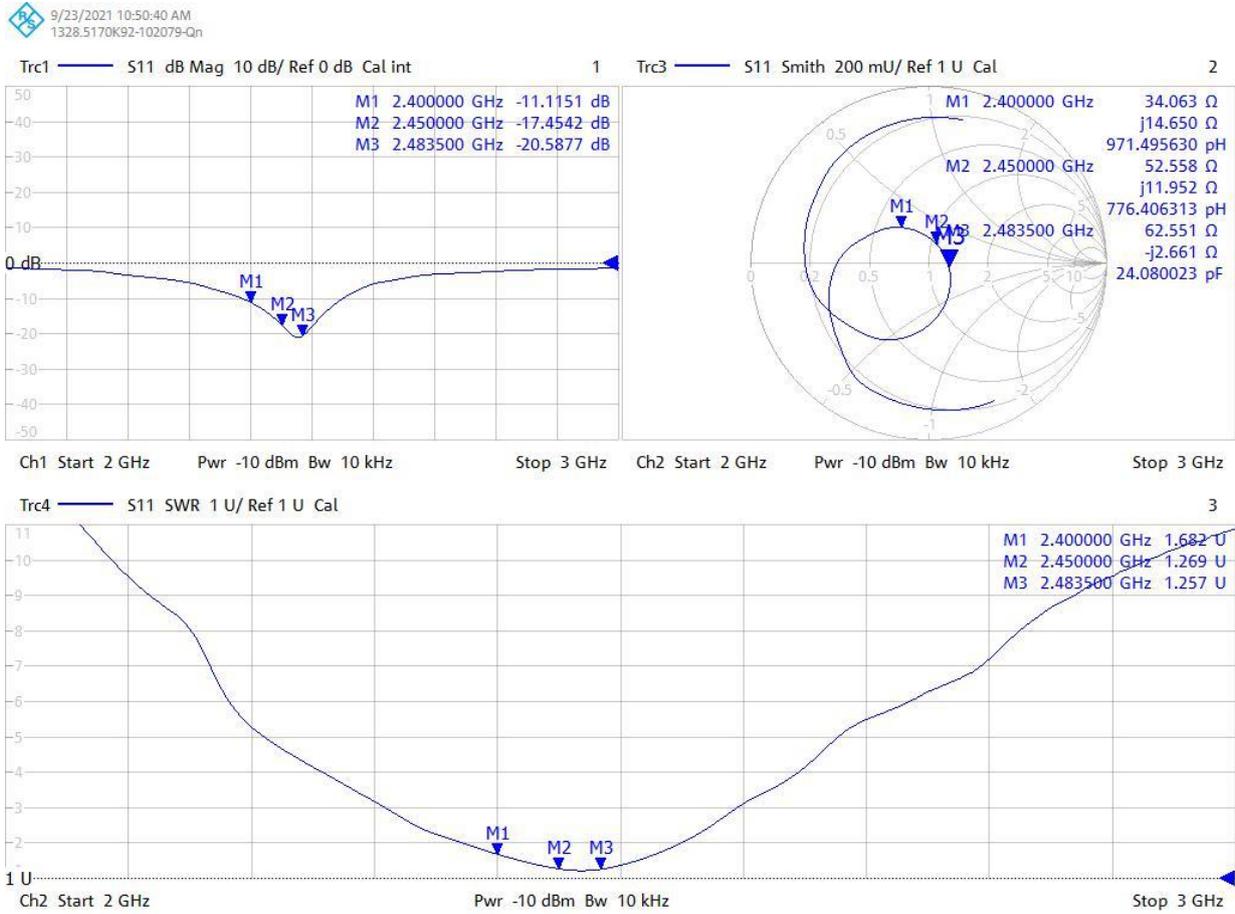
6.2. Antenna S parameter

Figure 8 Antenna S parameters

6.3. Antenna Gain and Efficiency

Table 7 Antenna Gain 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
Gain(dBi)	1.89	1.98	1.86	1.95	1.98	2.04	2.06	1.98	1.83	1.75	1.63
Efficiency(%)	60.23	61.27	59.41	60.36	59.85	59.53	59.10	57.85	56.20	55.85	54.62

6.4. Antenna field type diagram
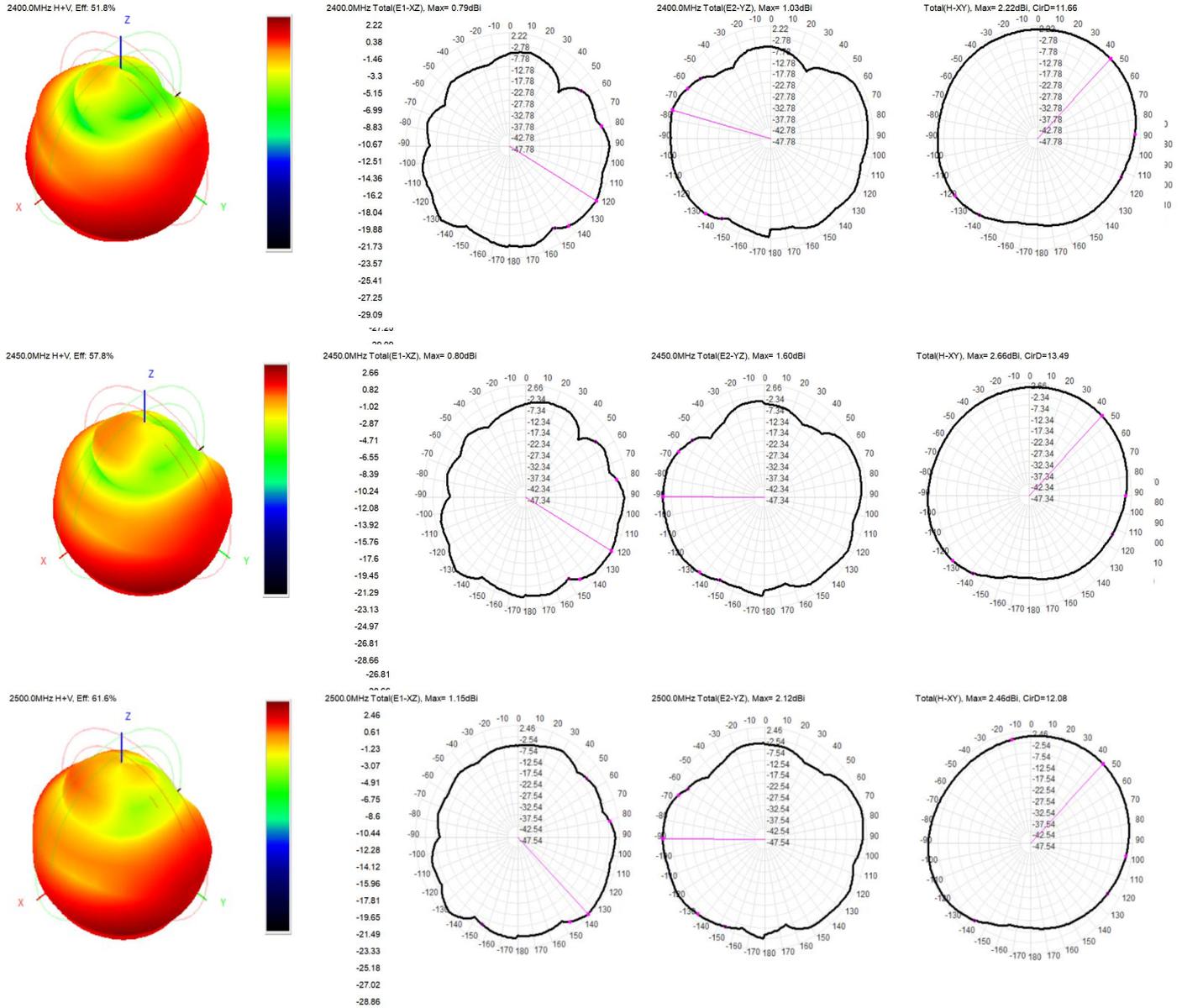
Figure 9 Antenna field type diagram

7. Design guidance

7.1. Module application circuit

(>=200mA,suggest use DC-DC or LDO independent power supply)
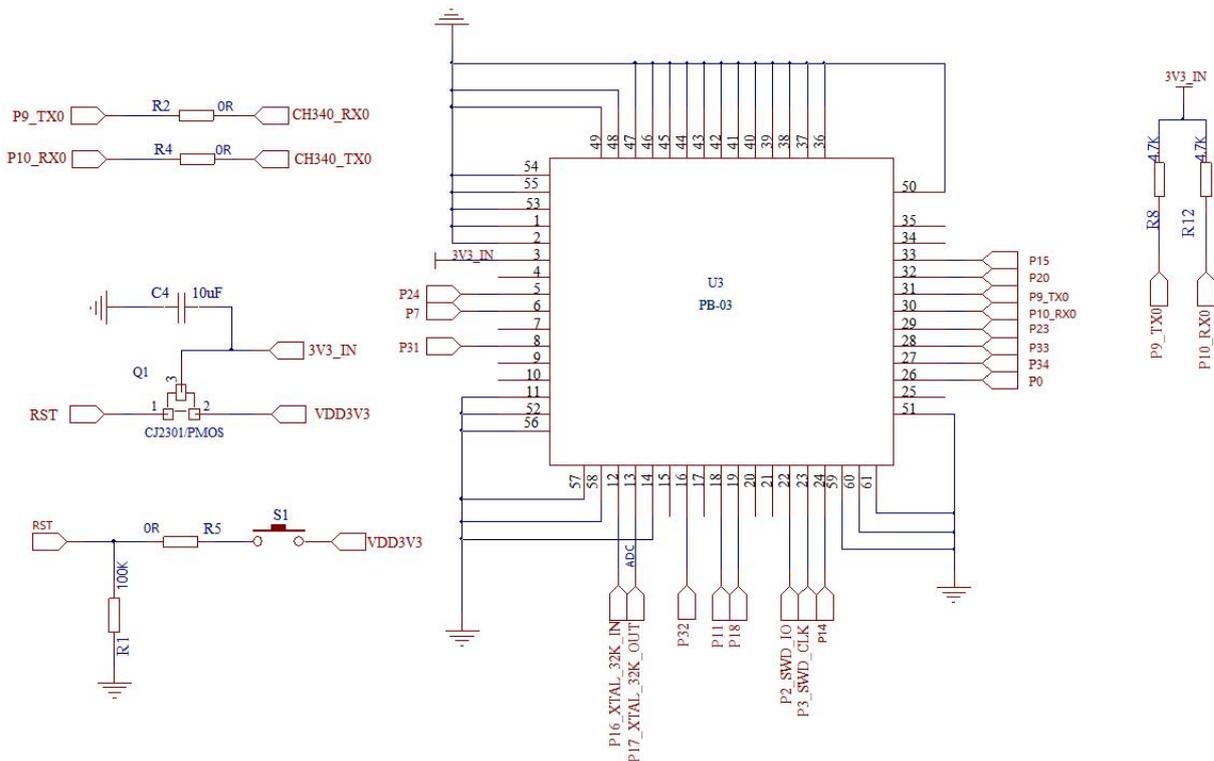
Figure 10 Application circuit diagram

Note:

■ Because the PB-03M does not have the reset pin,we can achieve the reduction by power off,we can restore the module with a PMOS to achieve the reduction of power off.

■ TX&RX serial port line,2 resistors are reserved,in series in the line.The 3.3V voltage used to prevent the serial port affects the reset of the module.

7.2. Antenna layout requirements

■ The installation position on the motherboard suggests the following 2 ways:

Scheme 1:Put the module on the edge of the motherboard,and the antenna area out of the motherboard edge

Scheme 2:Put the module on the edge of the motherboard,and empty an area along the antenna position.

■ To meet the performance of the on-board antenna,metal parts are not placed around the antenna,away from the high-frequency device
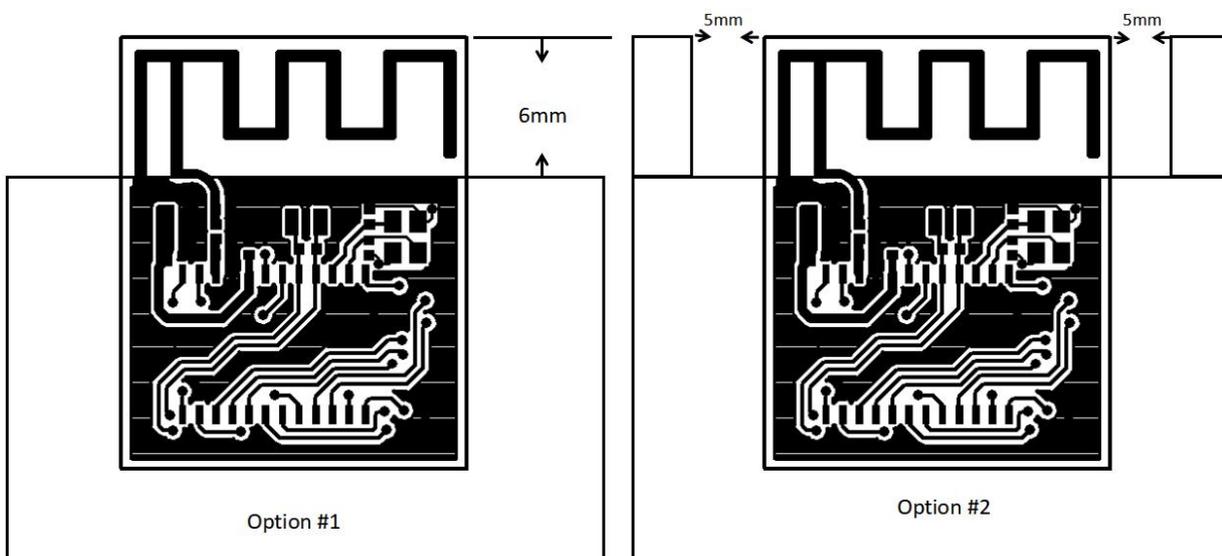

Figure 11 Schematic diagram of the antenna layout

7.3. Power supply

■ Recommended 3.3V voltage,peak current over 200mA.

■ Power supply is recommend to use LDO;If the DC-DC is used,the ripple is recommended to be controlled within 30mV

■ The DC-DC power supply circuit proposes to reserve the dynamic response capacitance to optimize the output ripple with large load changes.

■ 3.3V power interface it is recommended to add ESD devices.
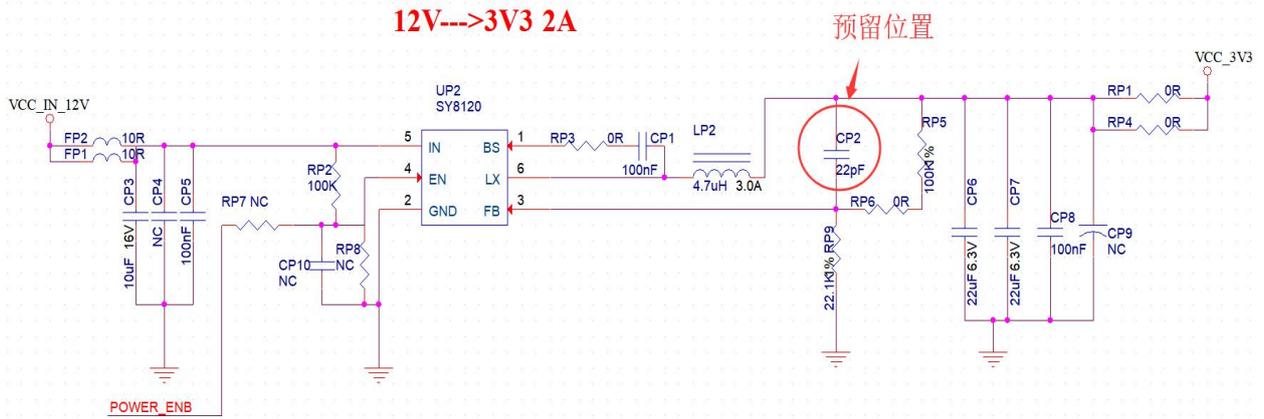
Figure 12 The DC-D C antihypertensive circuit diagram

7.4. GPIO

■ Some IO ports are lead outside the module,if using,a proposed resistance of 10-100 ohms on the IO port.This suppresses the overshoot and enables smoother levels on both sides,helping for both EMI and ESD.

■ The up and down of the special IO port should refer to the use instructions of the specification,which will affect the start-up configuration of the module.

■ The IO port of the module is 3.3V,if the main control does not match the IO port level of the module,the level conversion circuit should be increased.

■ If the IO port is directly connected to the peripheral interface,or terminals such as pin header,it is recommended to reserve ESD devices at the IO port line near the terminal.
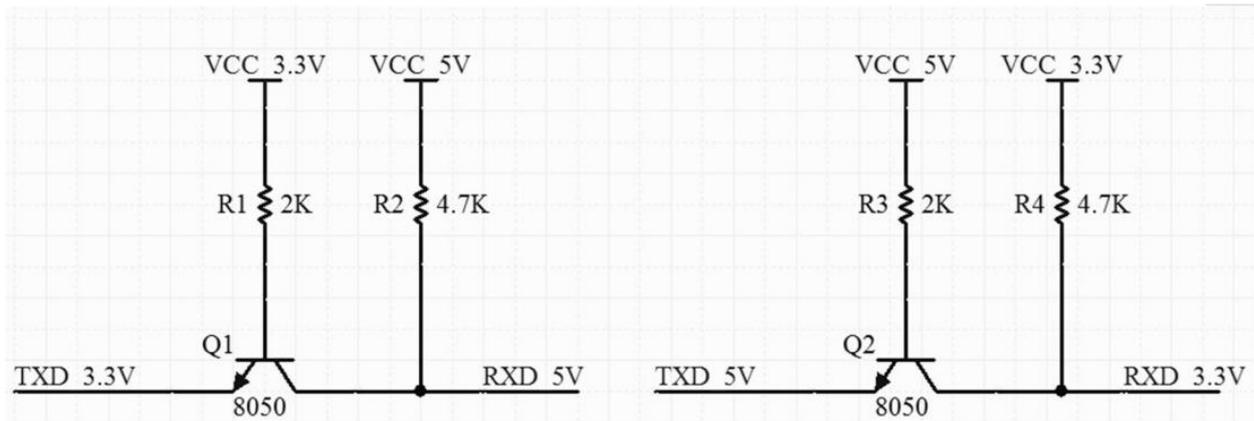

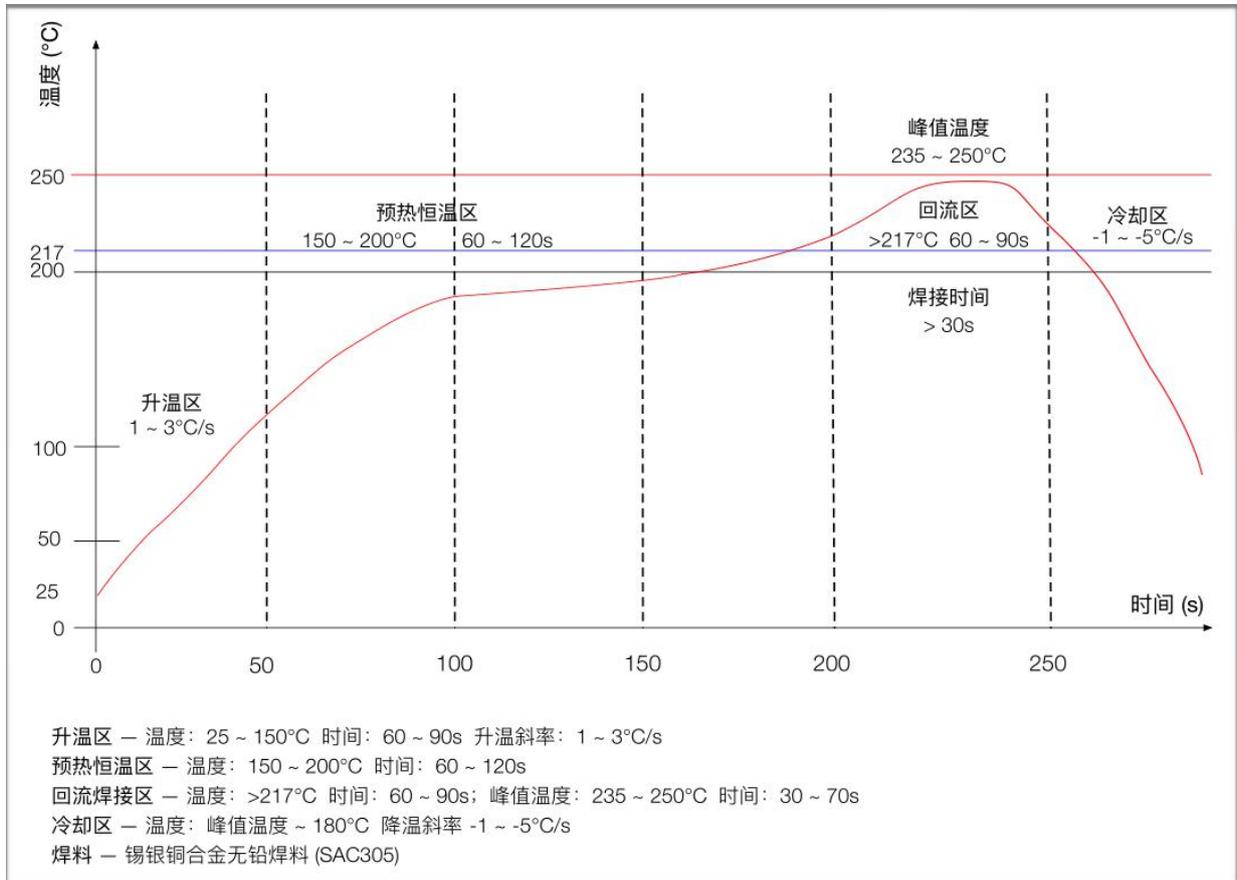**Figure 13 Level convert circuit**

8. Flow welding curve diagram

Figure 14 Flow welding diagram

9. Product related models

Table 8 Product related model list

Model	Power Supply	Package	Size	Antenna
PB-03F	2.7V~3.6V，I>200mA	SMD-22	24.0*16.0*3.1(±0.2)mm	On-board PCB
PB-03M	2.7V~3.6V，I>200mA	DIP-18 Gold finger plugin	18.0*18.0*2.8(±0.2)mm	On-board PCB
PB-03	2.7V~3.6V，I>200mA	SMD-61	16.6*13.2*2.8(±0.2)mm	On-board PCB
NodeMCU-PB-03F-Kit	5V, I>200mA	DIP-30	49.3*25.4*12.9(±0.2)mm	On-board PCB
NodeMCU-PB-03M-Kit	5V, I>200mA	DIP-20	32.8*28.6*18.3(±0.2)mm	On-board PCB
NodeMCU-PB-03-Kit	5V, I>200mA	DIP-30	49.3*25.4*12.9(±0.2)mm	On-board PCB
Product related information:https://docs.ai-thinker.com				

10. Product packaging information

PB-03 module was packaged in a tape,900pcs/reel.As shown in the below image:

Figure 15 Package and packing diagram

11. Contact us

Ai-Thinker offical website   Office forum   Develop DOCS

LinkedIn   Tmall shop   Taobao shop   Alibaba shop

Technic support email：support@aithinker.com

Domestic business cooperation：sales@aithinker.com

Overseas business cooperation：overseas@aithinker.com

Company Address：Room 403,408-410, Block C, Huafeng Smart Innovation Port, Gushu 2nd Road, Xixiang, Baoan District, Shenzhen.

Tel：+86-0755-29162996

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