



Ra-08 Specification

Version V1.1.0

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1. Product Overview

Ra-08 is an LoRa module designed and developed by Shenzhen Ai-Thinker Technology Co., Ltd. The module is used for ultra-long distance spread spectrum communications. Its chip ASR6601 is a universal LPWAN wireless communication SOC, integrated with RF transceivers, modems, and a 32-bit RISC MCU. The MCU adopts an ARM core with a working frequency of 48MHz. The Ra-08 module supports LoRa modulation and traditional (G)FSK modulation under the LPWAN. At the same time, the transmitter also supports BPSK modulation and (G)MSK modulation, receiver support (G)MSK modulation.

The Ra-08 module provides long-range and ultra-low power communications for LPWAN applications, which can be widely used in smart meters, supply chain and logistics, home building automation, security system, remote irrigation system and other scenes.

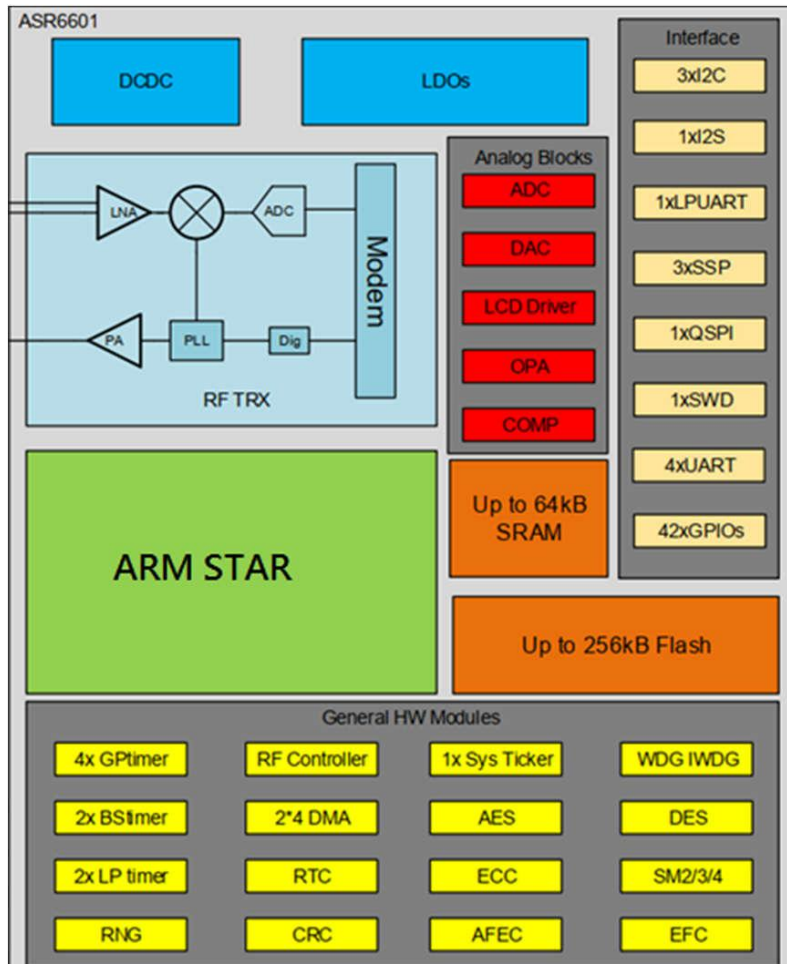


Figure 1 Main chip architecture diagram

1.1. Characteristic

- Adopt SMD-18 package
- Support frequency: 410MHz-525MHz
- Working voltage is 3.3V, theoretical maximum transmit power: +22dBm
- High sensitivity: -138dBm @125Kz SF12
- Support spread spectrum factor: SF5/SF6/SF7/SF8/SF9/SF10/SF11/SF12
- Embedded memory, 128KB FLASH,16KB SRAM
- Support LoRa/(G)FSK/BPSK/(G)MSK modulation
- Antenna interface is compatible with stamp holes / circular holes and IPEX, etc., support more option selection
- Support multiple sleep modes: depth sleep current is low to 0.9uA

2. Main parameters

Table 1 Description of the main parameters

Model	Ra-08
Package	SMD-18
Size	16.0*16.0*3.2(±0.2)mm
Antenna	half-hole pad / through-hole pad / IPEX
Frequency	410-525MHz
Operating temperature	-40 °C ~ 85 °C
Storage temperature	-40 °C ~ 125 °C, < 90%RH
Power supply	Voltage 2.7V ~ 3.6V, Current >500mA
Interface	UART/GPIO/ADC/DAC/I2C/I2S/SPI/PWM
IO	IO2,IO4,IO5,IO8,IO9,IO11,IO14,IO15
UART rate	Support 110 ~ 4608000 bps, Default 115200 bps
Crystal frequency	32MHz
SPI Flash	128KB
Transfer Protocol	LoRaWAN, LinkWAN

2.1. Static electricity requirements

Ra-08 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

Parameter	Name	Min.	Typical value	Max.	Unit	Remark	
Operating temperature	TOPR	-40	25	85	°C		
Supply voltage	VDD	2.7	3.3	3.6	V	≥3.3V can guarantee output power	
Power consumption	Sleep mode	Power consumption 1	-	0.9	-	uA	0.9uA@Without RF/MCU Retention, Without RTC
		Power consumption 2	-	1.3	-	uA	1.3uA@With RF/MCU Retention and RTC
	Operation mode		-	3.83	-	mA	Power on
	Full load mode TX:21dBm		-	115	-	mA	DC-DC mode
	Receive mode RX:SF10		-	9.5	-	mA	DC-DC mode

2.3. Digital port characteristics

Table 3 Digital port

port	name	Min.	Typical value	Max.	Unit
IO level	VIO	2.7	3.3	3.6	V
Enter logic level low	VIL	-	-	0.2	V
Enter logic level high	VIH	0.8	-	-	V
Output logic level low	VOL	-	-	0.1	V
Output logic level high	VOH	0.9	-	-	V

2.4. RF parameters

Table 4 RF parameters

Output Power					
Mode	Frequency band	Min.	Typical value	Max.	Unit
Transmit power	433MHz	-	21	-	dBm
Transmit power	470MHz	-	21	-	dBm
Transmit power	490MHz	-	21	-	dBm
Transmit power	510MHz	-	21	-	dBm
Receive sensitivity modulation bandwidth 125kHz					
Mode		Min.	Typical value	Max.	Unit
SF7		-	-123	-	dBm
SF8		-	-126	-	dBm
SF9		-	-128	-	dBm
SF10		-	-131	-	dBm
SF11		-	-135	-	dBm
SF12		-	-138	-	dBm

3. Appearance dimensions

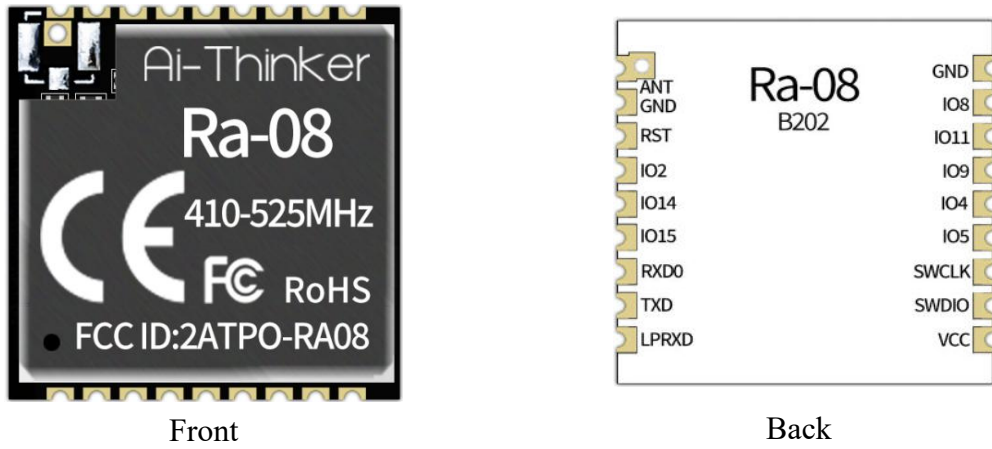


Figure 3 Appearance diagram pictures (for reference only)

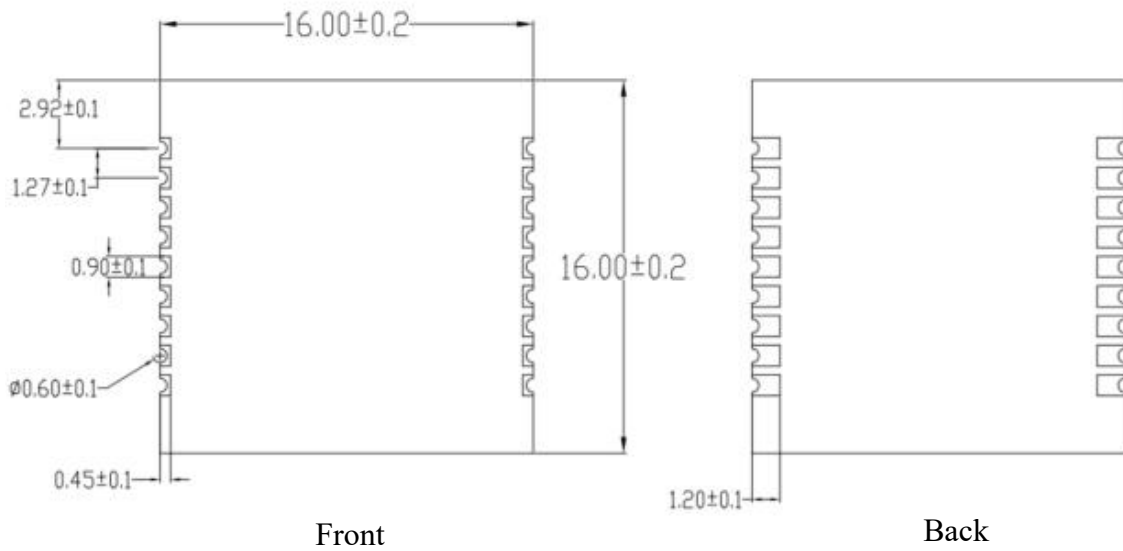


Figure 4 Module size diagram

4. Pin definition

Ra-08 has a total of 18 interfaces. As shown in below pin diagram, the pin function definition table is the interface definition.

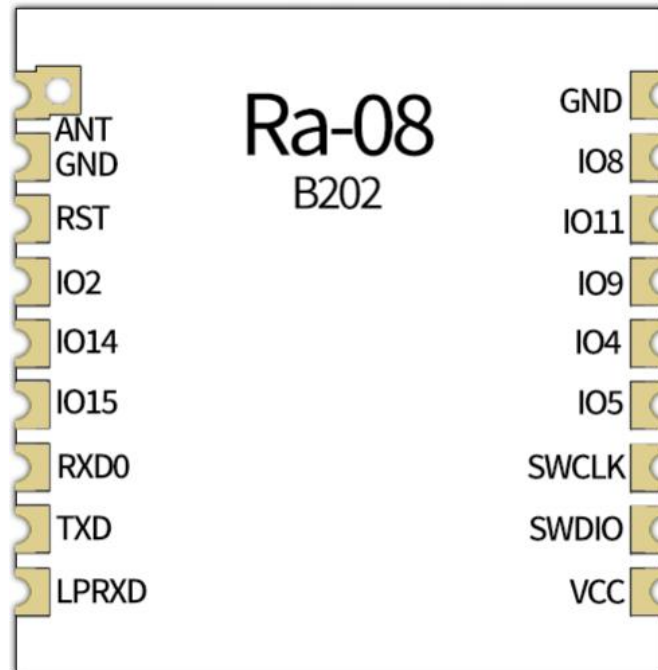


Figure 5 Schematic diagram of module pins

Table 6 Pin function definition table

No.	Name	Function
1管17	GND	Ground
2	IO8	GPIO8/ADC_IN1
3	IO11	GPIO11/ADC_IN0
4	IO9	GPIO9/DAC_OUT
5	IO4	GPIO4/SSP1_CLK
6	IO5	GPIO5/SSP1_NSS
7	SWCLK	GPIO7/SWD_CLK
8	SWDIO	GPIO6/SWD_DATA
9	VCC	3.3V power supply, recommended supply current \geq 500mA
10	LPRXD	GPIO60/LPUART-RX, Communication serial port
11	TXD	GPIO17/UART TX
12	RXD0	GPIO16/UART RX, Burning port
13	IO15	GPIO15/I2C_SDA
14	IO14	GPIO14/I2C_SCL
15	IO2	GPIO2/BOOT
16	RST	RSTN_IN external reset, low power is effective
18	ANT	Antenna interface

Table 7 Module Start Mode Description

System start mode			
Pin	Default	SPI startup mode	Download start mode
IO2	drop down	0	1

Note: Some pins have been pulled inside, please refer to the schematic.

5. Schematic

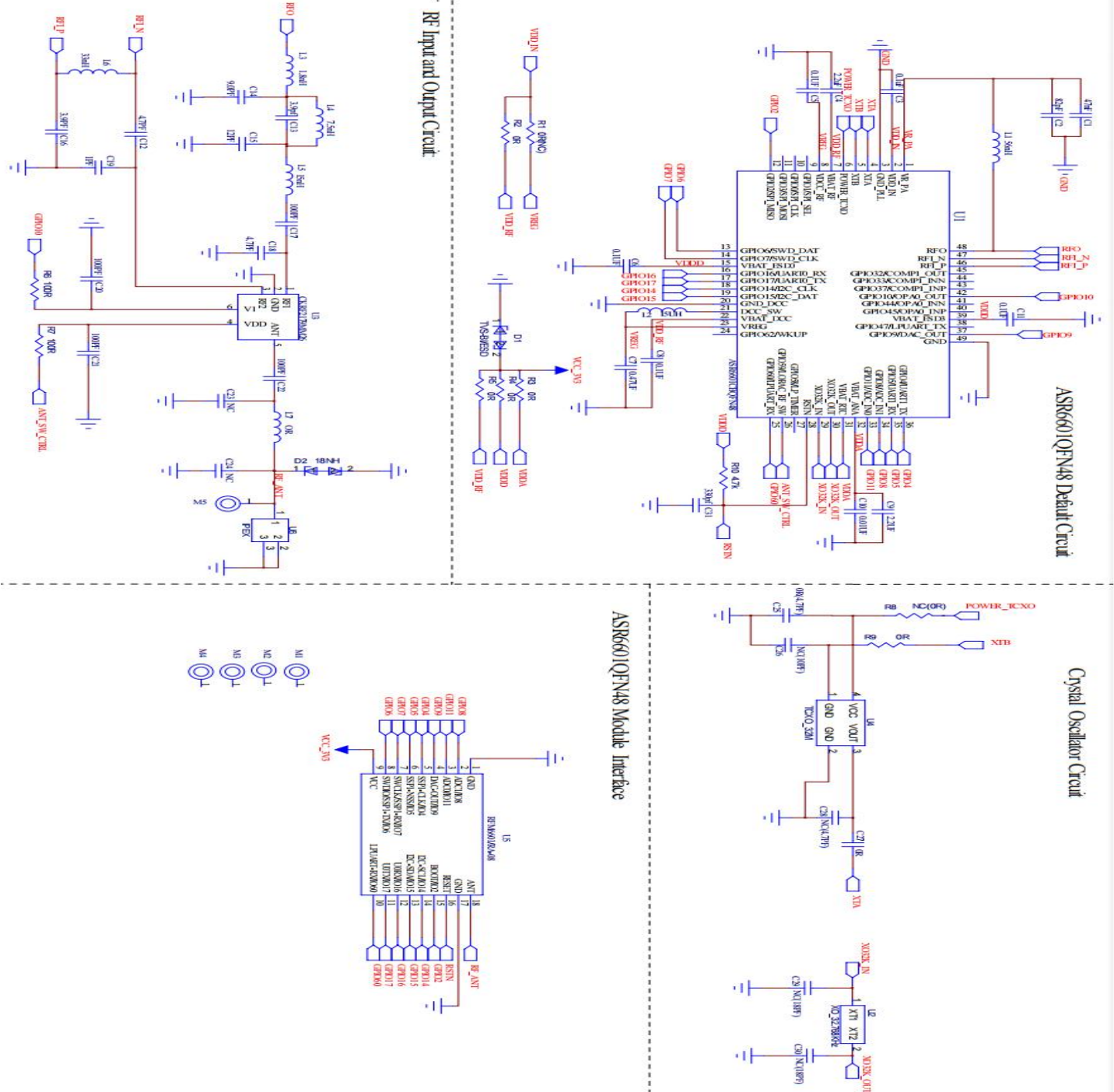
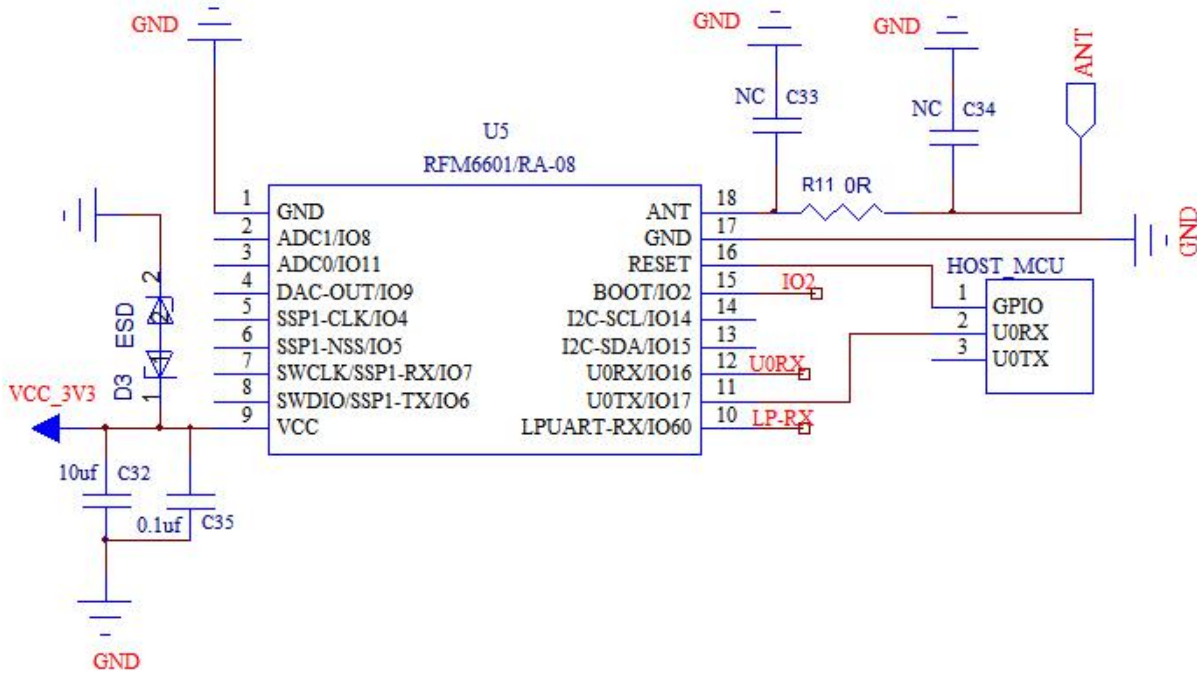


Figure 6 Module Schematic

6. Design Guide

6.1. Module Application Guidance Circuit



It is recommended to use DC-DC or LDO to use independently, current is greater than 500mA

Figure 7 application circuit diagram

Notice:

- IO2 is in normal operating mode for starting control feet, low levels, and at high levels are in a burning firmware mode. The internal default is low.
- U0RX is a burning serial port, LPRXD is a communication serial port, and select it according to the requirements.

6.2. Antenna Interface

- The Ra-08 module requires an external antenna. The antenna has three wiring methods, compatible with a half-hole pad, a through hole pad, and an IPEX. A standard IPEX seat interface is left on the module. The size map of the IPEX seat is as follows:

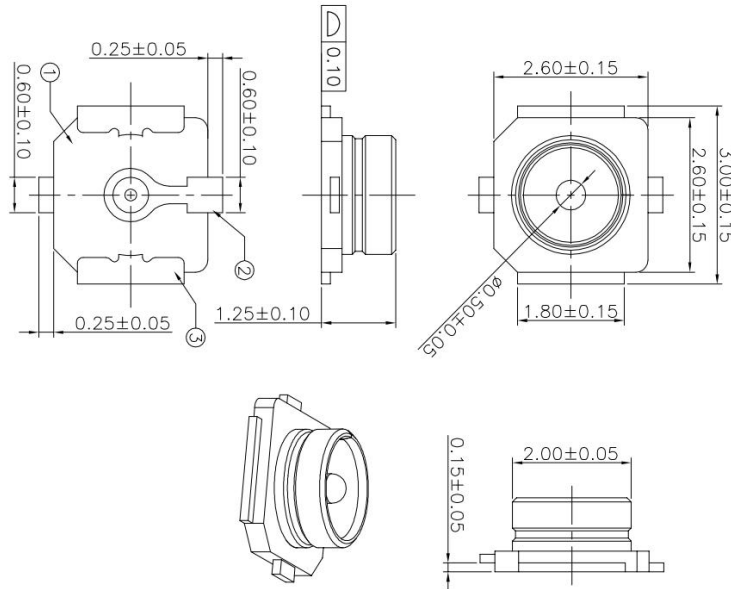


Figure 8 board end IPEX seat size diagram

6.3. Power supply

- Recommend 3.3V voltage, current peak $\geq 500\text{mA}$
- It is recommended to use LDO power; if the recommended ripple is within 30mV using DC-DC
- The DC-DC power supply circuit recommends that the position of the dynamic response capacitor can be optimized when the load changes, and the output ripple is optimized.
- 3.3V power interface suggestion increase ESD devices

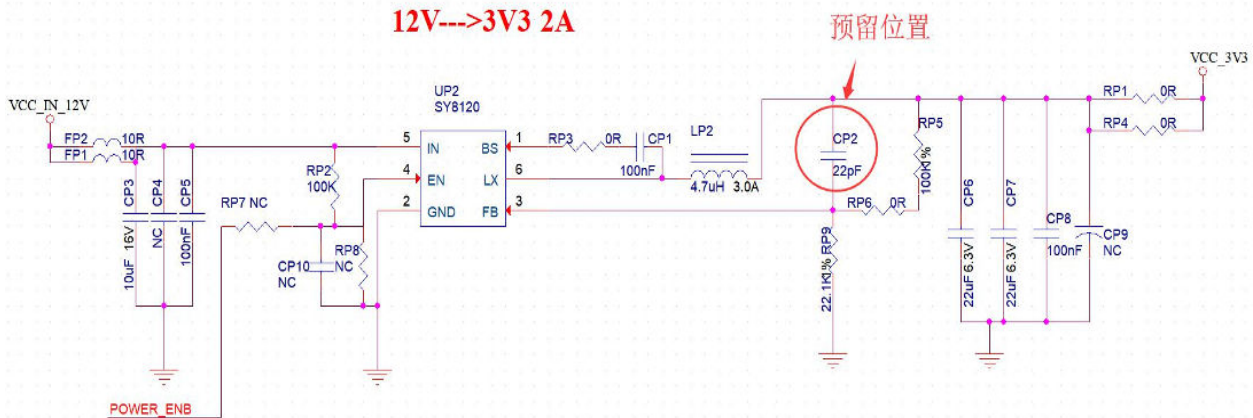


Figure 9 DC-DC step-down circuit diagram

6.4. GPIO

- The outer circumference of the module has taken some IO ports, and if you need to use it is recommended on the 10-100 ohms on the IO port. This can suppress overshoot, so that the two levels are more stable. Help for EMI and ESD.
- The top and pull-down of the special IO port will refer to the instructions of the specification, which will affect the startup configuration of the module.
- The IO port of the module is 3.3V. If the main control is not mismatched with the IO level of the module, it is necessary to increase the level conversion circuit.
- If the IO port is directly connected to the peripheral interface, or the pin and other terminals are recommended to reserve ESD devices at the IO port trace.

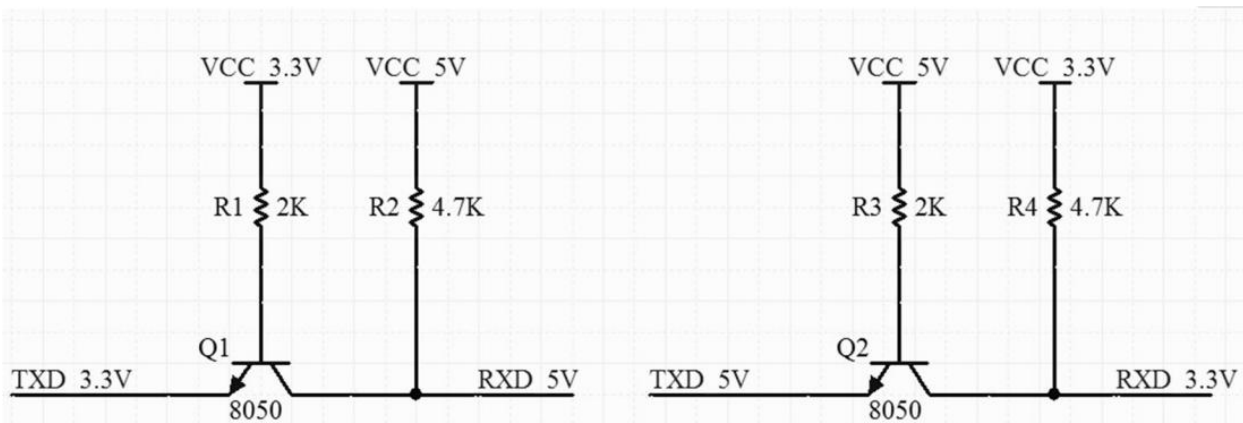


Figure 10 Level conversion circuit

7. Common issues

7.1. Effect of transmission distance factors

- 1 当存在直通信障碍时，通信距离会衰减
- 2 温度、湿度、同频干扰，会导致通信丢包率
- 3 地面吸收、反射性无线电波、贴近地面测试效果
- 4 海水对无线电波有非常强的吸收，所以海边测试效果很差。
- 5 天线附近有金属物体，或在金属壳内，信号衰减非常严重
- 6 功率寄存器设置错误，波特率太高（波特率越高，距离越近）
- 7 室温下气压低于推荐值，电压越低，功率越小
- 8 天线和模块匹配度或天线本身质量问题

7.2. Attention item for using module

- 1 检查电源，确保在推荐供电电压范围内。如果电源超过最大值，模块会永久损坏。
- 2 检查电源稳定性，电压不能大幅波动。
- 3 确保安装过程防静电操作，高频器件静电敏感性。
- 4 确保安装过程湿度不能太高，有些组件是湿度敏感器件。
- 5 如果没有特殊需求，不建议在过高或过低温度下使用。

7.3. Factors that cause interference to the module

- (1) 如果有类似信号干扰源 nearby，请远离干扰源或修改频率，避免信道干扰

- (2) If the clock waveform is not standard on the SPI, please check if there is interference on the SPI line, and the SPI bus line should not be too long.
- (3) Power supply is not ideal or may result in garbled, be sure to ensure the reliability of the power supply.
- (4) Extending the line, the quality is poor or too long, and the error rate is high.

8. Flow welding curve diagram

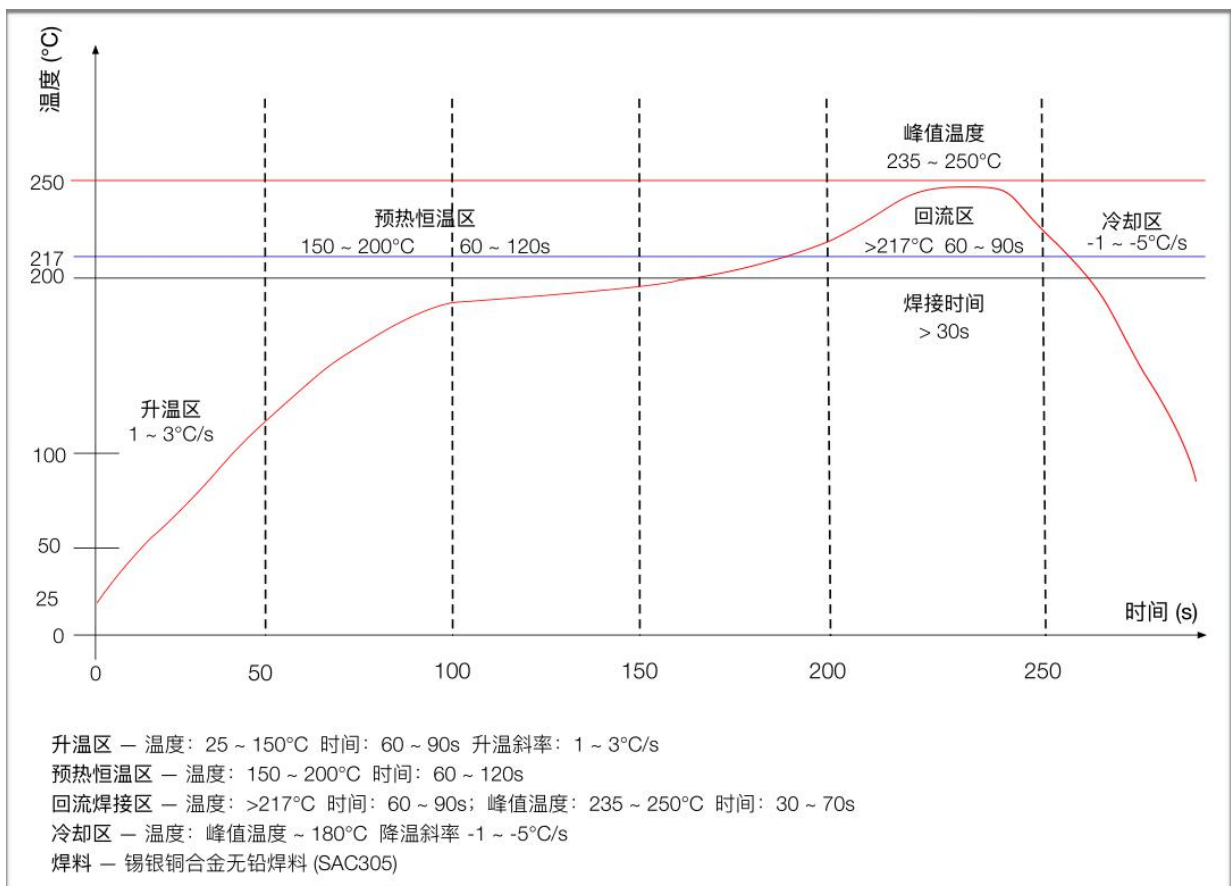


Figure 11 Flow welding diagram

9. Product related models

Table 8 Product related models

Model	Frequency band	Power supply	Package	Size	Antenna
Ra-08	410~525MHz	3.3V I>500mA	SMD-18	16*16 mm	Posts stamp pad/IPEX
Ra-08H	803~930MHz	3.3V I>500mA	SMD-18	16*16 mm	Posts stamp pad/IPEX
Ra-08-Kit	410~525MHz	5V, I>500mA	DIP-30	25.40*48.26(±0.2)mm	SMA-K
Ra-08H-Kit	803~930MHz	5V, I>500mA	DIP-30	25.40*48.26(±0.2)mm	SMA-K
Product related information: https://docs.ai-thinker.com/lr					

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