Ra-08H Specification

Version V1.1.0

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Document resume

Version	Date	Develop/revise content	Edition	Approve
V1.1.0	2022.1.22	First Edition	Shengzong Zou	Ning Guan

Content

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.

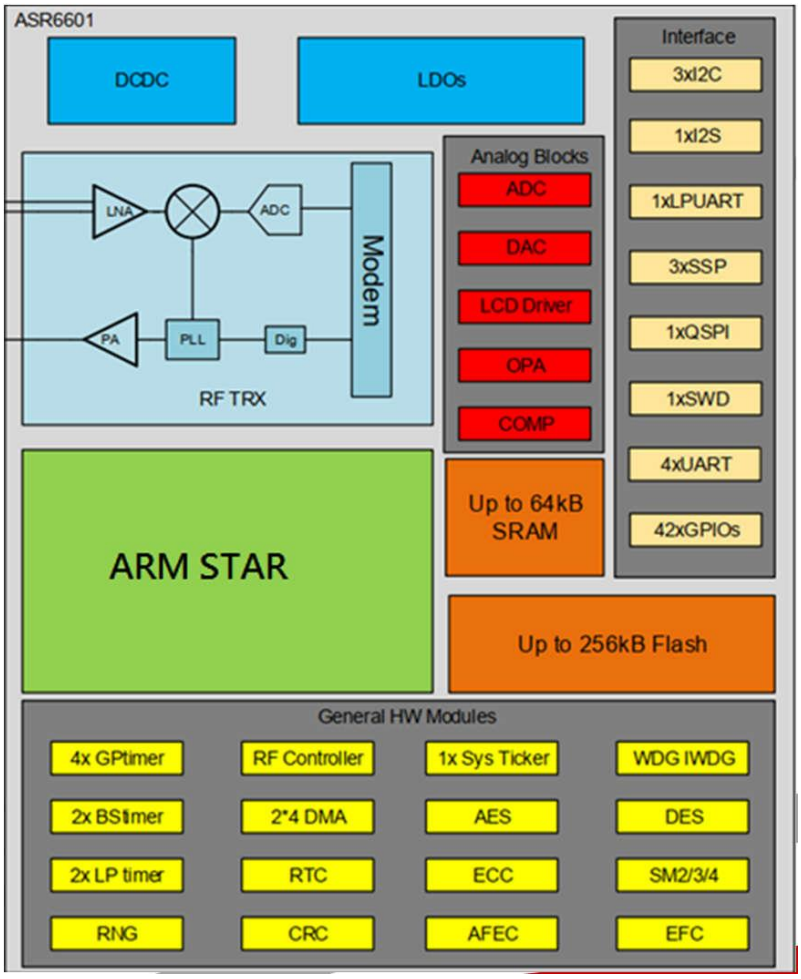


Figure 1 Main chip architecture diagram

1.1. Characteristic

- Adopt SMD-18 package
- Support frequency: 803MHz ~930MHz
- 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-08H
Package	SMD-18
Size	16.0*16.0*3.2(±0.2)mm
Antenna	half-hole pad / through-hole pad / IPEX
Frequency	803-930MHz
Operating temperature	-40 ℃ ~ 85 ℃
Storage temperature	-40 ℃ ~ 125 ℃, < 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-08H 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	℃	
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)

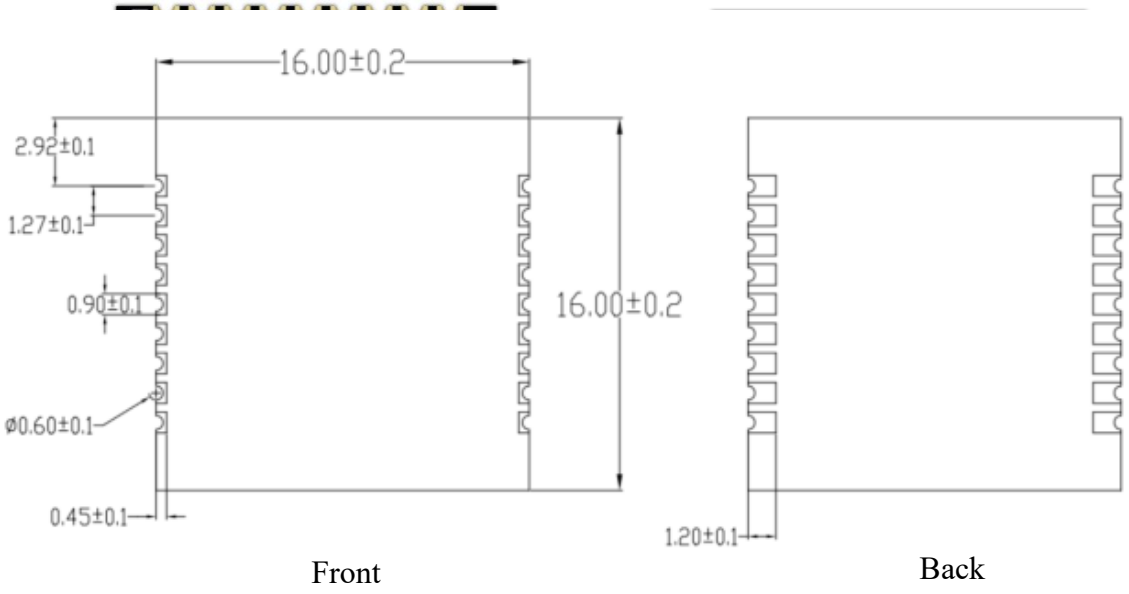


Figure 4 Module size diagram

4. Pin definition

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

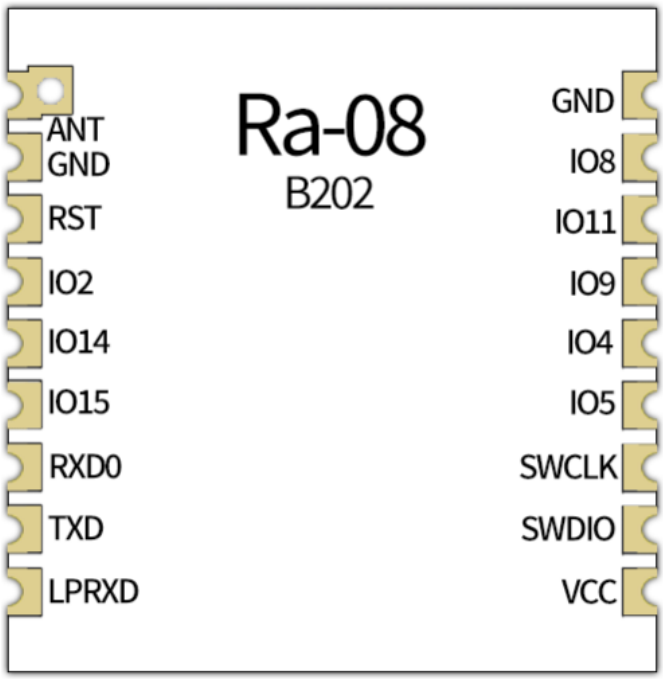


Figure 5 Schematic diagram of module pins

Table 6 Pin function definition table

No.	Name	Function
1，17	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≥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

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

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

5. Schematic

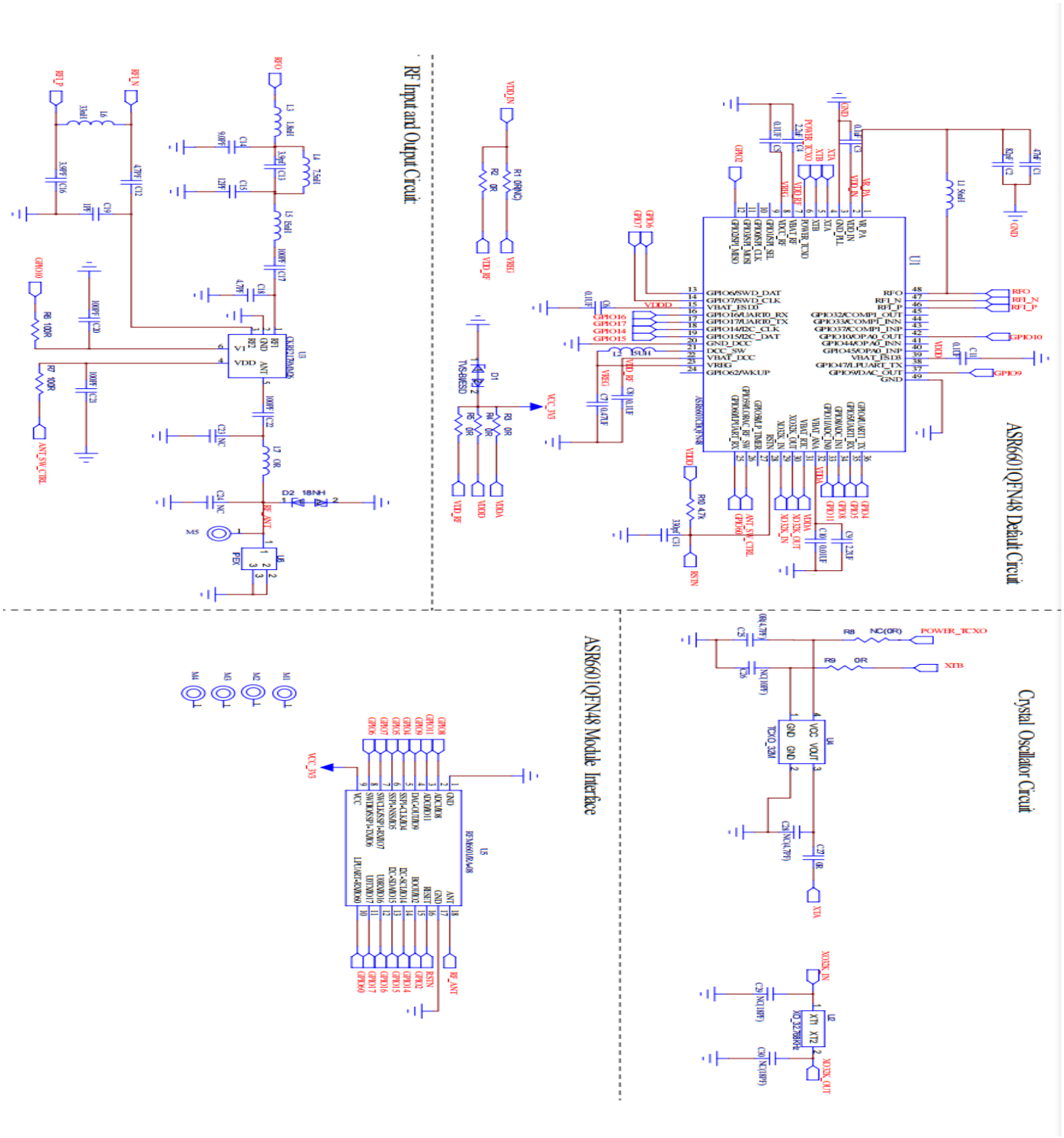
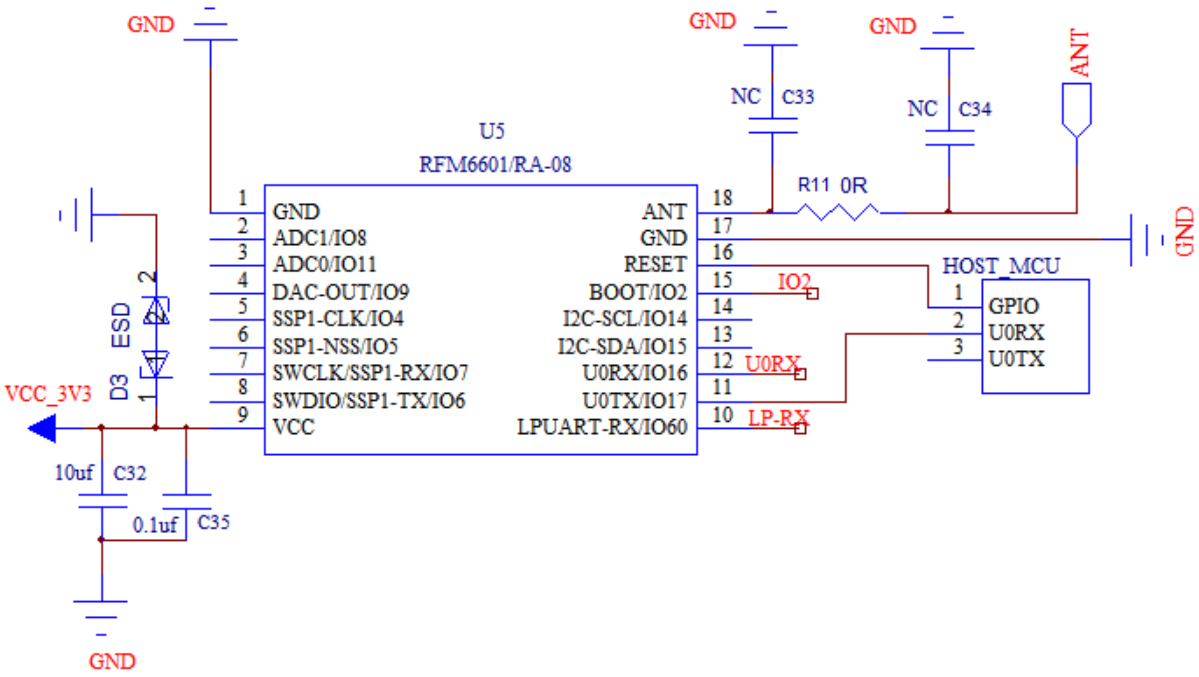


Figure 6 Module Schematic

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:

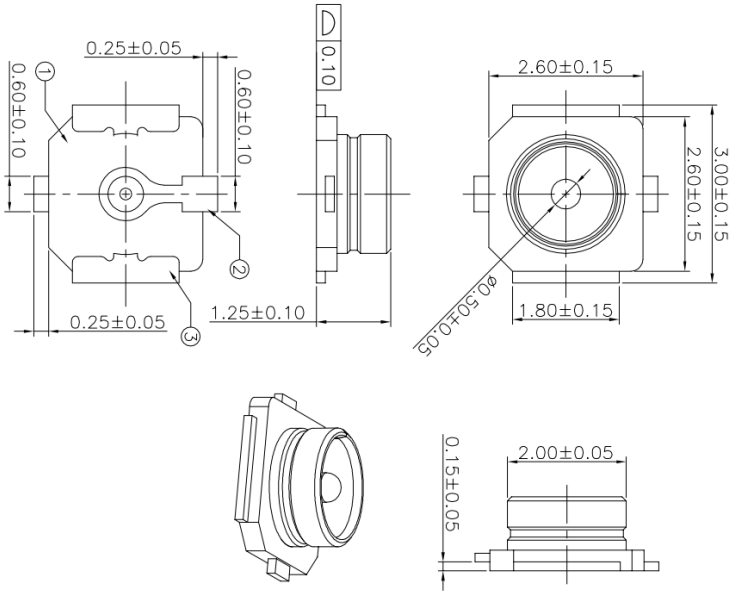


Figure 8 board end IPEX seat size diagram

6.3. Power supply

- Recommend 3.3V voltage, current peak ≥500mA
- 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

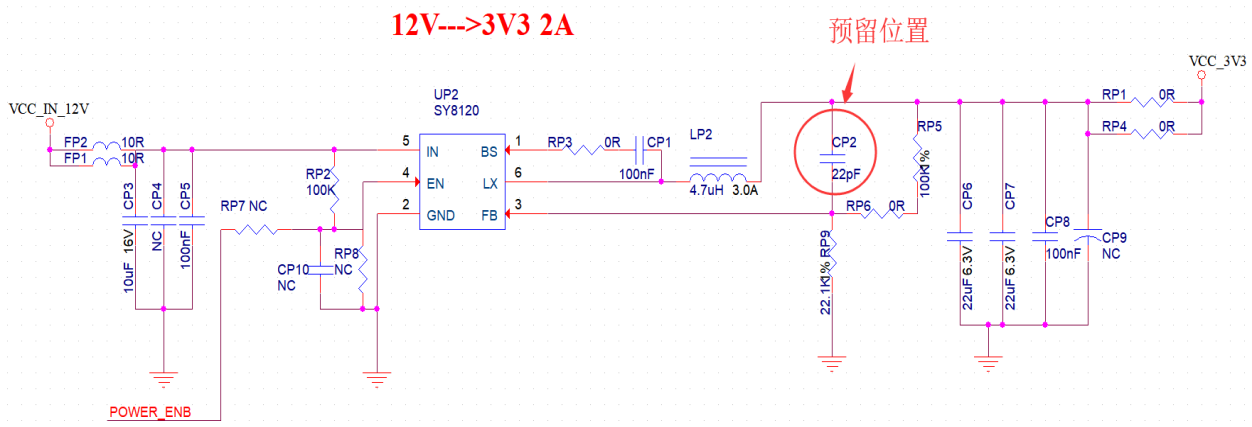


Figure 9 DC-DC step-down circuit diagram

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.

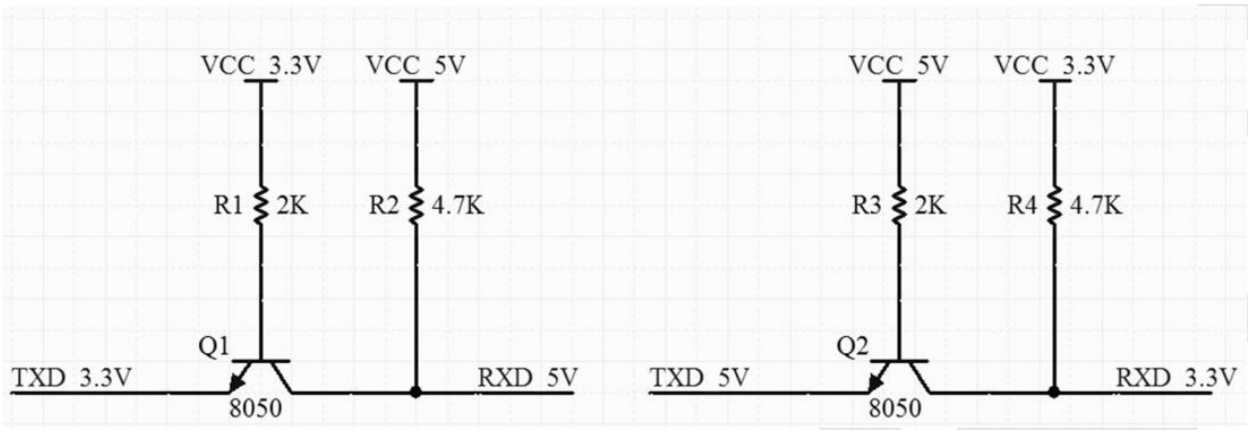


Figure 10 Level conversion circuit

7. Common issues

7.1. Effect of transmission distance factors

（1）When there is a straight communication barrier, the communication distance will attenuate

（2）Temperature, humidity, same frequency interference, can cause communication packet loss rate

（3）Ground absorption, reflective radio waves, close to the ground test effect

（4）Seawater has a very strong absorption of radio wave, so the test effect is poor in seaside.

（5）There are metal objects near the antenna, or in the metal shell, the signal attenuation is very serious

（6）Power register setting error, the air rate is too high (the higher the air rate, the closer distance)

（7）Low pressure at room temperature is lower than the recommended value, the lower the voltage, the smaller the power

（8）Use antenna and module matching degree or antenna itself quality problem

7.2. Attention item for using module

（1）Check the power supply, make sure that between the recommended supply voltage. If the power supply exceeds the maximum, the module is permanently damaged.

（2）Check the power stability, the voltage cannot fluctuate significantly.

（3）Make sure the installation process anti-static operation, high frequency device electrostatic sensitivity.

（4）Make sure the installation process is not too high, some components are humidity sensitive devices.

（5）If there is no special demand, it is not recommended to use in too high or too low temperatures.

7.3. Factors that cause interference to the module

(1) If there are similar signal interference nearby, pls away from interference or modified

frequencies, channel avoidance interference

(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

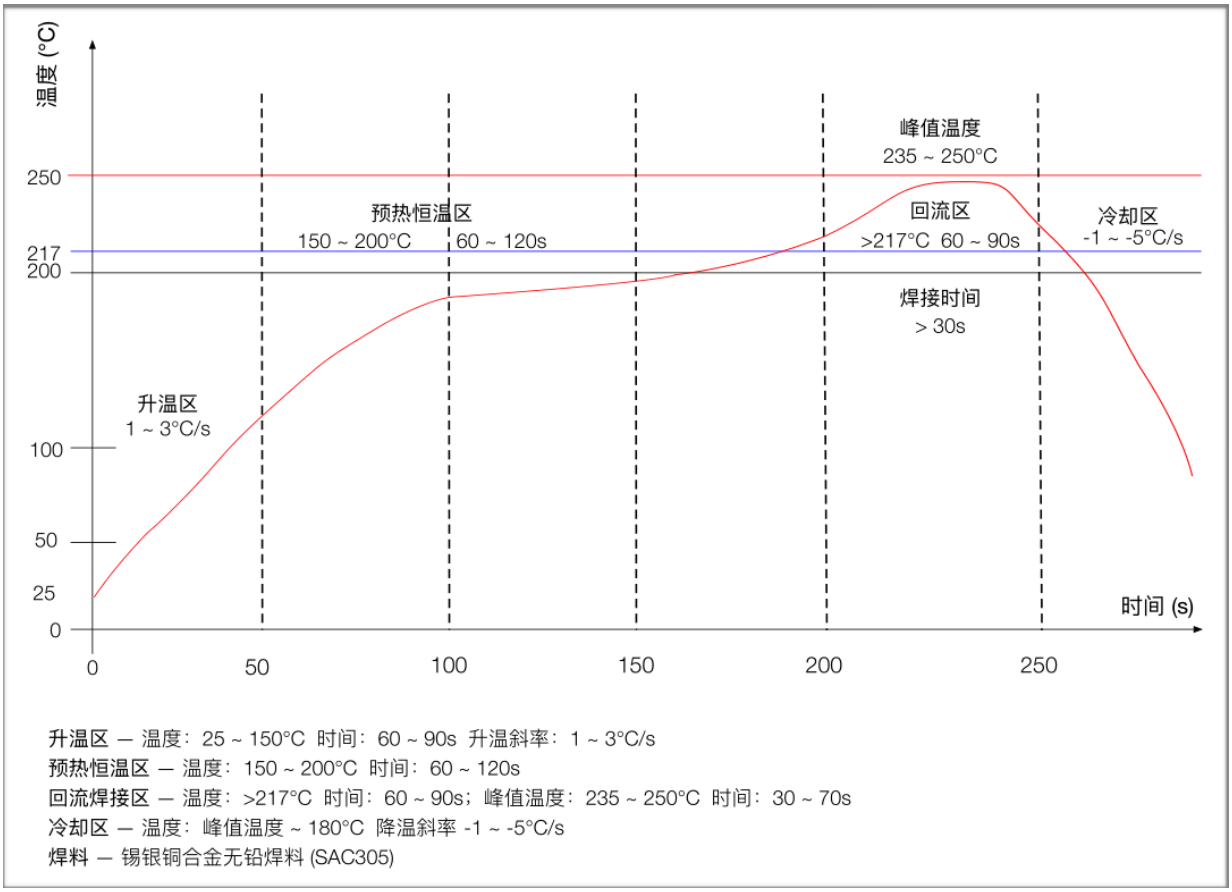


Figure 11 Flow welding diagram

9. Product related models

Table 8 Product related models

Model	Chip	Frequency band	Transmit power	Package	Size	Antenna
Ra-01	SX1278	410~525MHz	20dBm	SMD16	17*16 mm	Posts stamp pad/IPEX
Ra-01H	SX1276	803~930MHz	20dBm	SMD16	17*16 mm	Posts stamp pad/IPEX
Ra-01S	SX1268	410~525MHz	22dBm	SMD16	17*16 mm	Posts stamp pad/IPEX
Ra-01SH	SX1262	803~930MHz	22dBm	SMD16	17*16 mm	Posts stamp pad/IPEX
Ra-01SC	LLCC68	410~525MHz	22dBm	SMD16	17*16 mm	Posts stamp pad/IPEX
Ra-02	SX1278	410~525MHz	20dBm	SMD16	17*16 mm	IPEX
Ra-06	SX1278	410~525MHz	20dBm	SMD20	22.8*16 mm	Posts stamp pad/IPEX
Ra-08H	ASR6601	803~930MHz	22dBm	SMD18	16*16 mm	Posts stamp pad/IPEX
Ra-08	**ASR6601**	**410~525MHz**	**22dBm**	**SMD18**	**16*16 mm**	**Posts stamp pad/IPEX**
Product related information: https://docs.ai-thinker.com						

10. Product packaging information

Ra-08H module was packaged in a tape, 750pcs/ reel. As shown in the below image:

Figure 12 Package and packing diagram

11. Contact us

Ai-Thinker official website　Office forum　Develop DOCS

LinkedIn　Tmall shop　Taobao shop　Alibaba shop

Technical 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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