



Ra-08-P Specification

Version V1.0.1

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Document resume

| Version | Date | Develop/revise content | Edition | Approve |
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| V1.0.0 | 2024.11.15 | First Edition | Pengfei Dong | NingGuan |
| V1.0.1 | 2025.01.06 | Added explanation on module not being able to transmit without load, added explanation on module input power limit, added explanation on input power limit when module matches antenna, added rendering of module without IPEX socket. | Pengfei Dong | NingGuan |
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1. Product overview

Ra-08-P is a high-power LoRa module designed and developed by Shenzhen Anxinke Technology Co., Ltd., which is used for ultra-long-distance spread spectrum communication. Its chip ASR6601 is a general-purpose LPWAN wireless communication SoC that integrates an RF transceiver, a modem, and a 32-bit RISC MCU. The MCU uses an ARM core and has an operating frequency of up to 48MHz. The Ra-08-P module supports LoRa modulation and traditional (G)FSK modulation under LPWAN use cases; at the same time, the transmitter also supports BPSK modulation and (G)MSK modulation, and the receiver supports (G)MSK modulation. Based on this technology, the module has built-in power amplifiers (PA) and low-noise amplifiers (LNA), with high sensitivity exceeding -137dBm, +29dBm transmission power, long transmission distance, and high reliability. At the same time, compared with traditional modulation technologies, LoRa™ modulation technology also has obvious advantages in anti-blocking and selection, solving the problem that traditional design solutions cannot take into account distance, anti-interference and power consumption at the same time.

The Ra-08-P module provides ultra-long range and ultra-low power communication for LPWAN applications and can be widely used in scenarios such as smart meters, supply chain and logistics, home building automation, security systems, remote irrigation systems, etc.

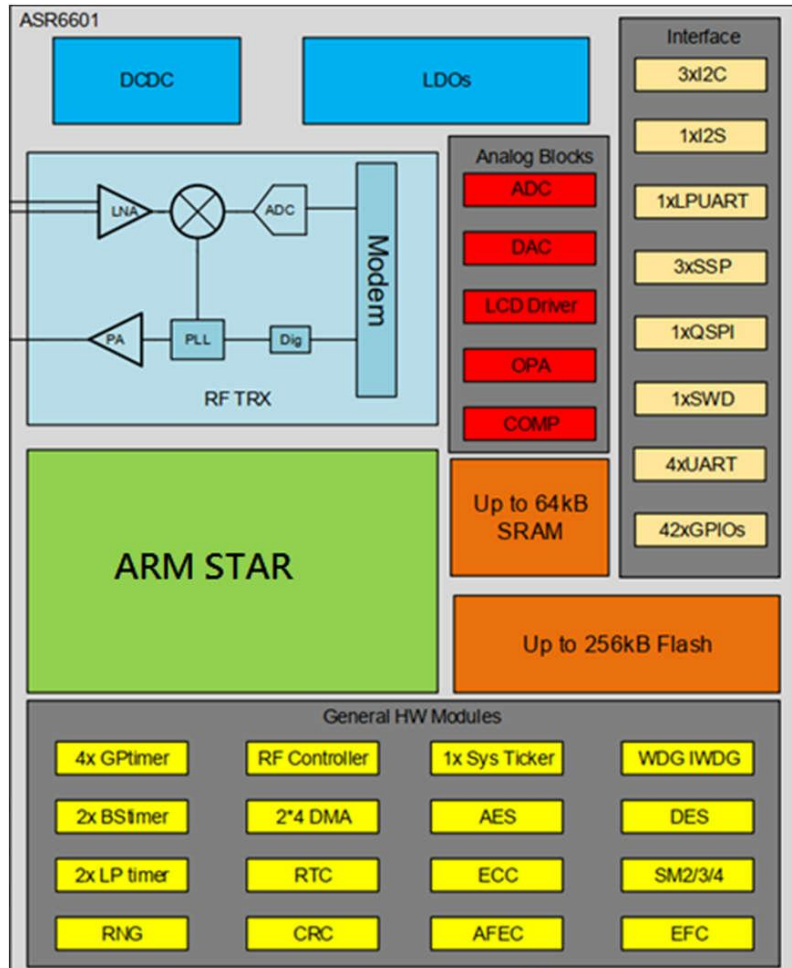


Figure 1 Main chip block diagram

1.1. Characteristic

- SMD-18 package
- Supported frequency bands: 410MHz-525MHz
- The operating voltage is 3.3V, Theoretical maximum transmit power +29dBm
- High sensitivity: -137dBm @125Kz SF10
- Supported spreading factors SF5/SF6/SF7/SF8/SF9/SF10/SF11/SF12
- Embedded memory, 128KB FLASH, 16KB SRAM
- Support LoRa/(G)FSK/BPSK/(G)MSK modulation
- The antenna interface is compatible with various connection methods such as stamp hole/round hole and IPEX, supporting more solution selection.
- Support multiple sleep modes: deep sleep current as low as 17uA

2. Main parameters

Table1 Description of main parameters

| | |
|------------------------------|---|
| Module | Ra-08-P |
| Package | SMD-18 |
| Size | 16.0*16.0*3.2(±0.2)mm |
| Antenna | Compatible with Half Hole Pad / Through Hole Pad / IPEX Sockets |
| Frequency range | 410-525MHz |
| Operating temperature | -40 °C ~ 85 °C |
| Storage environment | -40 °C ~ 125 °C, < 90%RH |
| Power supply range | Supply voltage 2.8V ~ 3.6V, supply current >800mA |
| Support interface | UART/GPIO/ADC/DAC/I2C/I2S/SPI/PWM |
| Number of IO ports | IO2,IO4,IO5,IO8,IO9,IO11,IO14,IO15 |
| Serial port rate | Support 110 ~ 4608000 bps, default 115200 bps |
| Crystal frequency | 32MHz |
| SPI Flash | 128KB |
| Transport protocol | LoRaWAN, LinkWAN |

2.1. Static electricity requirement

Ra-08-P is electrostatic sensitive equipment, so special precautions should be taken during handling.



Figure 2 ESD anti-static diagram

Tip:

Ra-08-P modules are Electrostatic Sensitive Devices (ESD) and require special ESD precautions and should normally be applied to ESD sensitive components. Proper ESD handling and packaging procedures must be employed throughout the handling, shipping and operation of any application incorporating Ra-08-P modules. Do not damage the module by touching it with your hands or by soldering with a non-antistatic soldering iron.

2.2. Electrical characteristics

Table 2 Table of Electrical Characteristics

| Parameter | Name | | Min. value | Typical value | Max. value | Un | Note |
|-----------------------|---------------------------|---------------|------------|---------------|------------|----|---------------------|
| Operating Temperature | TOPR | | -40 | 25 | 85 | °C | |
| Supply voltage | VDD | | 2.8 | 3.3 | 3.6 | V | ≥3.3V Guaranteed |
| Power consumption | Sleep Mode | Consumption 1 | - | 17 | - | uA | DeepSleep |
| | | Consumption 2 | - | 7 | - | mA | standby mode |
| | Full-load mode (TX:29dBm) | | - | 700 | - | mA | DC-DC Mode |
| | Reception mode (RX:SF7) | | - | 16 | - | mA | DC-DC Mode |

2.3. Digital port characteristics

Table 3 Digital Ports

| Interface | Name | Min. value | Typical value | Max. value | Unit |
|-------------------------|------|------------|---------------|------------|------|
| IO Level | VIO | 2.8 | 3.3 | 3.6 | V |
| Input logic level low | VIL | - | - | 0.2 | V |
| Input 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 | RF Band | Min. | Typical | Max. | Unit |
| Transmit power | 433MHz | - | +29 | - | dBm |
| Transmit power | 470MHz | - | +29 | - | dBm |
| Transmit power | 490MHz | - | +29 | - | dBm |
| Transmit power | 510MHz | - | +29 | - | dBm |
| Receiving sensitivity Modulation bandwidth 125kHz | | | | | |
| Mode | | Min. | Typical | Max. | Unit |
| SF7 | | - | -127 | - | dBm |
| SF8 | | - | -130 | - | dBm |
| SF9 | | - | -134 | - | dBm |
| SF10 | | - | -137 | - | dBm |

3. Appearance Dimensions

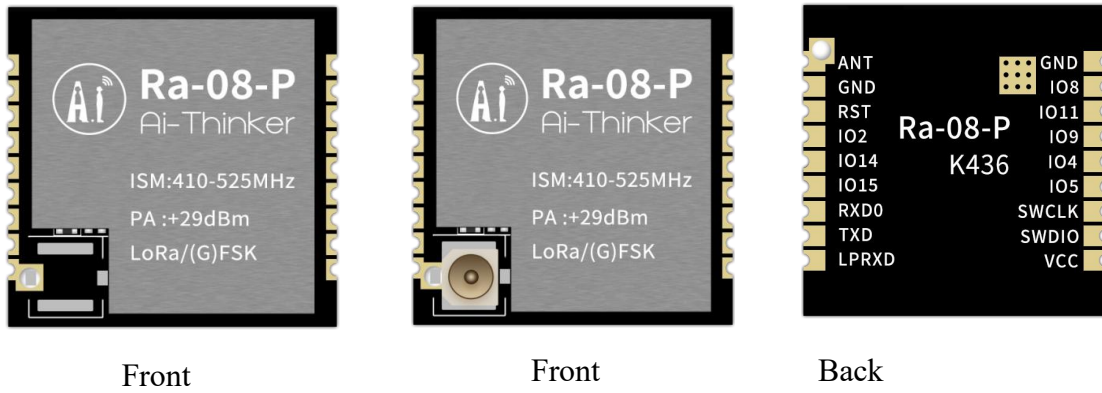


Figure 3 Exterior view (Rendering for reference only, subject to physical condition)

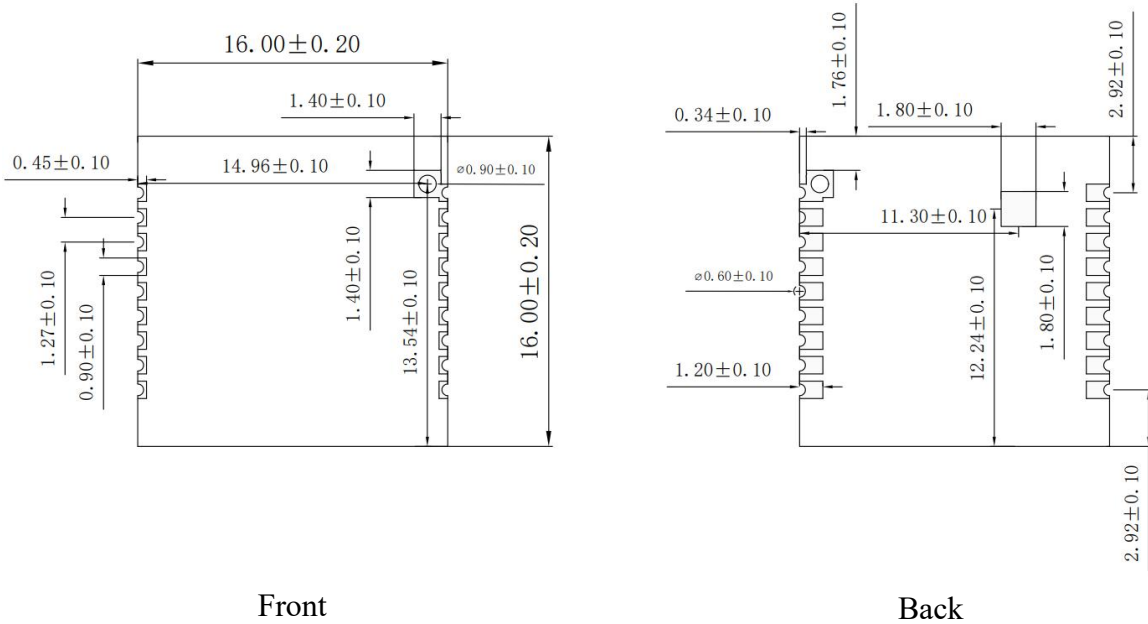


Figure 4 Dimensional drawing (unit: mm)

4. Pin Definition

Ra-08-P module connects 19 pins as shown in the pin diagram, and the pin function definition table is the interface definition.

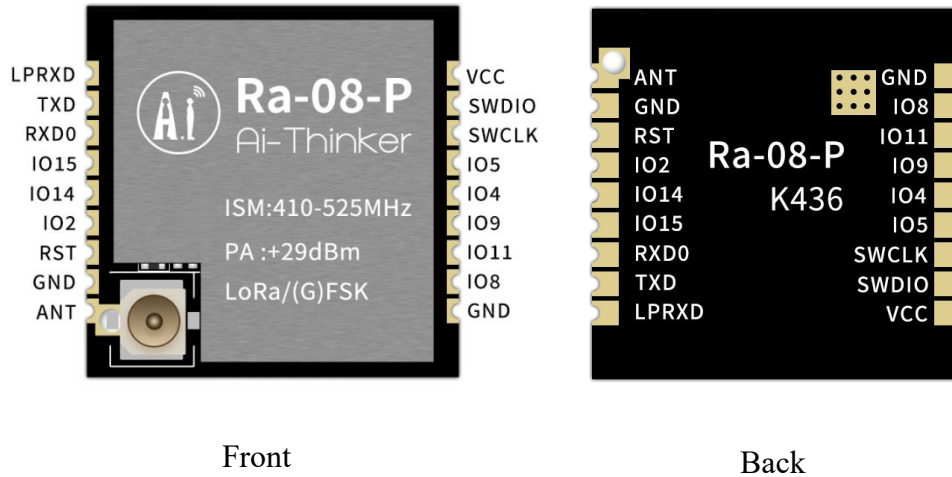


Figure 5 Pin diagram

Table 5 Definition table of pin functions

| 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 supply, recommended supply current >800mA. |
| 10 | LPRXD | GPIO60/LPUART-RX, Communication serial port. |
| 11 | TXD | GPIO17/UART TX |
| 12 | RXD0 | GPIO16/UART RX, Burning a serial port. |
| 13 | IO15 | GPIO15/I2C_SDA |
| 14 | IO14 | GPIO14/I2C_SCL |
| 15 | IO2 | GPIO2/BOOT |
| 16 | RST | RSTN_IN External reset, active low. |
| 18 | ANT | Antenna Interface |
| EPAD | GND | Grounding, need to be reliable grounding, conducive to heat dissipation. |

Table 6 Module start-up mode description.

| System boot mode | | | |
|------------------|-----------|---------------|--------------------|
| Pin | Default | SPI boot mode | Download boot mode |
| IO2 | Pull-down | 0 | 1 |

Note: Some pins have been internally pulled-up, refer to the schematic.

5. Schematic

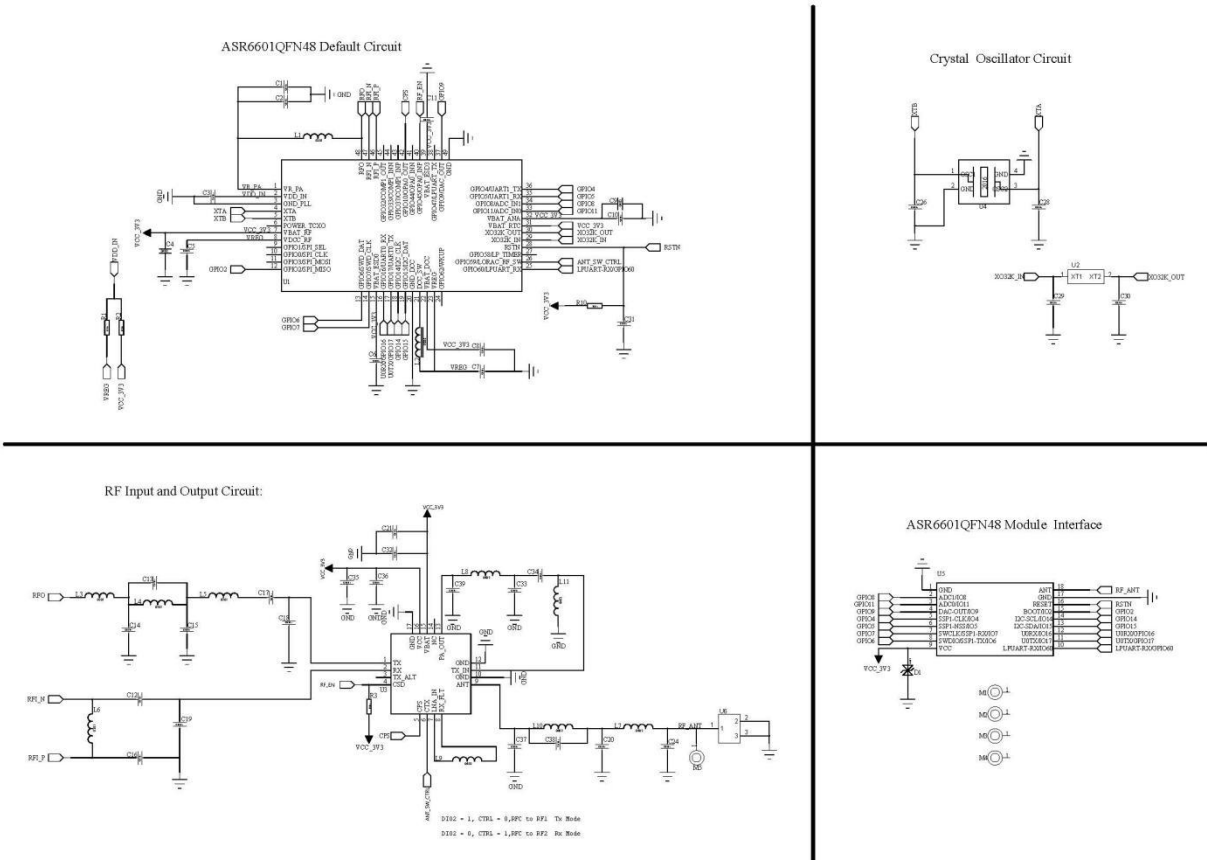
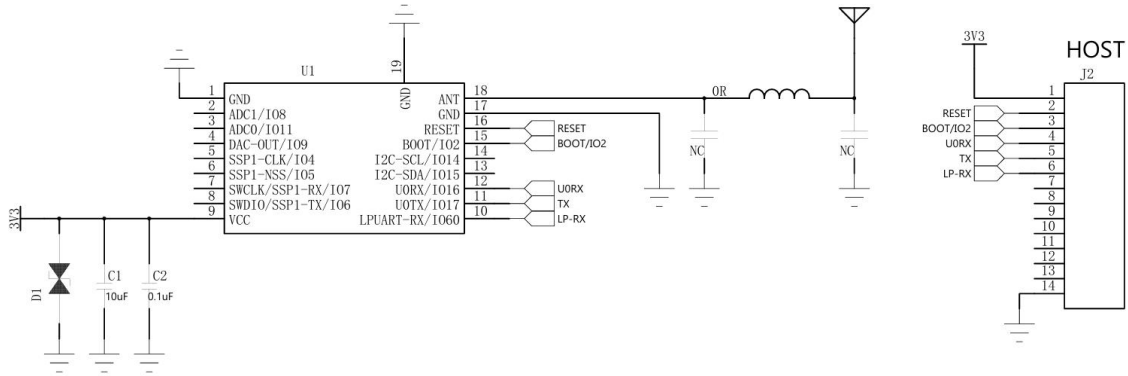


Figure 6 Schematic

6. Design Guidance

6.1. Application circuit



(Recommended to use DC-DC or LDO independent power supply use,
the current is more than 800mA)

Figure 7 Application Circuit Diagram

Attention:

- IO2 is the boot control pin. It is in normal working mode when it is low level and in firmware burning mode when it is high level. The default low level is inside the chip.
- U0RX is the burning serial port, and LPRXD is the communication serial port. Please choose according to your needs.
- The transmit power level configured by the module ASR6601 cannot be greater than 3dBm. Otherwise, the excessive power level will burn the PA.
- When the module is in TX transmission, do not let the module antenna port be suspended, because the VSWR is very large during no-load transmission, and the risk of FEM chip damage is high; if the ANT port cannot be avoided from being suspended, the maximum TX input signal power should not exceed 0dBm to ensure that the chip is not damaged.
- During the matching and debugging of the antenna, the impedance may not be matched, resulting in a large VSWR. In this process, it is recommended not to directly send saturated power to avoid damaging the chip due to excessive VSWR. After the antenna impedance debugging is completed, send saturated power.
- The power supply current must meet the specification requirements. If the current is limited, the saturated power cannot be pushed up.

6.2. Recommend PCB footprint size

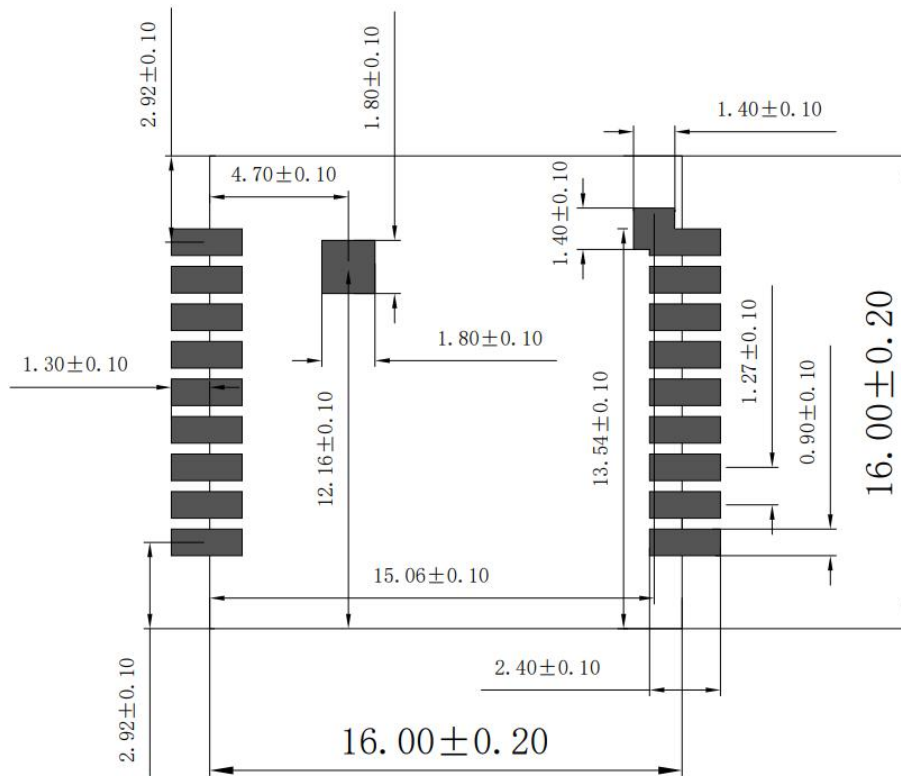


Figure 8 Recommended PCB package size diagram (unit: mm)

6.3. Antenna installation

- The Ra-08-P requires an external antenna for use, and the module has half-hole pads to lead to the motherboard.
- For optimal antenna performance, the antenna should be mounted away from metal parts.
- Antenna mounting structure has a great influence on the module performance, make sure the antenna is exposed, preferably vertically upwards. When the module is installed inside the case, you can use a good quality antenna extension cable to extend the antenna to the outside of the case.
- The antenna should never be mounted inside a metal case, as this will result in a significant weakening of the transmission range.

6.4. Power supply

- Recommends 3.3V voltage and 1A+ peak current.
- Recommends the use of LDO power supply; if using DC-DC it is recommended that the ripple is controlled within 100mV.
- The DC-DC power supply circuit recommends reserving the location of a dynamic response capacitor, which can optimise the output ripple when the load varies greatly.
- Additional ESD devices are recommended for the 3.3V power interface.
- When designing the power supply circuit for the module, it is recommended to keep more than 30% of the power supply current, so that the whole machine is conducive to long-term stable operation.
- Please pay attention to the correct connection of the positive and negative terminals of the power supply, such as reverse connection may lead to permanent damage to the module.

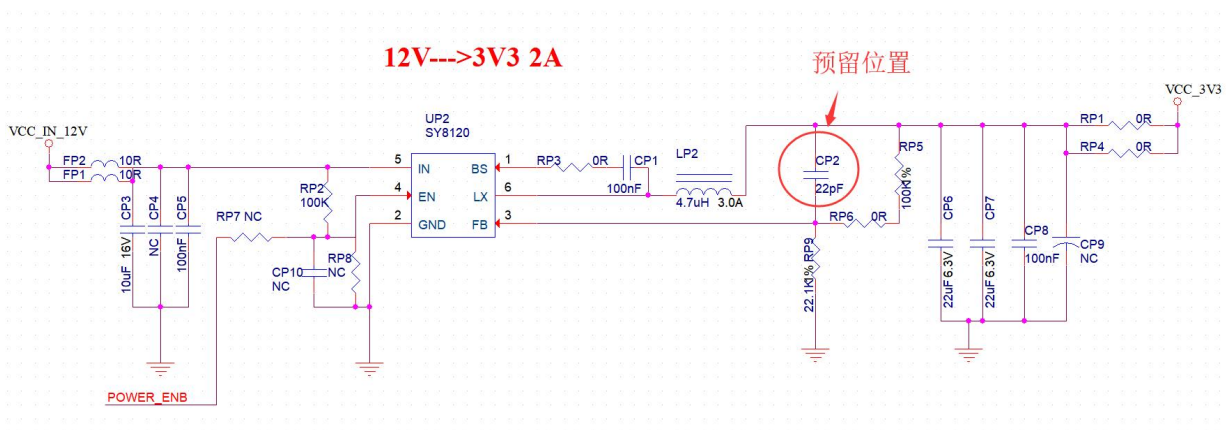


Figure 9 DC-DC Buck Circuit

6.5. GPIO level conversion.

- There are some IO ports leading out of the periphery of the module, if you need to use it, it is recommended to connect 10-100 ohm resistors in series on the IO ports. This will suppress overshoot and make the levels smoother on both sides. It is helpful for both EMI and ESD.
- The pull-up and pull-down of the special IO ports should be referred to the usage instructions in the datasheet, and the start-up configuration of the module will be affected here.
- The IO port of the module is 3.3V, if the IO port level of the master control and the module do not match, you need to add a level conversion circuit.
- If the IO port is directly connected to a peripheral interface, or a terminal such as a row of pins, it is recommended to reserve an ESD device in the IO port alignment near the terminal.

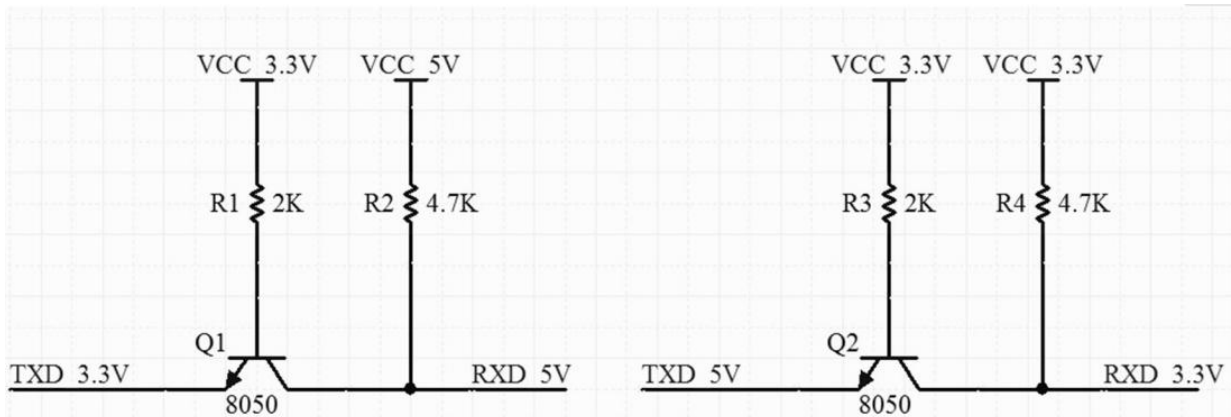


Figure 10 Level conversion circuit

6.6. Software writing

- The maximum input power of the FEM chip cannot exceed +3dBm. To avoid burning the FEM chip, users need to strictly configure the output power of ASR6601. 0dBm-3dBm is recommended.
- This module is an ASR6601+ peripheral circuit and the user can follow the ASR6601 chip manual exactly.

7. Frequently Asked Questions

7.1. Factors affecting transmission distance

- When there is a straight-line communication barrier, the communication distance is attenuated accordingly.
- Temperature, humidity, and co-frequency interference, can lead to increased communication packet loss.
- The ground absorbs and reflects radio waves and is less effective when tested close to the ground.
- Seawater has a very strong ability to absorb radio waves, so the results of the seaside test are poor.
- Signal attenuation can be very severe when there are metal objects near the antenna, or when it is placed in a metal case.
- The power register is set incorrectly, the air rate is set too high (the higher the air rate, the closer the distance).
- The low voltage of the power supply at room temperature is lower than the recommended value, and the lower the voltage, the lower the generating power.
- Using an antenna that is poorly matched to the module or the quality of the antenna itself.

7.2. Modules usage precautions

- Check the power supply to ensure that it is between the recommended supply voltages, exceeding the maximum value can cause permanent damage to the module.
- Check the stability of the power supply, the voltage should not fluctuate significantly and frequently.
- Ensure that the process of installation and use of anti-static operation, high-frequency devices electrostatic sensitivity.
- Ensure that the process of installation and use should not be too high humidity, some components are humidity sensitive devices.
- It is not recommended to use it at too high or too low a temperature if there is no special need.

7.3. Factors causing interference with the module

- There is co-channel signal interference in the vicinity, stay away from the interference source or modify the frequency or channel to avoid the interference.
- The clock waveform on SPI is not standard, check whether there is interference on the SPI line, and the SPI bus alignment should not be too long.
- Unsatisfactory power supply may also cause garbled code, be sure to ensure the reliability of the power supply.
- Poor quality or too long extension cables and feeder cables can also cause high BER.

8. Storage condition

Products sealed in moisture-proof bags should be stored in a non-condensing atmosphere of $<40^{\circ}\text{C}/90\%\text{RH}$.

The moisture sensitivity class MSL of the module is 3.

After the vacuum bag is unpacked, it must be used within 168 hours at $25 \pm 5^{\circ}\text{C}/60\%\text{RH}$, otherwise it will need to be baked before it can be put on line a second time.

9. Reflow welding curve diagram

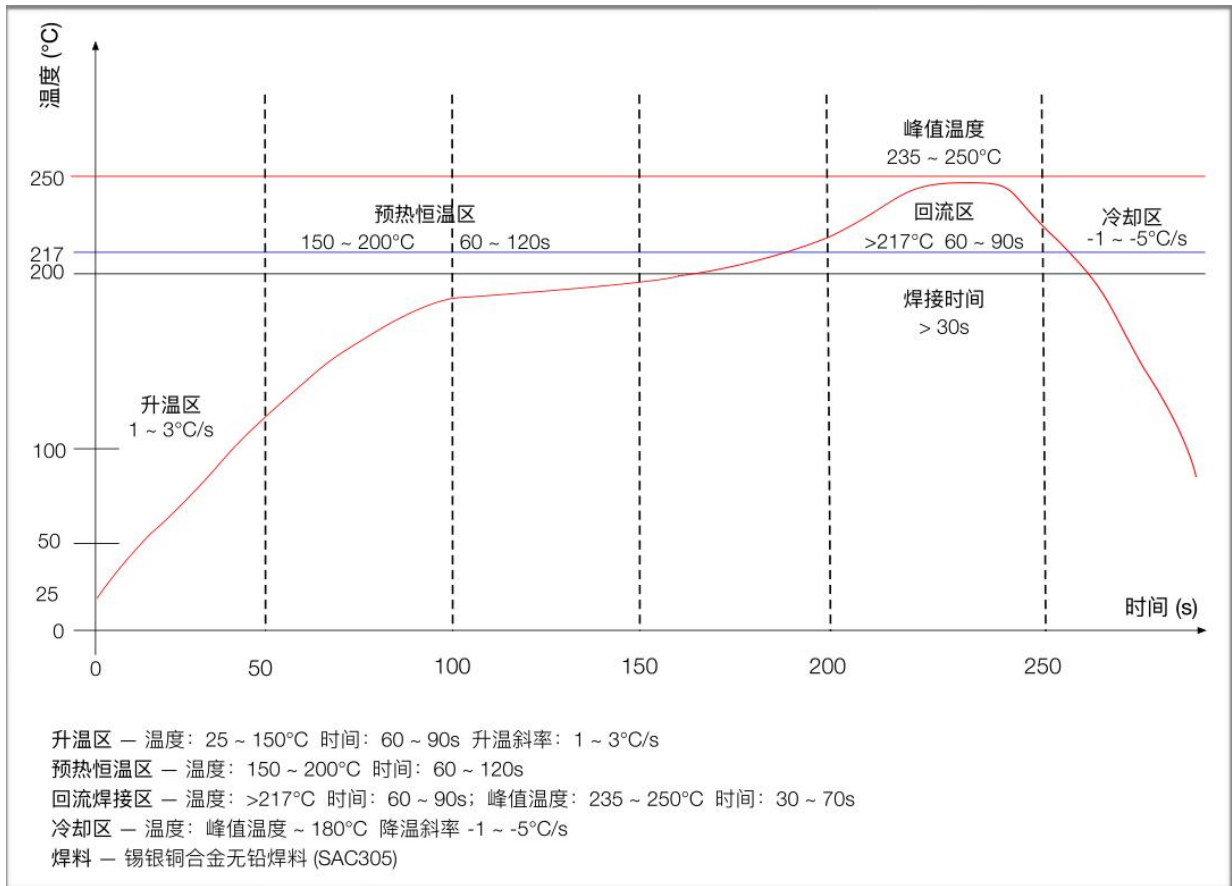


Figure 11 Reflow welding curve

10. Product packaging information

Ra-08-p is packaged in braided tape, 750pcs/tray. As shown in the picture below:



Figure 12 Packing braid

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