ESP-01S Specification

Version V1.0

Document resume

Version	Date	Develop/revise content	Edition	Approval
V 0 . 9	2015.06.08	First edition	Yang Xiaofei	
V1.0	2019.10.29	Data update	Xie Yiji	

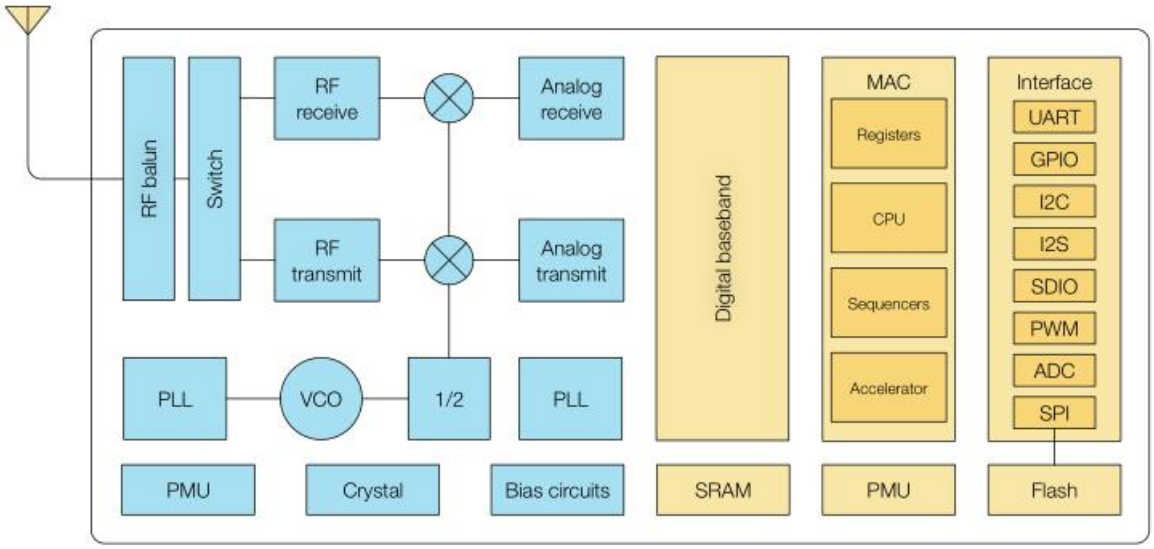
Content

1. Product Overview

ESP-01S is a Wi-Fi module developed by Ai-Thinker Technology . The core processor of this module, ESP8266, integrates the industry-leading Tensilica L106 ultra-low power 32-bit micro MCU in a smaller package, with 16-bit streamlined mode, main frequency supports 80 MHz and 160 MHz, supports RTOS, and integrates Wi-Fi MAC/BB/RF/PA/LNA.

ESP-01S The Wi-Fi module supports standard IEEE802.11 b/g/n protocols and a complete TCP/IP protocol stack. Users can use this module to add networking capabilities to existing devices or build independent network controllers.

ESP8266 is a high-performance wireless SoC that provides maximum practicality at the lowest cost, providing unlimited possibilities for embedding Wi-Fi functions into other systems.



ESP8266 has a complete and self-contained Wi-Fi network function. It can be used independently or as a slave to other host MCUs. When ESP8266 is used independently, it can be directly started from an external flash. The built-in cache memory is conducive to improving system performance and optimizing the storage system .

In another case, ESP8266 can be used as a Wi-Fi adapter through the SPI/SDIO interface or UART interface and applied to any microcontroller design.

ESP8266's powerful on-chip processing and storage capabilities allow it to integrate sensors and other application-specific devices through the GPIO port, greatly reducing the cost of initial development .

Characteristic

- Complete 802.11b/g/n Wi-Fi S o C module
- Built-in Tensilica L106 ultra-low power 32-bit micro MCU, main frequency supports 80 MHz and 160 MHz, supports RTOS
- Built-in 1-channel 10-bit high-precision ADC
- Support UART/GPIO/PWM interface
- DIP -8 package
- Integrated Wi-Fi MAC/BB/RF/PA/LNA
- Support multiple sleep modes , standby power consumption as low as 1.0mW
- The maximum serial port rate is 4Mbps
- Embedded Lwip protocol stack
- Support STA/AP/STA+AP working mode
- one-click network configuration via Smart Config (APP) /AirKiss (WeChat) for Android and IOS
- Support serial port local upgrade and remote firmware upgrade (FOTA)
- General AT commands can be used quickly
- Supports secondary development and integrates Windows and Linux development environments

Main parameters

Table 1 Description of main parameters

Model	ESP-01S
Package	DIP-8
size	24.4 * 1 4.4 * 11.2 (±0.2)MM Note: 11.2mm is the pin header height
Antenna type	Onboard PCB antenna
Frequency range	2400 ~ 2483.5MHz
Operating temperature	-20 ℃ ~ 70 ℃
Storage Environment	-40℃ ~ 125 ℃ , < 90%RH
Power supply range	Supply voltage 3.0V ~ 3.6V , supply current>500mA
Supported interfaces	UART/GPIO/PWM
Number of IO ports	2
Serial port rate	Support 110 ~ 4608000 bps, default 115200 bps
Security	WEP/WPA-PSK/WPA2-PSK
SPI Flash	Default 8 Mbit
Certification	RoHS

2. Electrical parameters

Electrical Characteristics

parameter		condition	Minimum	Typical Value	Maximum	unit
Supply voltage		VDD	3.0	3.3	3.6	V
I/O	V_{IL}/V_{IH}	-	-0.3/0.75VIO	-	0.25VIO/3.6	V
	V_{OL}/V_{OH}	-	N/0.8VIO	-	0.1VIO/N	V
	I_{MAX}	-	-	-	12	mA

RF Performance

describe	Typical Value	unit
Operating frequency	2400 - 2483.5	MHz
Output Power		
11n mode , the PA output power is	1 3±2	dBm
11g mode , the PA output power is	14±2	dBm
In 11b mode, PA output power	16±2	dBm
Receiving sensitivity		
CCK, 1 Mbps	<= -9 0	dBm
CCK, 11 Mbps	<= - 85	dBm
6 Mbps (1/2 BPSK)	<= - 88	dBm
54 Mbps (3/4 64-QAM)	<= - 70	dBm
HT2 0 (MCS7)	<= - 67	dBm

3. Power consumption

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

- All measurements were performed at the antenna interface without a SAW filter.
- All transmit data is measured based on a 90% duty cycle in continuous transmit mode.

model	Minimum	Typical Value	Maximum	unit
Transmit 802.11b, CCK 11Mbps, POUT=+17dBm	-	170	-	mA
Transmit 802.11g, OFDM 54Mbps, POUT =+15dBm	-	140	-	mA
Transmit 802.11n, MCS7, POUT =+13dBm	-	120	-	mA
Receive 802.11b, packet length 1024 bytes, -80dBm	-	50	-	mA
Receive 802.11g, packet length 1024 bytes, -70dBm	-	56	-	mA
Receive 802.11n, packet length 1024 bytes, -65dBm	-	56	-	mA
Modem-Sleep①	-	20	-	mA
Light-Sleep②	-	2	-	mA
Deep-Sleep③	-	20	-	uA
Power Off	-	0.5	-	uA

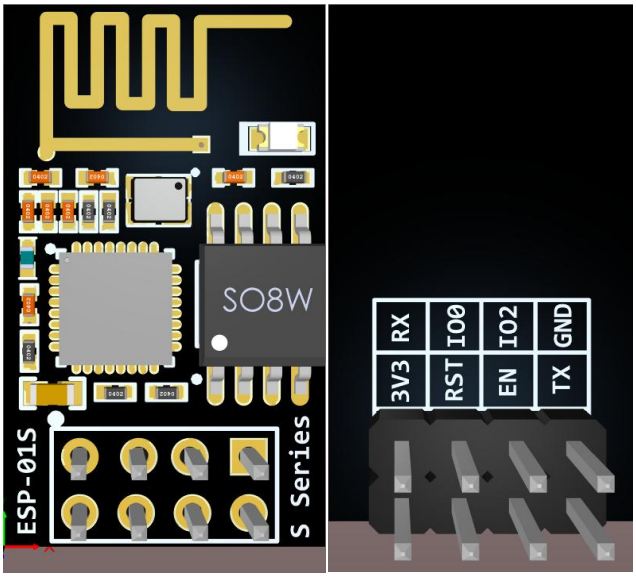
illustrate:

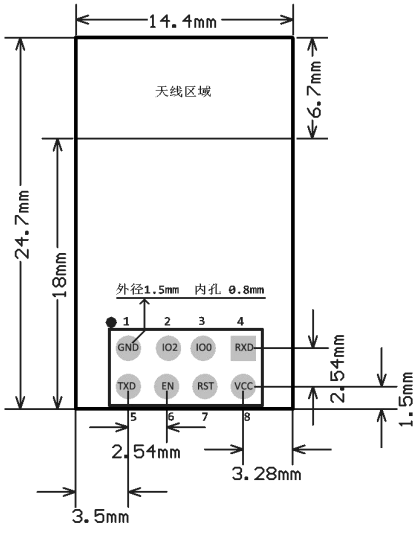
- Modem-sleep is used for applications that require the CPU to be in working state all the time, such as PWM or I2S applications. When maintaining a Wi-Fi connection, if there is no data transmission, the Wi-Fi Modem circuit can be turned off to save power according to the 802.11 standard (such as U-APSD). For example , in DTIM3, every 300 ms of sleep, wake up 3 ms to receive the AP's Beacon packet, etc., the overall average current is about 20 mA.
- Light-sleep is used for applications where the CPU can be suspended, such as Wi-Fi switches. When maintaining a Wi-Fi connection, if there is no data transmission, the Wi-Fi

Modem circuit can be turned off and the CPU can be suspended to save power according to the 802.11 standard (such as U-APSD). For example, in DTIM3, the overall average current is about 2 mA if the device sleeps for 300 ms and wakes up for 3 ms to receive the AP's Beacon packet.

- Deep-sleep is used for applications that do not need to maintain Wi-Fi connection all the time and send data packets only once in a long time, such as a sensor that measures temperature every 100 seconds. For example, after waking up every 300 seconds, it takes 0.3s to 1s to connect to the AP to send data, so the overall average current can be much less than 1 mA. The current value of 20 μA is measured at 2.5V.

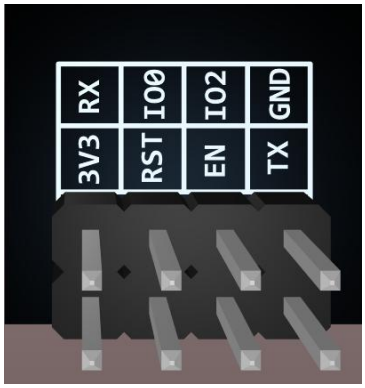
4. Dimensions





5. Pin Definition

The ESP-01S module has a total of 8 interfaces, as shown in the pin diagram. The pin function definition table is the interface definition.



ESP-01S pin diagram

surface Pin Function Definition

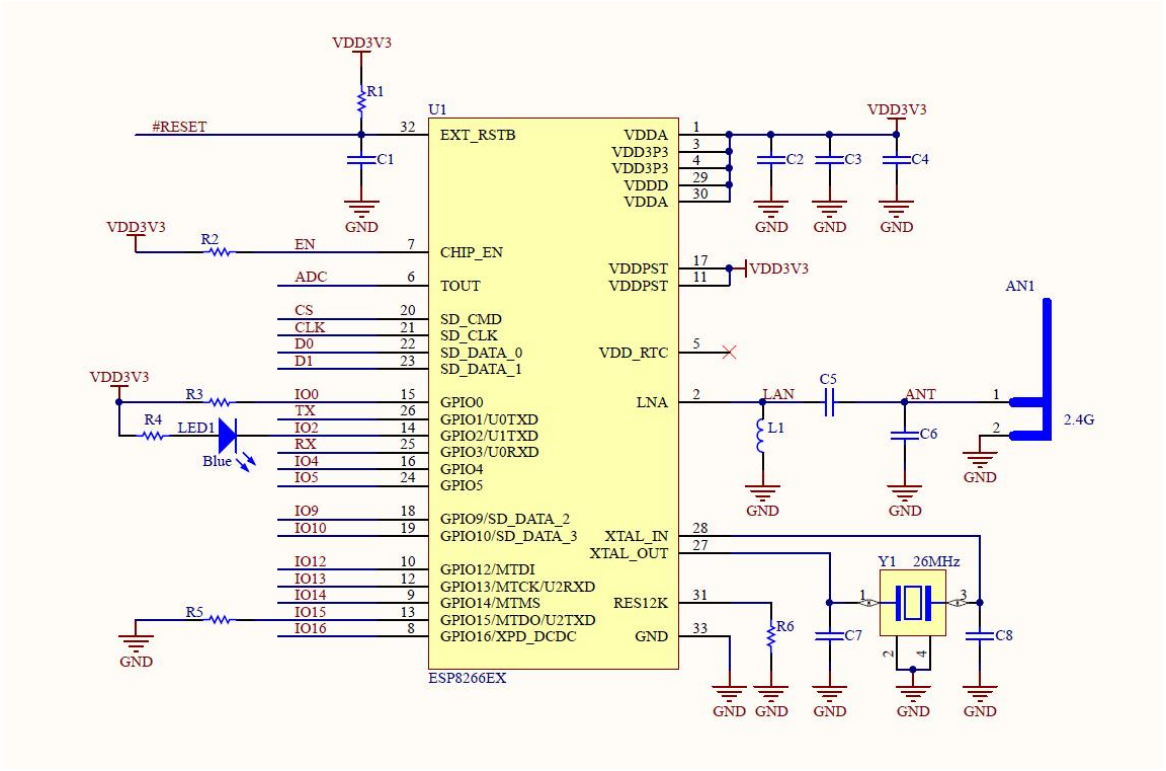
Footer	name	Functional Description
1	GND	Grounding
2	IO2	GPIO 2/UART1_TXD
3	IO0	GPIO0; Download mode: external pull-down; Operation mode: floating or external pull-up
4	RxD	UART0_RXD/GPIO3
5	TXD	UART0_TXD/GPIO1
6	EN	Chip enable terminal, high level is effective
7	RST	Reset
8	VCC	3.3V power supply (VDD); the external power supply output current is recommended to be above 500mA

Table module startup mode description

model	CH_PD(EN)	RST	GPIO15	GPIO0	GPIO2	TXD0
Download Mode	high	high	Low	Low	high	high
Operation Mode	high	high	Low	high	high	high

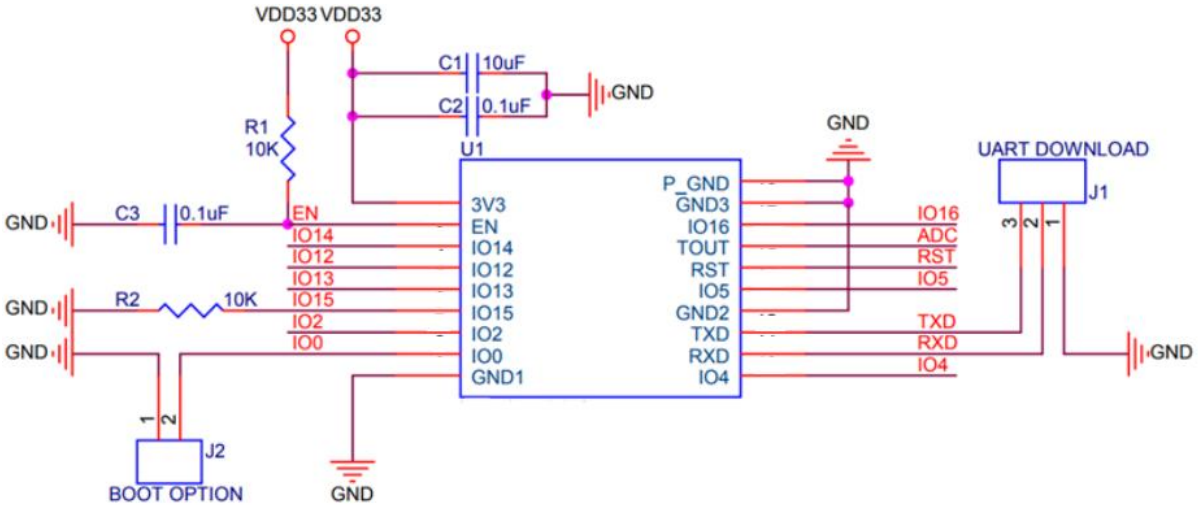
Note: Some pins have been internally pulled up, please refer to the schematic diagram

6. Schematic



7. Design Guidance

(1) Application Circuit

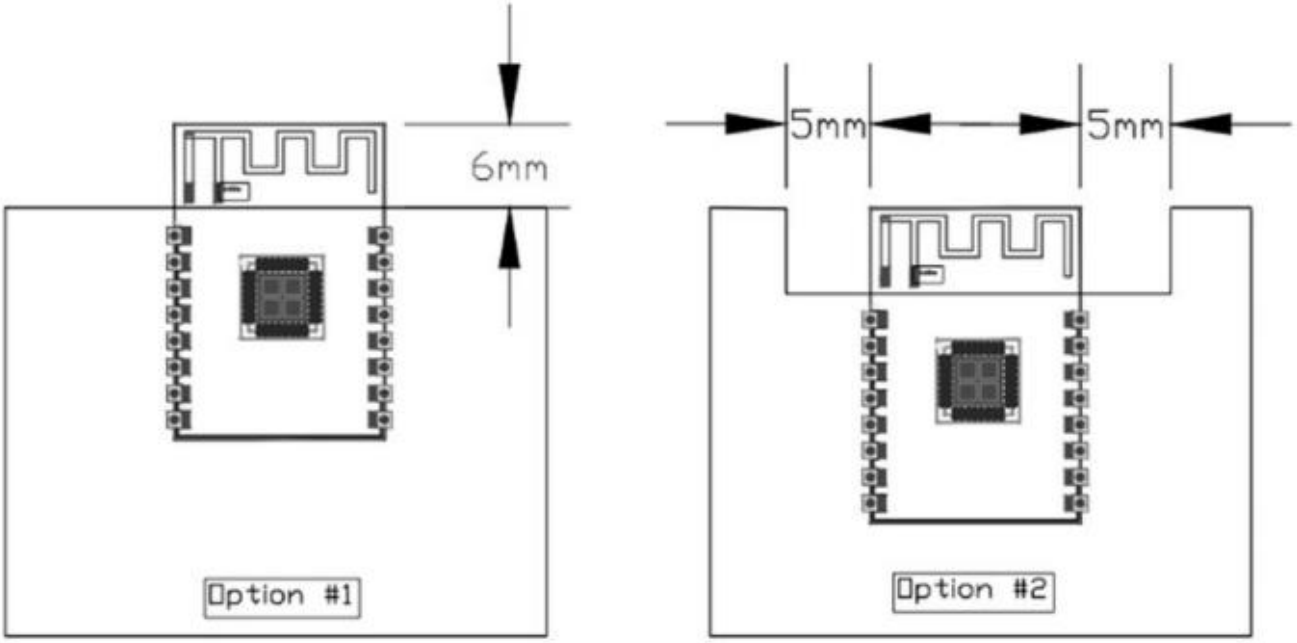


(2) Antenna layout requirements

①The following two methods are recommended for installation on the motherboard:
Solution 1: Place the module on the edge of the mainboard, with the antenna area extending out of the edge of the mainboard.

Solution 2: Place the module on the edge of the mainboard and hollow out an area on the edge of the mainboard at the antenna position.

②To ensure the performance of the onboard antenna, metal parts must not be placed around the antenna and must be kept away from high-frequency devices.

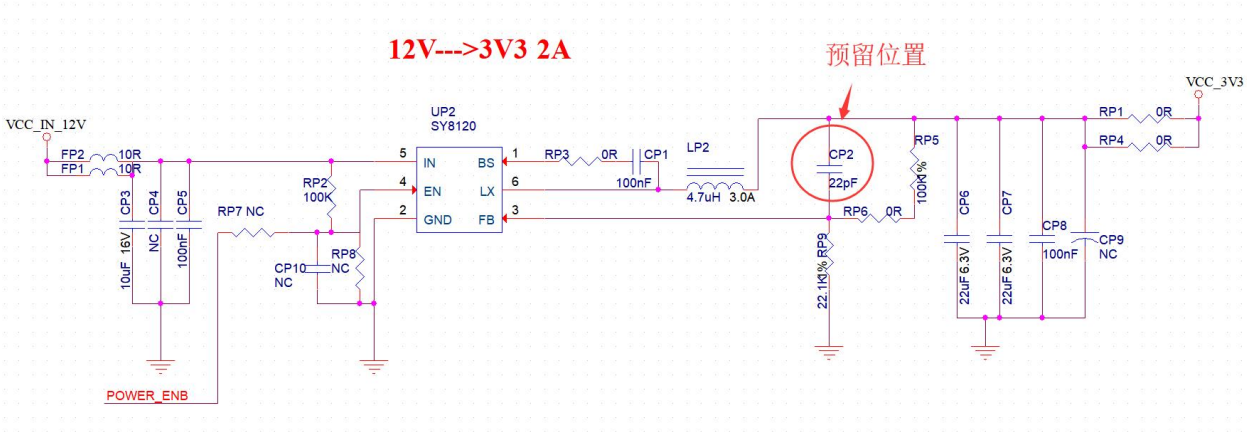


(3) Power supply

① Recommended voltage: 3.3V, peak current: 500mA or above

② It is recommended to use LDO power supply; if DC-DC is used, it is recommended to control the ripple within 30mV.

③ It is recommended to reserve space for dynamic response capacitors in the DC-DC power supply circuit to optimize the output ripple when the load changes greatly.



（4）Use of GPIO port

① Some GPIO ports are connected to the module. If you need to use them, it is recommended to connect a 10-100 ohm resistor in series to the IO port. This can suppress overshoot and make the levels on both sides more stable. It is helpful for EMI and ESD.

② For the pull-up and pull-down of special IO ports, please refer to the instructions in the specification, which will affect the startup configuration of the module.
③The IO port of the module is 3.3V. If the IO levels of the main control and the module do not match, a level conversion circuit needs to be added.
④ If the IO port is directly connected to a peripheral interface, or a pin header or other terminal, it is recommended to reserve an ESD device near the terminal on the IO trace.

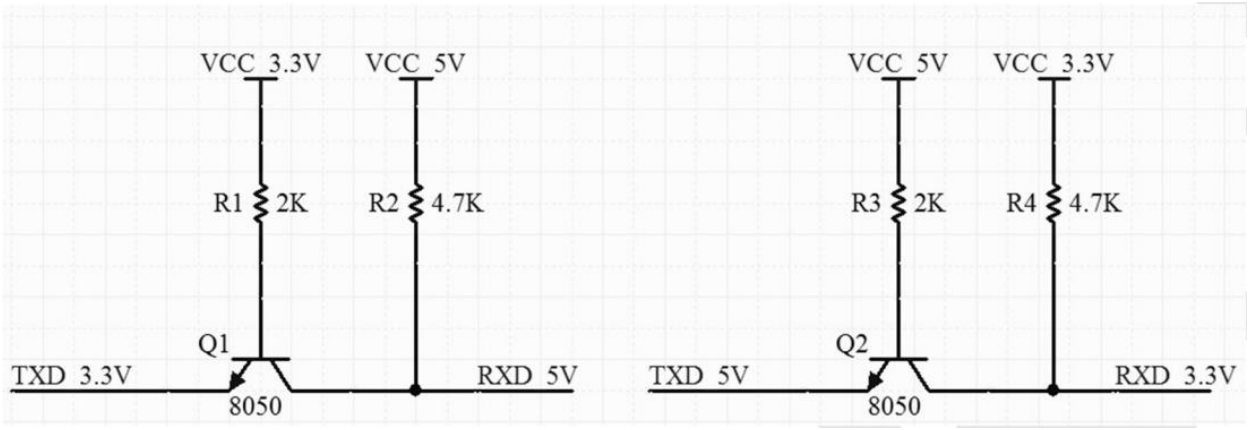
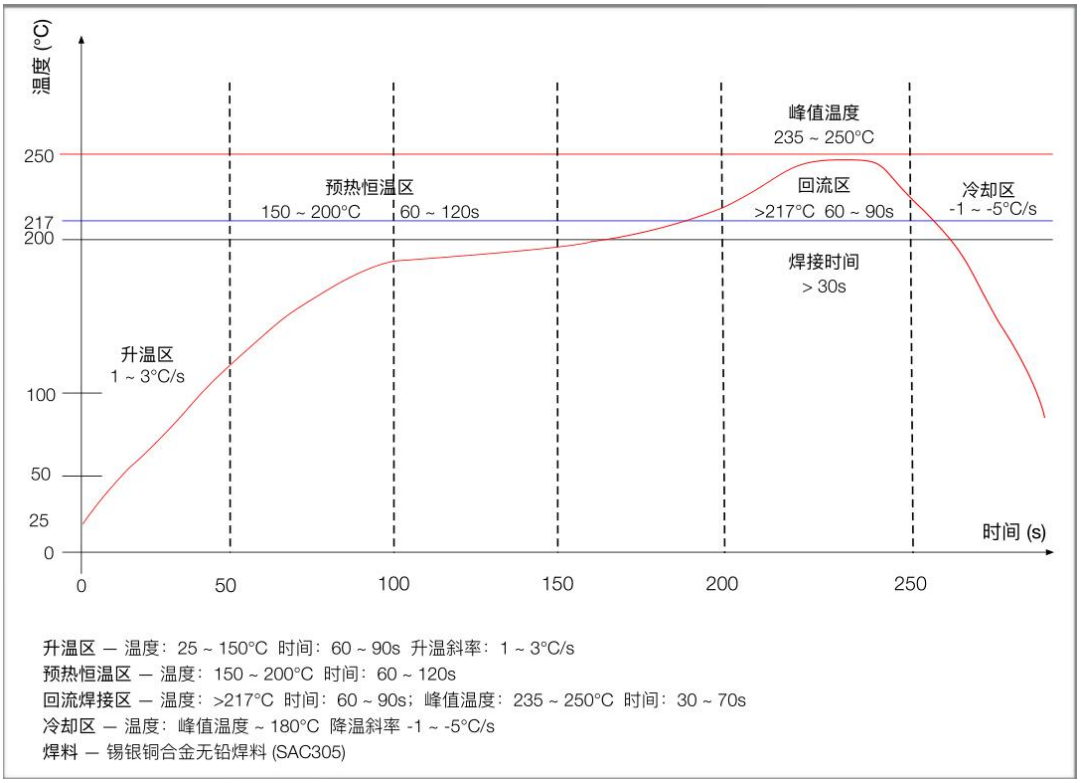


Figure 1. Level conversion circuit

8. Reflow Oven Profile



升温区 — 温度：25 ~ 150°C 时间：60 ~ 90s 升温斜率：1 ~ 3°C/s
预热恒温区 — 温度：150 ~ 200°C 时间：60 ~ 120s
回流焊接区 — 温度：>217°C 时间：60 ~ 90s；峰值温度：235 ~ 250°C 时间：30 ~ 70s
冷却区 — 温度：峰值温度 ~ 180°C 降温斜率 -1 ~ -5°C/s
焊料 — 锡银铜合金无铅焊料 (SAC305)

9. Packaging Information

As shown in the figure below, the packaging of ESP-01S is a tape . (The figure below is a schematic diagram)

10. Contact Us

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