



# ESP-12S 规格书

版本 V1.0

版权 ©2019

## Disclaimer and copyright notice

The information in this article, including the URL address for reference, is subject to change without prior notice. The Documentation is provided "as is" without any warranty, including any warranties of merchantability, fitness for a particular purpose, or non-infringement, and any warranties mentioned in the proposal, specification or sample. This document is not responsible for any infringement of any patent rights arising out of the use of the information in this document. No license, express or implied, by estoppel or otherwise, is hereby granted.

The test data obtained in this paper are all obtained by Ai-Thinker laboratory, and the actual results may be slightly different. The Wi-Fi alliance membership mark is owned by the WiFi alliance.

All trade mark names, trademarks and registered trademarks mentioned herein are the property of their respective owners and are hereby declared.

The final interpretation right is owned by Shenzhen Ai-Thinker Technology Co., Ltd.

### Note

The contents of this manual may be changed due to the version upgrade of the product or other reasons. Shenzhen Ai-Thinker Technology Co., Ltd. reserves the right to modify the contents of this manual without any notice. This manual is only used as a guide, and Shenzhen Ai-Thinker Technology Co., Ltd. makes every effort to provide accurate information in this manual, but Shenzhen Ai-Thinker Technology Co., Ltd. does not ensure that the contents of the manual are completely true, All statements and information in this manual. and the recommendations do not constitute for any warranty, express or implied.



---

## Contents

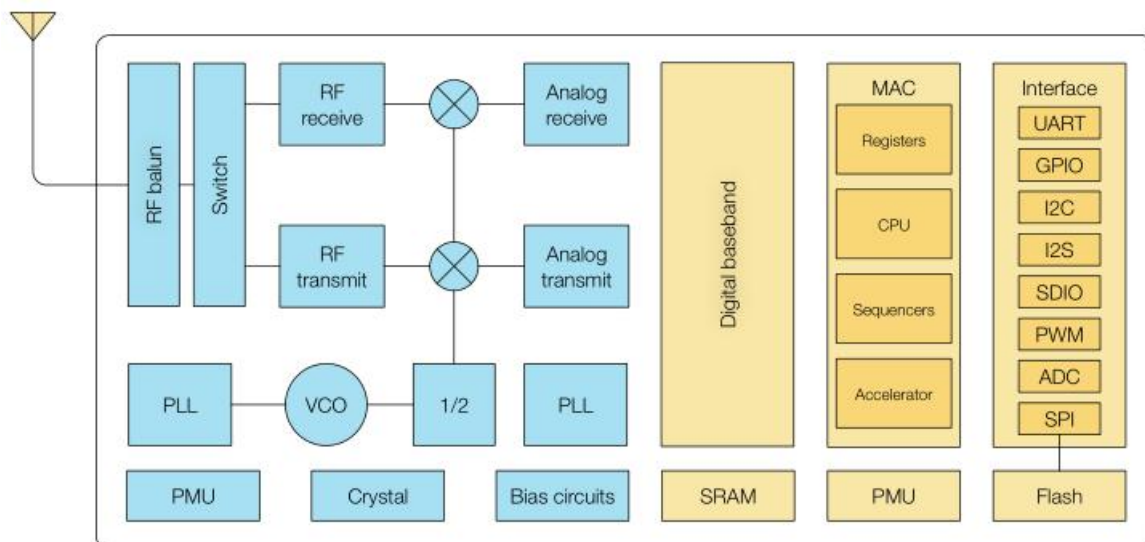
1. Product overview .....	5
2. Electrical parameter .....	8
3. Appearance size .....	10
4. Pin definition .....	11
5. Schematics .....	13
6. Design Guidance .....	14
7. Reflow Welding Curve .....	16
8. Packaging information .....	17
9. Contact us .....	17

## 1. Product overview

The ESP-12S WiFi module was developed by B&T Technology. The core processor of the module ESP8266 integrates the industry-leading Tensilica L106 ultra-low-power 32-bit micro MCU in a smaller package with 16-bit reduced mode. The main frequency supports 80 MHz and 160 MHz, supports RTOS, and integrates Wi-Fi MAC / BB / RF / PA / LNA.

The ESP-12S WiFi module supports the standard IEEE802.11 b/g/n protocol, a complete TCP/IP protocol stack. Users can use this module to add networking capabilities to existing devices or to build separate network controllers.

The ESP8266 is a high-performance wireless SOC that offers maximum utility at the lowest cost and unlimited possibilities for embedding WiFi functionality into other systems.



ESP8266 has a complete and self-contained Wi-Fi network function, which can be used independently or run as a slave on other host MCUs. When ESP8266 is applied independently, it can be started directly from external flash. The built-in cache memory helps improve system performance and optimizes the storage system.

Another case is that ESP8266 can be used as a Wi-Fi adapter only through SPI / SDIO interface or UART interface, and can be applied to any microcontroller-based design.

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

## Features

- Complete 802.11b / g / n Wi-Fi SoC module
- The core is Tensilica L106 low power 32-bit MCU, frequency supports 80 MHz and 160 MHz, supports RTOS
- Built-in 10-bit high-precision ADC
- Support UART / GPIO / ADC / PWM / SPI / I2C interface
- SMD-16 package for easy welding
- Integrated Wi-Fi MAC / BB / RF / PA / LNA
- Support multiple sleep modes, deep sleep current as low as 20uA
- UART baud speed up to 4Mbps
- Embedded Lwip protocol stack
- Support STA / AP / STA + AP operation mode
- Smart Config (APP) / AirKiss (WeChat) support for Android and IOS
- Support serial local upgrade and remote firmware upgrade (FOTA)
- General AT commands can be used easy and quickly
- Support for second development, integration of Windows、Linux development environment

## Parameters

Figure 1 Main Parameter

Model	ESP-12S
Package	SMD-16
Size	24*16*3(±0.2)MM
Antenna	PCB antenna
Frequency Range	2400 ~ 2483.5MHz
Operating Temperature	-20 °C ~ 70 °C
Storage Environment	-40 °C ~ 125 °C , < 90%RH
Power supply range	Voltage: 3.0V ~ 3.6V, Current>500mA
Interface	UART/GPIO/ADC/PWM/SPI/I2C
IO	9
UART Baud	Support 110 ~ 4608000 bps , default:115200 bps
Security	WEP/WPA-PSK/WPA2-PSK
SPI Flash	Default: 32Mbit
Certification	FCC、CE、RoHS、SRRC

## 2. Electrical parameter

### Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit
Storage temperature	VDD	3.0	3.3	3.6	V
I/O	$V_{IL}/V_{IH}$	-	-	0.25VIO/3.6	V
	$V_{OL}/V_{OH}$	-	-	0.1VIO/N	V
	$I_{MAX}$	-	-	12	mA

### Radio Performance

Description	Typ	Unit
Operating frequency	2400 - 2483.5	MHz
<b>Output Power</b>		
11n mode, PA output power	$13 \pm 2$	dBm
11g mode, PA output power	$14 \pm 2$	dBm
11b mode, PA output power	$16 \pm 2$	dBm
<b>Sensitivity</b>		
CCK, 1 Mbps	$\leq -90$	dBm
CCK, 11 Mbps	$\leq -85$	dBm
6 Mbps (1/2 BPSK)	$\leq -88$	dBm
54 Mbps (3/4 64-QAM)	$\leq -70$	dBm
HT20 (MCS7)	$\leq -67$	dBm



## Power Consumption

The following power consumption data were obtained from the tests with a 3.3V power supply and a voltage stabilizer, in 25°C ambient temperature.

- All measurements are done at the antenna interface without the SAW filter.
- All data are based on 90% duty cycle and measured in continuous transmission mode.

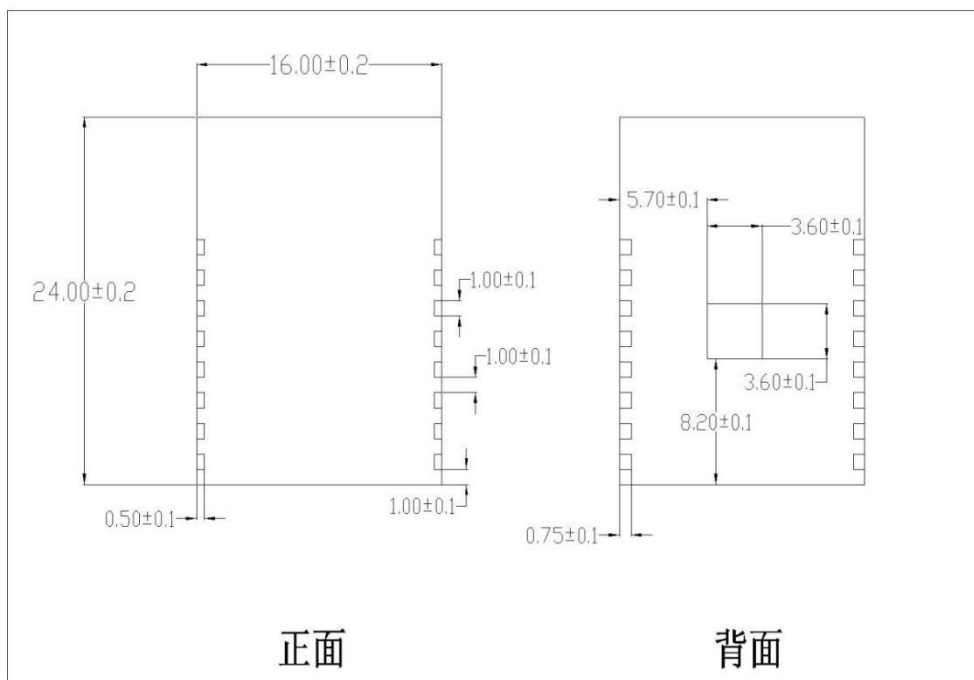
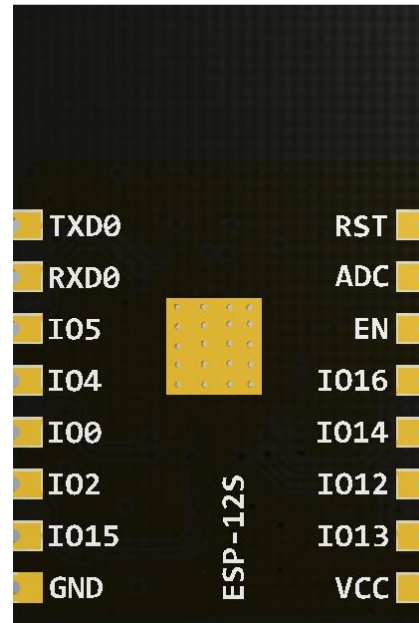
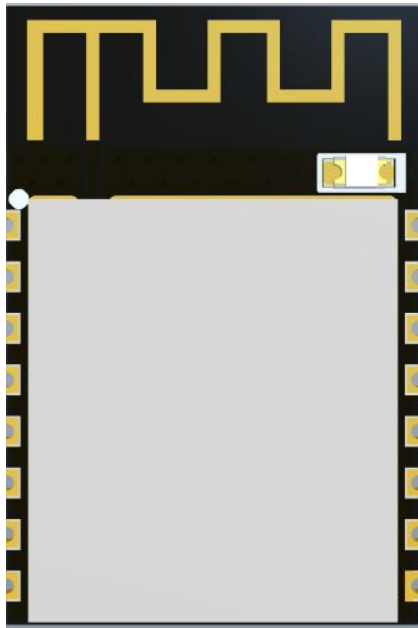
Mode	Min	Typ	Max	Unit
Tx 802.11b, CCK 11Mbps, POUT=+17dBm	-	170	-	mA
Tx 802.11g, OFDM 54Mbps, POUT =+15dBm	-	140	-	mA
Tx 802.11n, MCS7, POUT =+13dBm	-	120	-	mA
Rx 802.11b, 1024 bytes packet length, -80dBm	-	50	-	mA
Rx 802.11g, 1024 bytes packet length, -70dBm	-	56	-	mA
Rx 802.11n, 1024 bytes packet length, -65dBm	-	56	-	mA
Modem-Sleep <sup>①</sup>	-	20	-	mA
Light-Sleep <sup>②</sup>	-	2	-	mA
Deep-Sleep <sup>③</sup>	-	20	-	uA
Power Off	-	0.5	-	uA

### Note:

- Modem-sleep is used when such applications as PWM or I2S require the CPU to be working. In cases where Wi-Fi connectivity is maintained and data transmission is not required, the Wi-Fi Modem circuit can be shut down to save power, according to 802.11 standards (such as U-APSD). For example, in DTIM3, when ESP8266EX sleeps for 300ms and wakes up for 3ms to receive Beacon packages from AP, the overall average current consumption is about 20mA.
- During Light-Sleep, the CPU may be suspended in applications like Wi-Fi switch. Without data transmission, the Wi-Fi Modem circuit can be turned off and CPU suspended to save power according to the 802.11 standard (U-APSD).  
 E.g. in DTIM3, to maintain a sleep 300ms-wake 3ms cycle to receive AP's Beacon packages, the current is about 0.9mA.

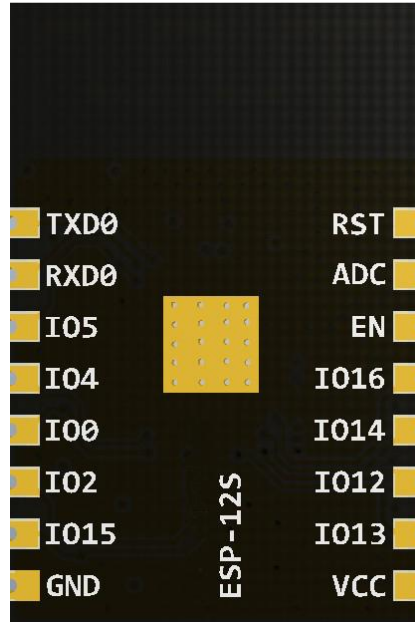
Deep-Sleep does not require Wi-Fi connection to be maintained. For application with long time lags between data transmission, e.g. a temperature sensor that checks the temperature every 100s, sleep 300s and waking up to connect to the AP (taking about 0.3~1s), the overall average current is less than 1mA.

### 3.Appearance size



## 4.Pin definition

ESP-12S has 16 interfaces, show as the pin diagram, the pin function definition table is the interface definition.



ESP-12S Pin diagram

Table Pin function definition

No.	Name	Function
1	RST	Reset, active low
2	ADC	A/D conversion, Input voltage range 0~1V, the value range is 0~1024.
3	EN	Chip Enabled Pin, Active High
4	IO16	Connect with RST pin to wake up Deep Sleep
5	IO14	HSPI_CLK/IR_T/I2C_CLK/I2SI_WS
6	IO12	HSPI_MISO
7	IO13	HSPI_MOSI/UART0_CTS
8	VCC	3.3V; output current of external power supply is recommended over 500mA
9	GND	Ground
10	IO15	HSPI_CS/U0_RTS/I2SO_BCK

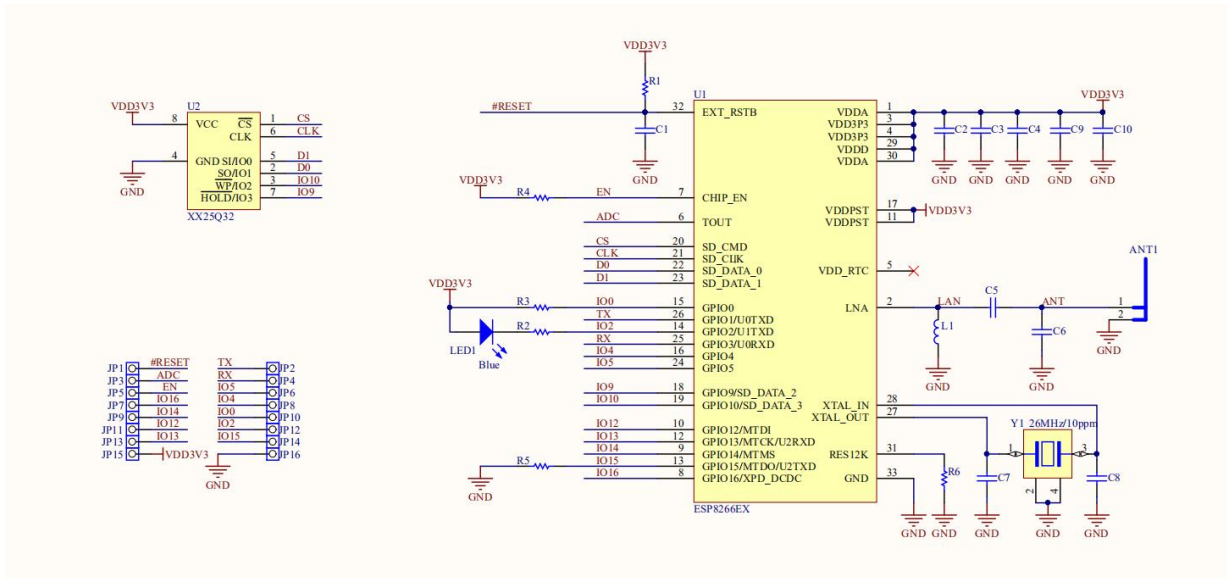
11	IO2	U1_TXD/I2C_SDA/I2SO_WS
12	IO0	GPIO0; download mode:external pull low, running mode: floating or external pull high
13	IO4	GPIO4
14	IO5	IR_R
15	RX	RX receive
16	TX	TX transmit

Table Description of the ESP series module boot mode

Mode	CH_PD(EN)	RST	GPIO15	GPIO0	GPIO2	TXD0
Download mode	High	High	Low	Low	High	High
Running mode	High	High	Low	High	High	High

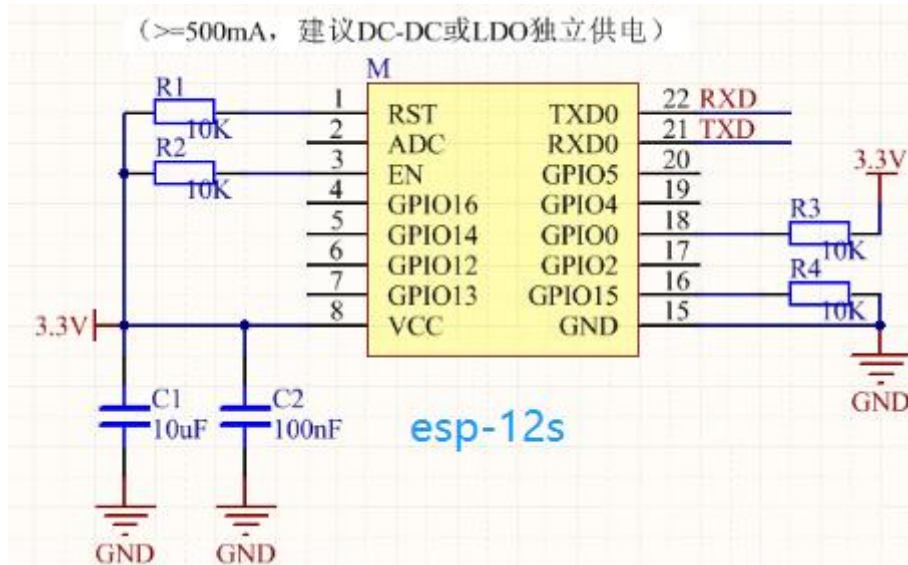
Note: Some of the pins inside the module had been pulled up or pulled down, Please refer to the schematic diagram.

## 5.Schematics



## 6.Design Guidance

### 1、Application Circuit



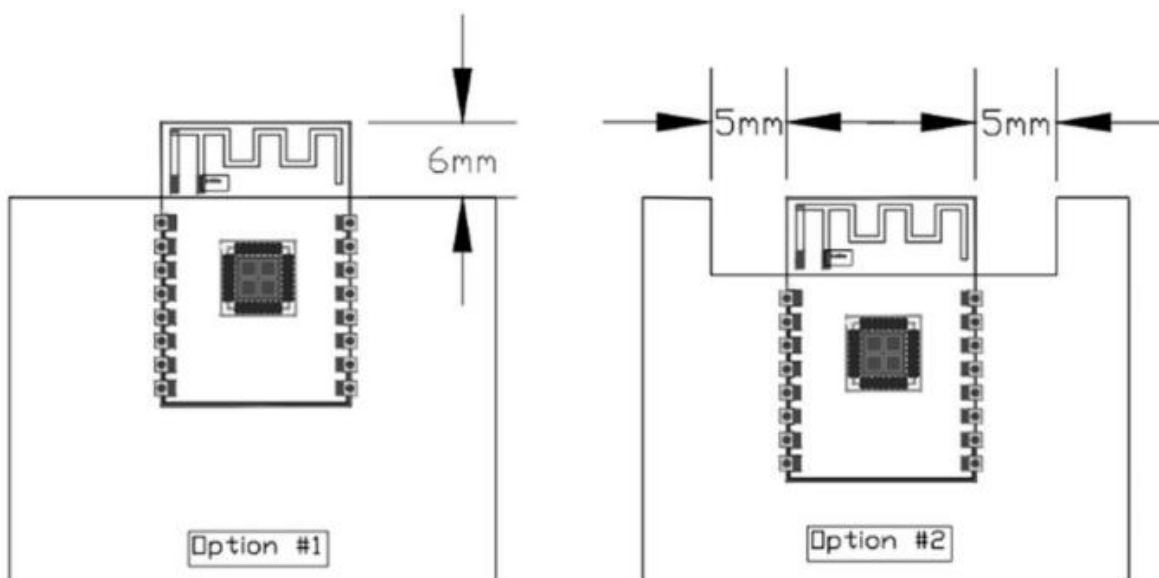
### 2、Antenna layout requirements

(1). Installation position on the main board, advise for following two ways:

Option 1: The module is placed on the edge of the main board, and the antenna area is extended out of the edge of the main board.

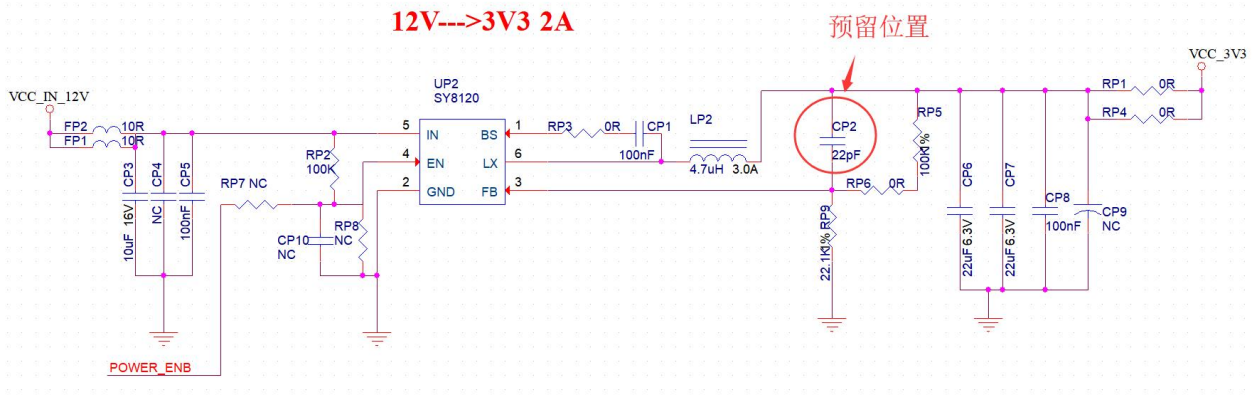
Option 2: Put the module on the edge of the motherboard, and the edge of the motherboard is hollowed out in the antenna position.

(2). In order to meet the performance of the on-board antenna, metal parts are prohibited from being placed around the antenna.



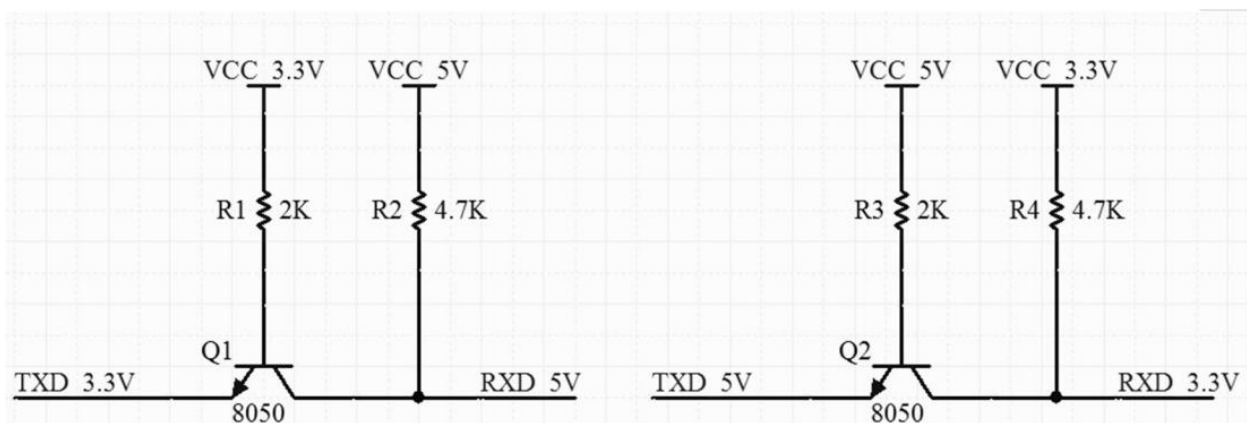
### 3、Power Supply

- (1). Recommended voltage 3.3 V, Peak:Current over 500mA .
- (2). It is recommended to use the IDO power supply; If DC-DC is used, the ripple is controlled within 30 mV.
- (3). DC-DC power supply circuit is recommended to reserve the position of the dynamic response capacitor, and the output ripple can be optimized when the load change is large.
- (4). 3.3V power interface is recommended to add ESD devices.



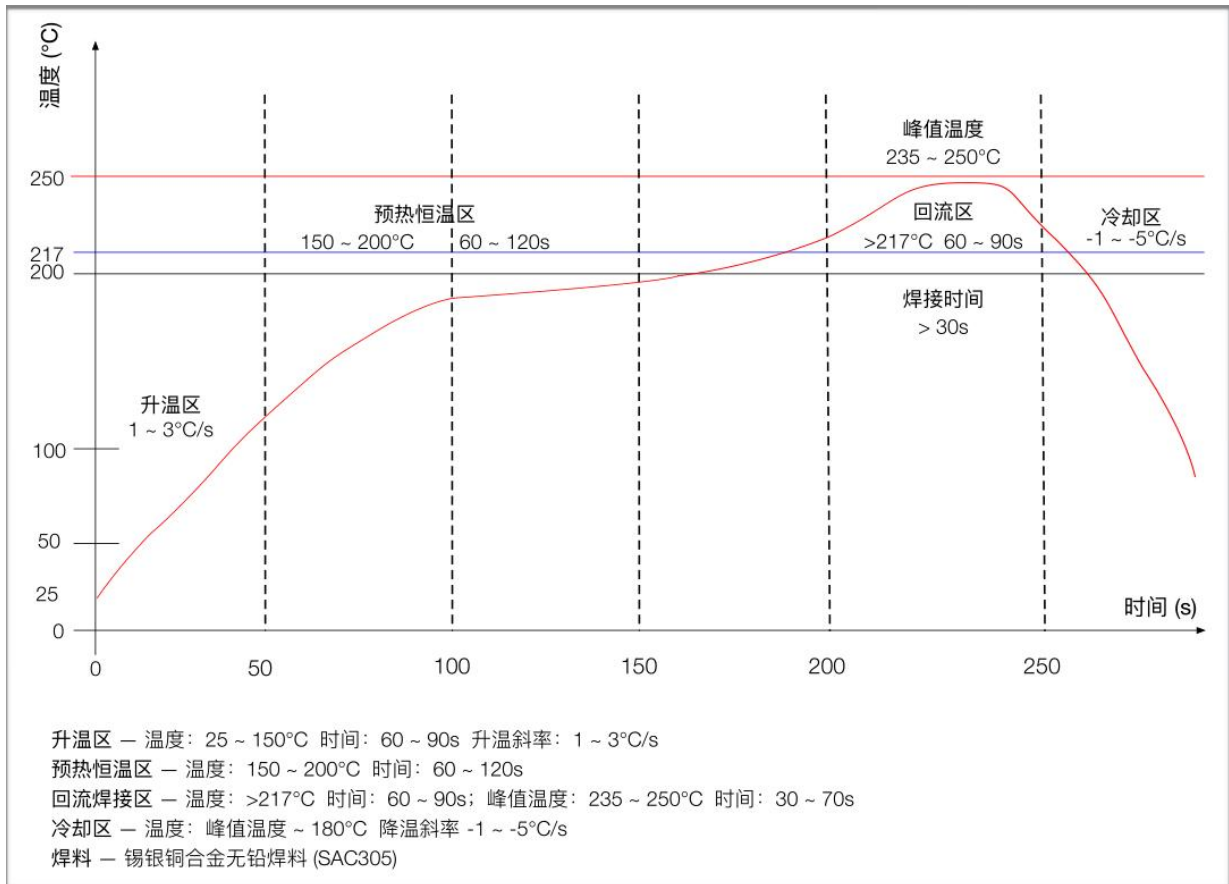
### 4、GPIO

- (1). There's a few GPIO port design outside the module, if require to use recommend the IO port to tadem the resistance for 10 to 100 ohmic. This can suppress overshoot, It's even more stable on both sides. It would help both EMI and ESD.
- (2). Special IO's pull up and down, should refer to the direction of use in Specification, here will affect the startup configuration of the module.
- (3). IO port of module is 3.3V, if master control and the IO level of module doesn't match, required to add Level switching circuit.
- (4). If IO port connected to out-ring interface directly, pin or other etc, recommended to reserved ESD device near the terminal of IO circuit line .



Level switching circuit

## 7.Reflow Welding Curve





## 8.Packaging information

As shown below, the packaging of ESP-12S is braided.



## 9.Contact us

Official website: <https://www.ai-thinker.com>

Develop DOCS: <https://docs.ai-thinker.com>

Official Forum: <http://bbs.ai-thinker.com>

Sample purchase: <https://anxinke.taobao.com>

Business cooperation: [sales@aithinker.com](mailto:sales@aithinker.com)

Technical support: [support@aithinker.com](mailto:support@aithinker.com)

Company address: Shenzhen Baoan District Xixiang

Gushu Huafeng Smart Innovation Port C building 410

Contact number: 0755-29162996

