



ESP-13U Specification

Version V1.1

Copyright ©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.

Document development/revision/revocation resume

Version	Date	Revised content	Edition	Approve
V1.0	2020.10.28	First Edition	Yuan Nannan	Xuhong
V1.1	2021.04.25	Update size of module	Yuan Nannan	Yuan Nannan

CONTENT

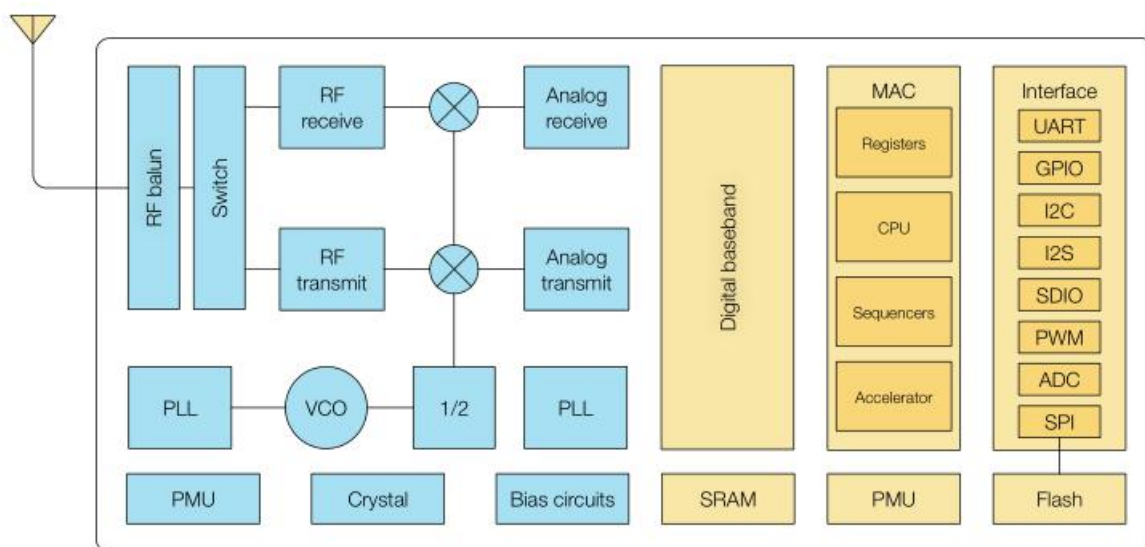
一、 Product Overview.....	V
二、 Electrical parameters.....	VIII
三、 Appearance size.....	X
四、 Pin definition.....	XI
五、 Schematics.....	XIII
六、 Design Guidance.....	XIII
七、 Reflow Welding Curve.....	XVI
八、 Package Information.....	XVII
九、 Contacts.....	XVII

一、Product Overview

ESP-13U WiFi module was developed by Ai-Thinker 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.

ESP-13U 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 MCU. 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 is 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
- Using SMD-18 package
- Integrated Wi-Fi MAC/ BB/RF/PA/LNA
- Support multiple sleep modes, the standby power consumption 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 UART port 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-13U
Package	SMD-18
Size	18*14*3(±0.2)MM
Antenna	I-PEX, Customers can match their own antenna
Frequency range	2400 ~ 2483.5MHz
Operating Temperature	-40 °C ~ 85 °C
Storage Temperature	-40 °C ~ 125 °C , < 90%RH
Power supply range	Supply voltage 3.0V ~ 3.6V, Supply current >500mA
Support Interface	UART/GPIO/ADC/PWM/SPI/I2C
I/O	9
UART Rate	Support 110 ~ 4608000 bps , default 115200 bps
Security	WEP/WPA-PSK/WPA2-PSK
SPI Flash	Default 32Mbit
Certification	FCC、CE、RoHS、SRRC

二、Electrical parameters

ESP-13U module is electrostatic sensitive equipment, special preventive measures should be taken during handling



Electrical characteristics

Parameter		Condition	Min.	Typ.	Max.	Unit
Supply voltage		VDD	3.0	3.3	3.6	V
I/O	V_{IL}/V_{IH}	-	-0.3/0.75V _{IO}	-	0.25V _{IO} /3.6	V
	V_{OL}/V_{OH}	-	N/0.8V _{IO}	-	0.1V _{IO} /N	V
	I_{MAX}	-	-	-	12	mA

WIFI RF performance

Description	Typ.	Unit
Operating frequency	2400 - 2483.5	MHz
Output power		
11n mode, PA output power	13±2	dBm
11g mode, PA output power	14±2	dBm
11b mode, PA output power	16±2	dBm
Receiving sensitivity		
CCK, 1 Mbps	≤ -90	dBm
CCK, 11 Mbps	≤ -85	dBm
6 Mbps (1/2 BPSK)	≤ -88	dBm

54 Mbps (3/4 64-QAM)	≤ -70	dBm
HT20 (MCS7)	≤ -67	dBm

Power consumption

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

- All measurements are completed at the antenna interface without SAW filters.
- all emission data were measured in the mode of continuous emission based on a 90% duty cycle.

Mode	Min.	Typ.	Max.	Unit
Transfer 802.11b, CCK 11Mbps, POUT=+17dBm	-	170	-	mA
Transfer 802.11g, OFDM 54Mbps, POUT =+15dBm	-	140	-	mA
Transfer 802.11n, MCS7, POUT =+13dBm	-	120	-	mA
Receive 802.11 b, packet length 1024 bytes ,-80 dBm	-	50	-	mA
Receive 802.11 g, packet length 1024 bytes ,-70 dBm	-	56	-	mA
Receive 802.11 n, packet length 1024 bytes ,-65 dBm	-	56	-	mA
Modem-Sleep①	-	20	-	mA
Light-Sleep②	-	2	-	mA
Deep-Sleep③	-	20	-	uA
Power Off	-	0.5	-	uA

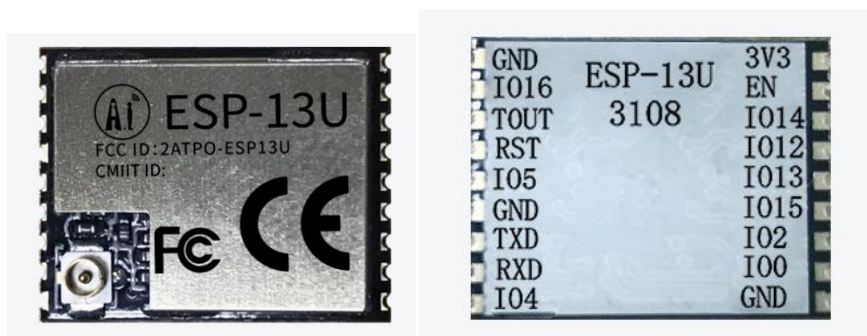
Note:

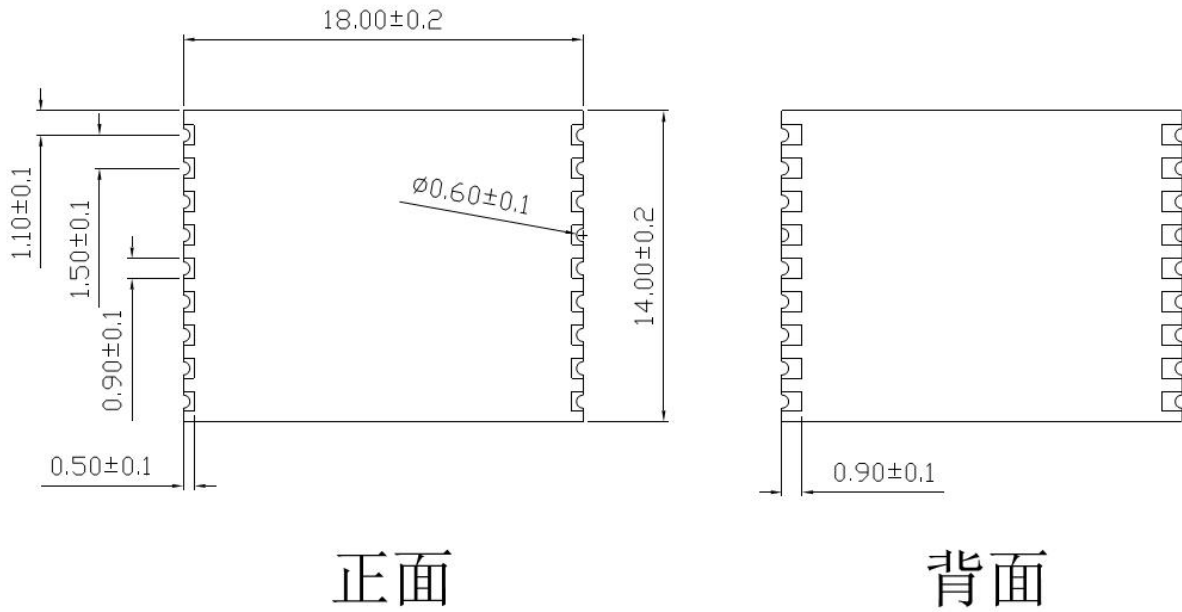
- Modem-sleep for applications that require CPU to remain in working condition, such as PWM or I2S applications, etc. And while maintaining Wi-Fi connection, If there's no data transfer, According to the 802.11 standard (e.g. U-APSD),

close the Wi-Fi Modem circuit to save electricity. For example, at DTIM3 per 300 ms sleep mode and wake up 3 ms to receive AP Beacon packets, the overall average current is about 20mA.

- Light-sleep used for CPU suspensive applications, like Wi-Fi switch. And while maintaining Wi-Fi connection, If there's no data transfer, could according to the 802.11 standard (e.g. U-APSD), turn off the Wi-Fi Modem circuit and pause the CPU to save electricity. For example, at DTIM3 per 300 ms sleep mode and wake up 3 ms to receive AP Beacon packets, the overall average current is about 2mA.
- Deep-sleep is used for applications that do not need to keep Wi-Fi connected all the time, and just sending a packet after a long time, every 100s to measure temperature, for example, need 0.3 s ~ 1 s to send data every 300s wake up, and the overall average current is much less than 1mA. The current value of 20 μA is measured at 2.5V.

三、 Appearance size





四、 Pin definition

ESP-13U has eighteen interface, refer to following Pin diagram.

GND	ESP-13U	3V3
I016		EN
TOUT	3108	I014
RST		I012
I05		I013
GND		I015
TXD		I02
RXD		I00
I04		GND

ESP-12F pin diagram

Table Pin function definition

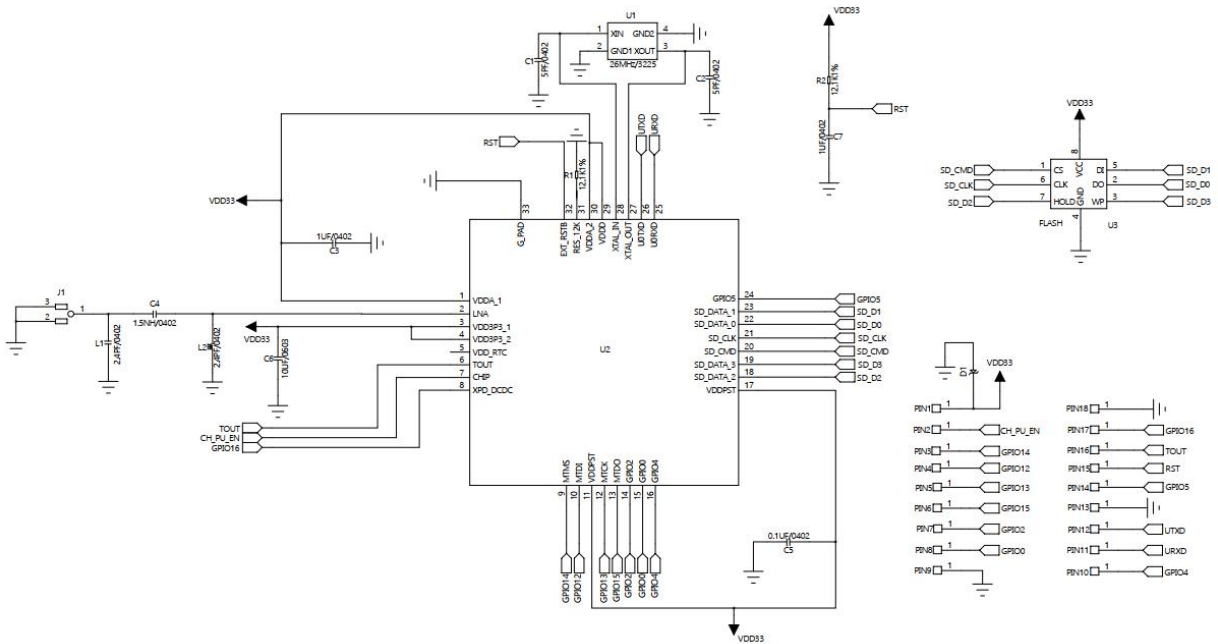
No	Name	Function
1	3V3	3.3V power supply (VDD); external power supply output current recommended above 500 mA
2	EN	chip enable end, high level efficient
3	I014	GPI014/HSPI_CLK
4	I012	GPI012/HSPI_MISO
5	I013	GPI013/HSPI_MOSI/UART0_CTS
6	I015	GPI015/MTDO/HSPICS/UART0_RTS
7	I02	GPI02/UART1_TXD
8	I00	GPI00 ; download mode:external pull down , operating/running mode:suspension or external pull up
9 13 18	GND	Ground
10	I04	GPI04
11	RXD	UART0_RXD/GPI03
12	TXD	UART0_TXD/GPI01
14	I05	GPI05/IR_R
15	RST	Reset
16	TOUT	ADC port
17	I016	GPI016/ can wake up deep sleep when you connect RST pin

Table Description of the ESP series module boot mode

Mode	CH_PD(EN)	RST	GPI015	GPI00	GPI02	TXD0
Download mode	High	High	Low	Low	High	High
Operating mode	High	High	Low	High	High	High

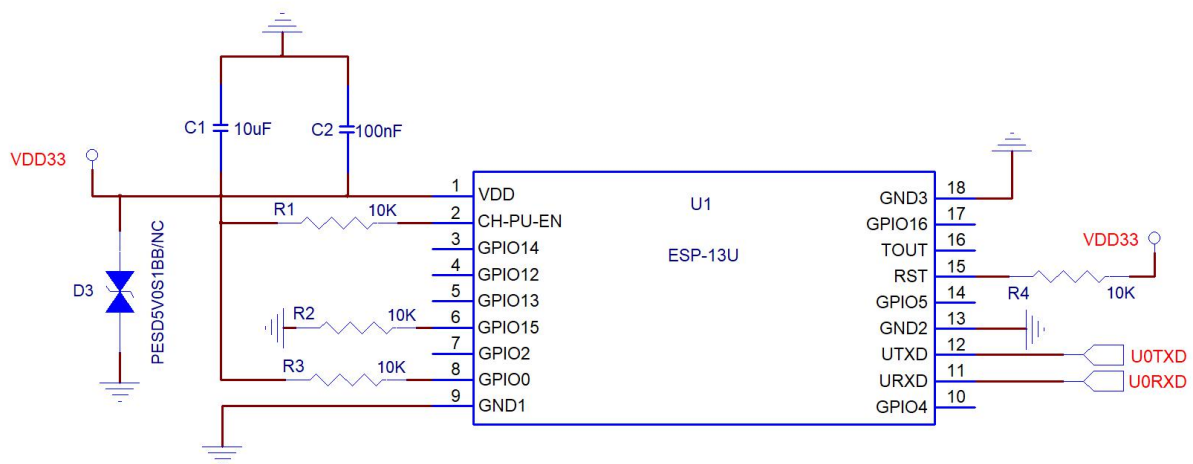
Note: Some of the pins inside the module had been pulled up or pulled down, Please refer to the schematic diagram.

五、 Schematics



六、 Design Guidance

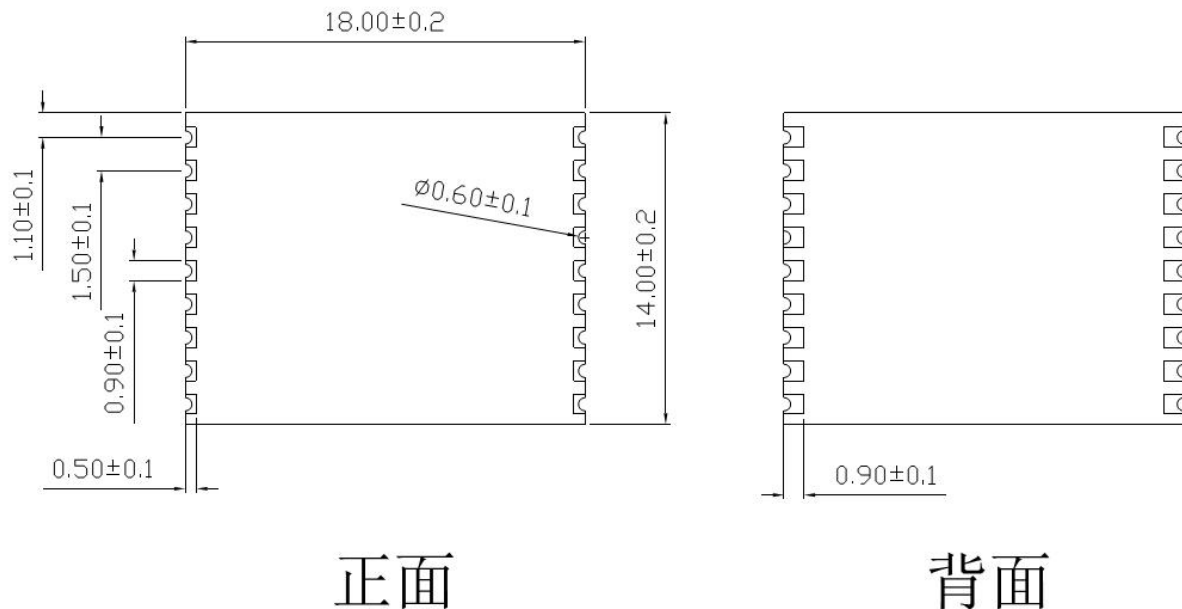
1、 Application Circuit



Note:

- (1)、Module external circuit, GPIO0 must pull up. VCC,GPIO15 must pull down to GND.
- (2)、EN and RST pin must pull to VCC.

2、Recommended Module Package Design Size

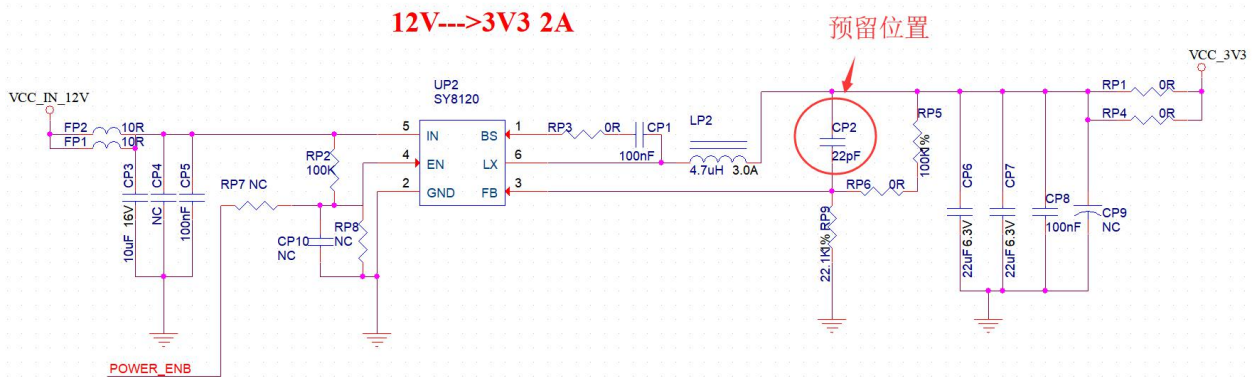


Note:

This is the ESP-13U module package diagram, it is recommended to design the PCB plate according to this diagram, so that the module can work normally on PCB board, When designing the pad, we should pay attention to the fact that the specific module of the pad design on the PCB can not correspond to the internal shrinkage offset of the pad, but the expansion of the PCB pad relative to the module pad does not affect the use of the module.

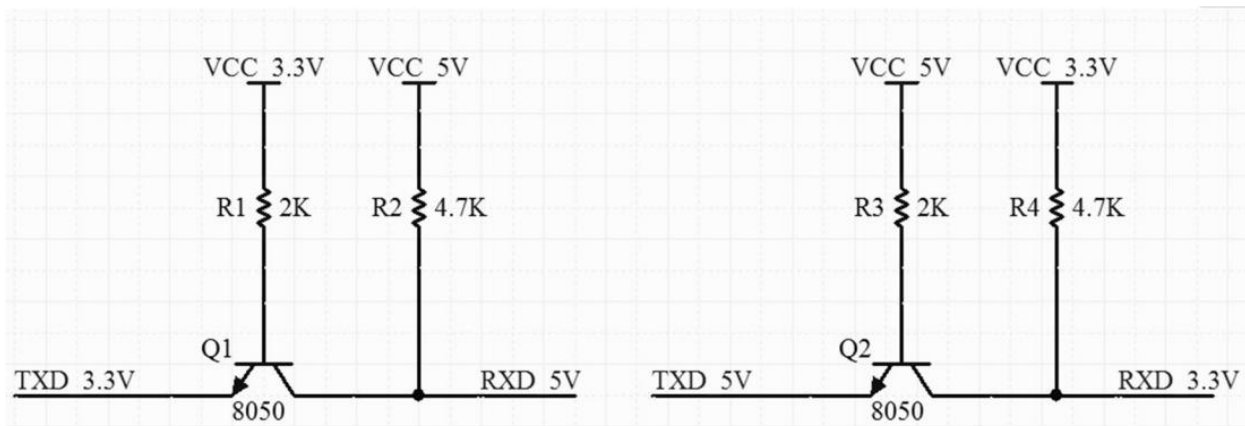
3、Power Supply

- (1)、Recommended voltage 5V, Peak:Current over 800mA .
- (2)、It is recommended to use the LDO 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)、Proposed addition of ESD Devices to 5V Power supply Interface.



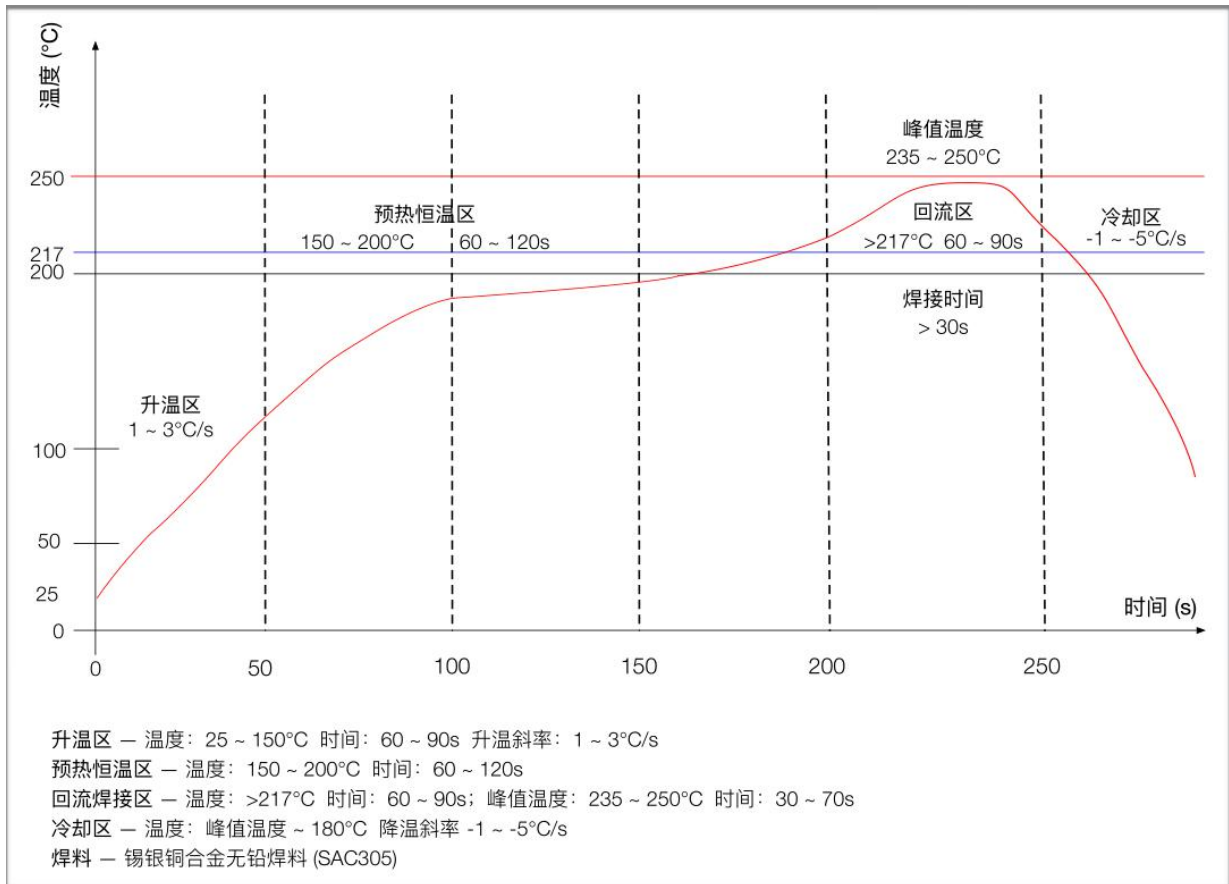
4、GPIO

- (1) At the periphery of the module, some GPIO ports are led out, and a resistance of 10-100 ohms can be connected in series on the IO port for use. This suppresses overshoot and is more stable on both sides. Help for both EMI and ESD.
- (2) For the up-and-down drawing of the special io-port, reference will be made to the use description of the specification, which will affect the start-up configuration of the module.
- (3) The IO port of the module is 3.3 v. If the main control does not match the io-level of the module, it is necessary to increase the level conversion circuit. (4) If the IO interface is directly connected to the peripheral interface, or the pins and other terminals, it is recommended to reserve the ESD device near the terminal at the IO trace.



Level switching circuit

七、Reflow Welding Curve



八、 Package Information

As shown below, the packing of ESP-13U is in tape/reel.



九、 Contacts

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

Developer Wiki: <http://wiki.ai-thinker.com>

Company forum: <http://bbs.ai-thinker.com>

Sampling purchasing: <https://anxinke.taobao.com>

Business cooperation: sales@aithinker.com

Technology support: support@aithinker.com

Company address: Seventh floor, Building B, xixiang street Baoan District, Shenzhen, China

Contacts: 0755-29162996

