



ESP-13U Specification

Version V1.0

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Document development/revision/revocation resume

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V1.0	2020.10.28	First Edition	Yuan Nannan	

CONTENT

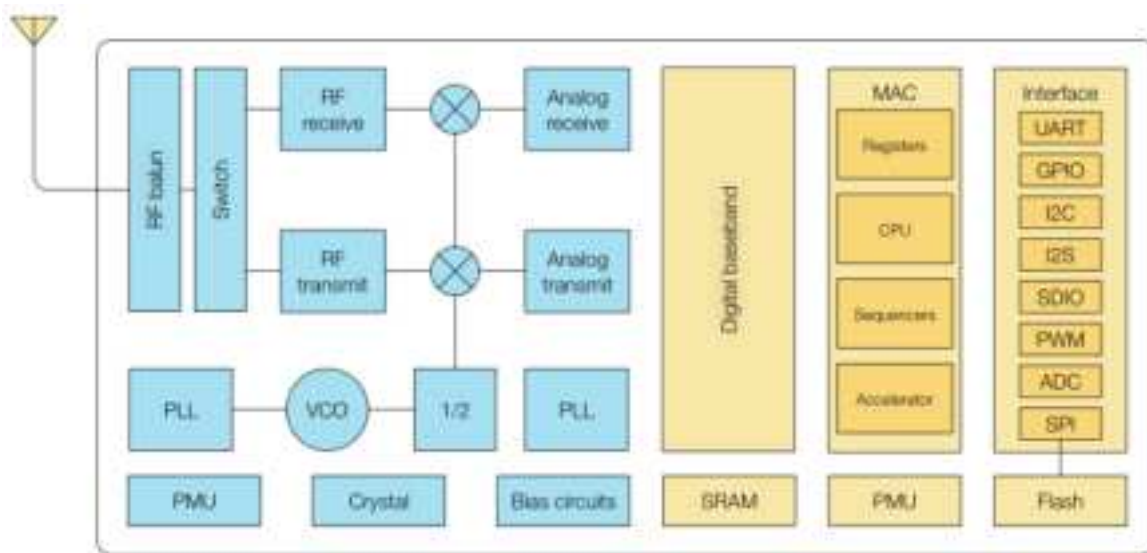
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1. Product Overview

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	28*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
IO	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

2. 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

Note: The maximum output power cannot more than 18dBm

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.

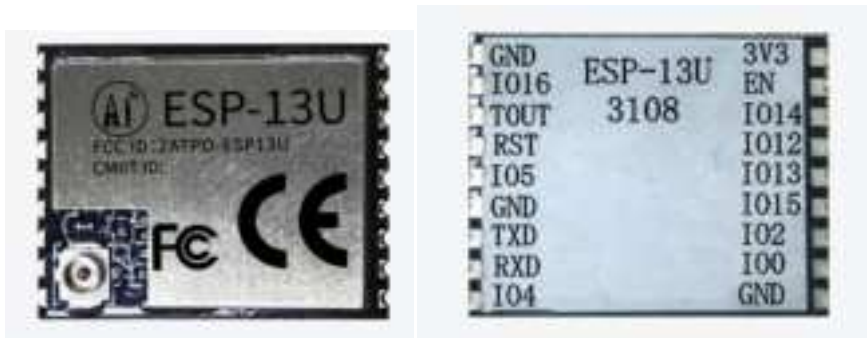
Mode	Min.	Typ.	Max.	Unit
Transfer802.11b, CCK 11Mbps, POUT=+17dBm	–	170	–	mA
Transfer802.11g, OFDM 54Mbps, POUT =+15dBm	–	140	–	mA
Transfer802.11n, MCS7, POUT =+13dBm	–	120	–	mA
Receive 802.11 b, packet length 1024 bytes , -80 dBm	–	50	–	mA
Receive 802.11 g, packet length 1024 bytes , -70 dBm	–	56	–	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 DTIM3per 300 ms sleep mode andwake 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 DTIM3per 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 $0.3\text{ s} \sim 1\text{ s}$ to send data every 300s wake up, and the overall average current is much less than 1mA. The current value of $20\text{ }\mu\text{A}$ is measured at 2.5V.

3. Appearance size

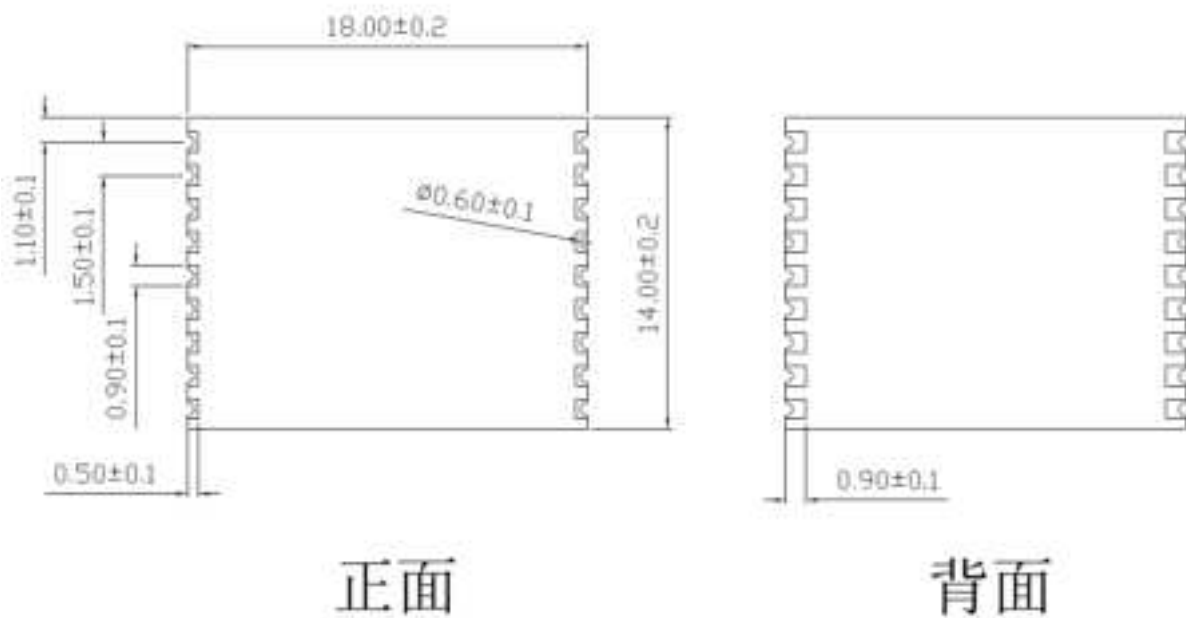


4. A complete Appearance size



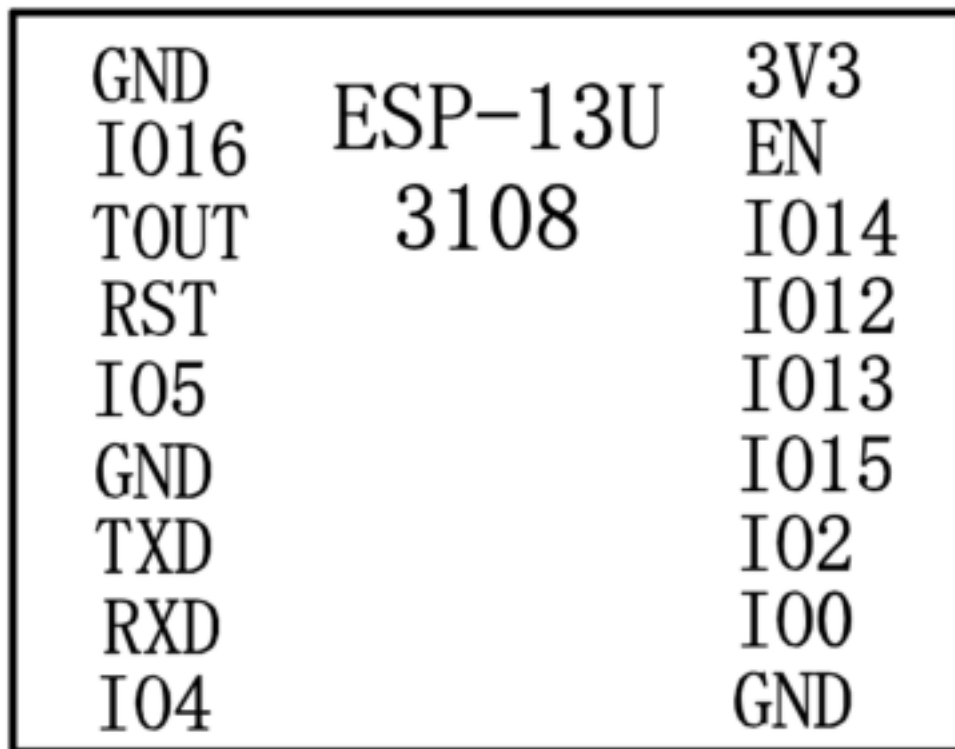
RF exposure considerations

To maintain compliance with FCC' s RF Exposure guidelines, This equipment should be installed and operated with minimum distance between 20cm the radiator your body: Use only the supplied antenna and can not remove.



5. Pin definition

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



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/MTD0/HSPICS/UART0_RTS
7	I02	GPI02/UART1_TXD

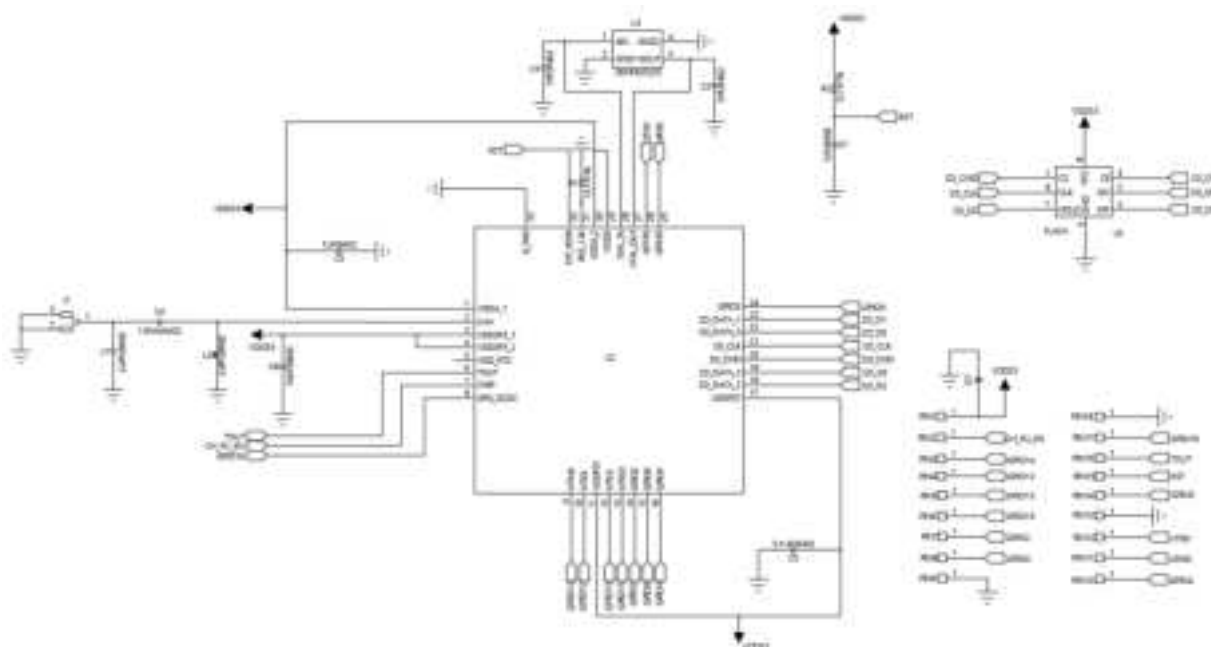
8	I00	GPI00; download mode: external pull down, operating/running mode: suspension or external pull up
9 13 18	GND	Ground
10	I04	GPI04
11	RXD	UART0_RXD/GPI03
12	TXD	UART0_TXD/GPI01
14	I05	GPI05/IR_R
15	RST	Reset
16	TOUT	ADC port
17	I016	GPI016/ can wake up deep sleep when you connect RST pin

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

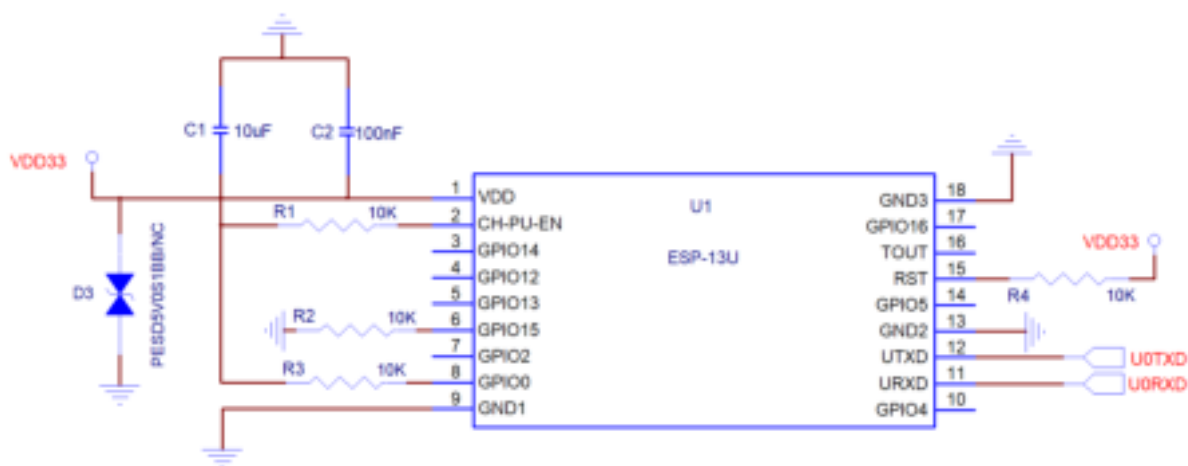
Note: Some of the pins inside the module had been pulled up or pulled down, Please refer to the schematic diagram.

6. Schematics



7. Design Guidance

1、Application Circuit

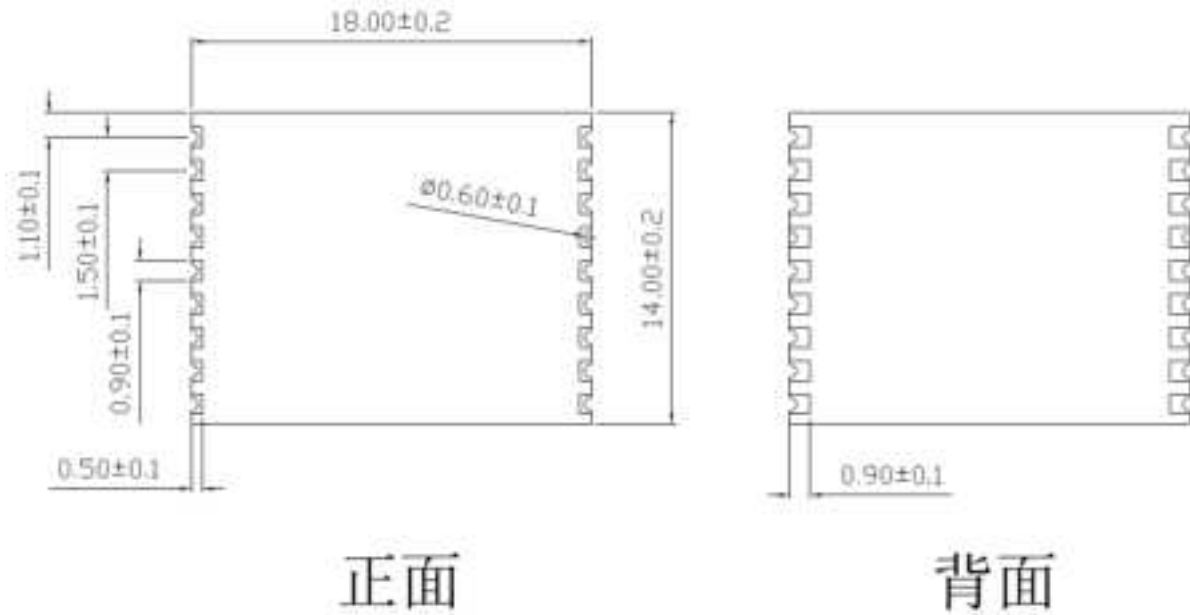


Note:

(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:

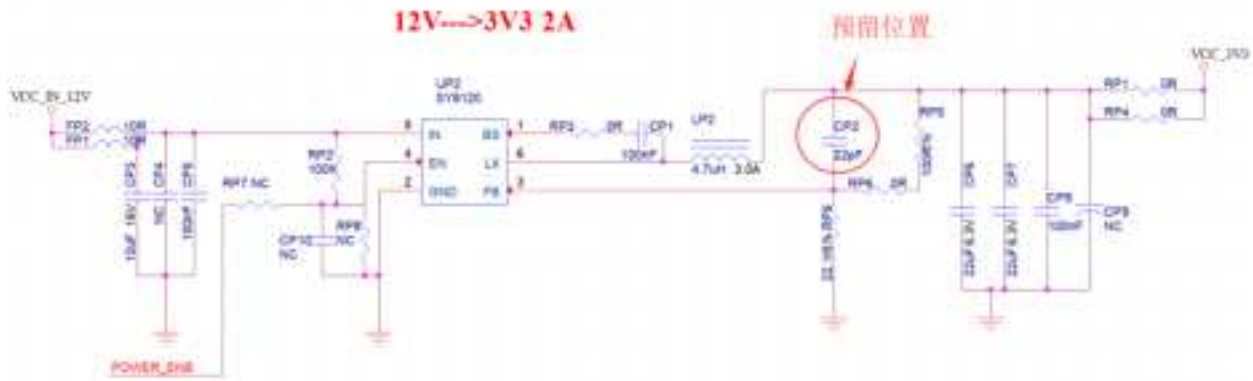
This is the ESP-13U module package diagram, it is recommended to design the PCB plate according to this diagram, so that the module can work normally on PCB board, When designing the pad, we should pay attention to the fact that the specific module of the pad design on the PCB can not correspond to the 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 over800mA.
- (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.

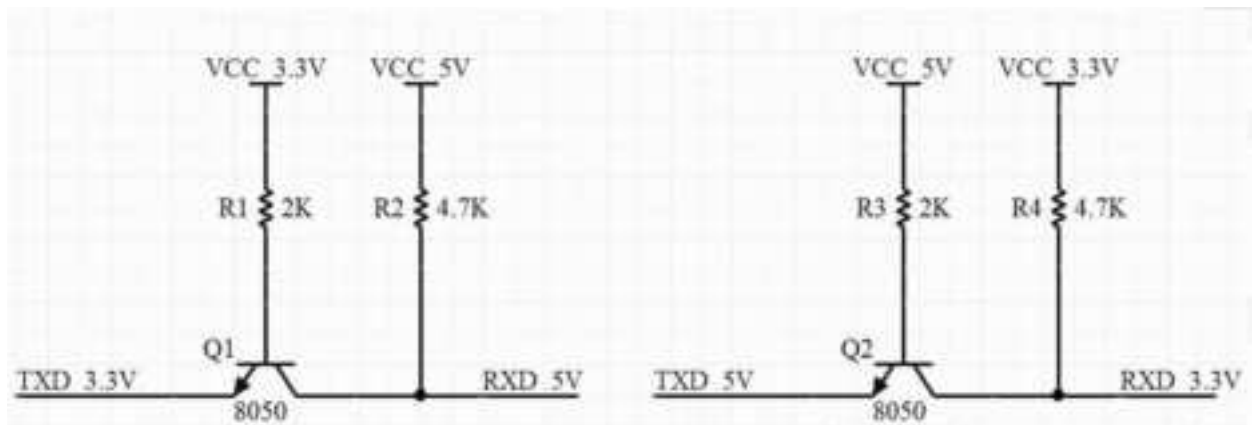


4、GPIO

(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.

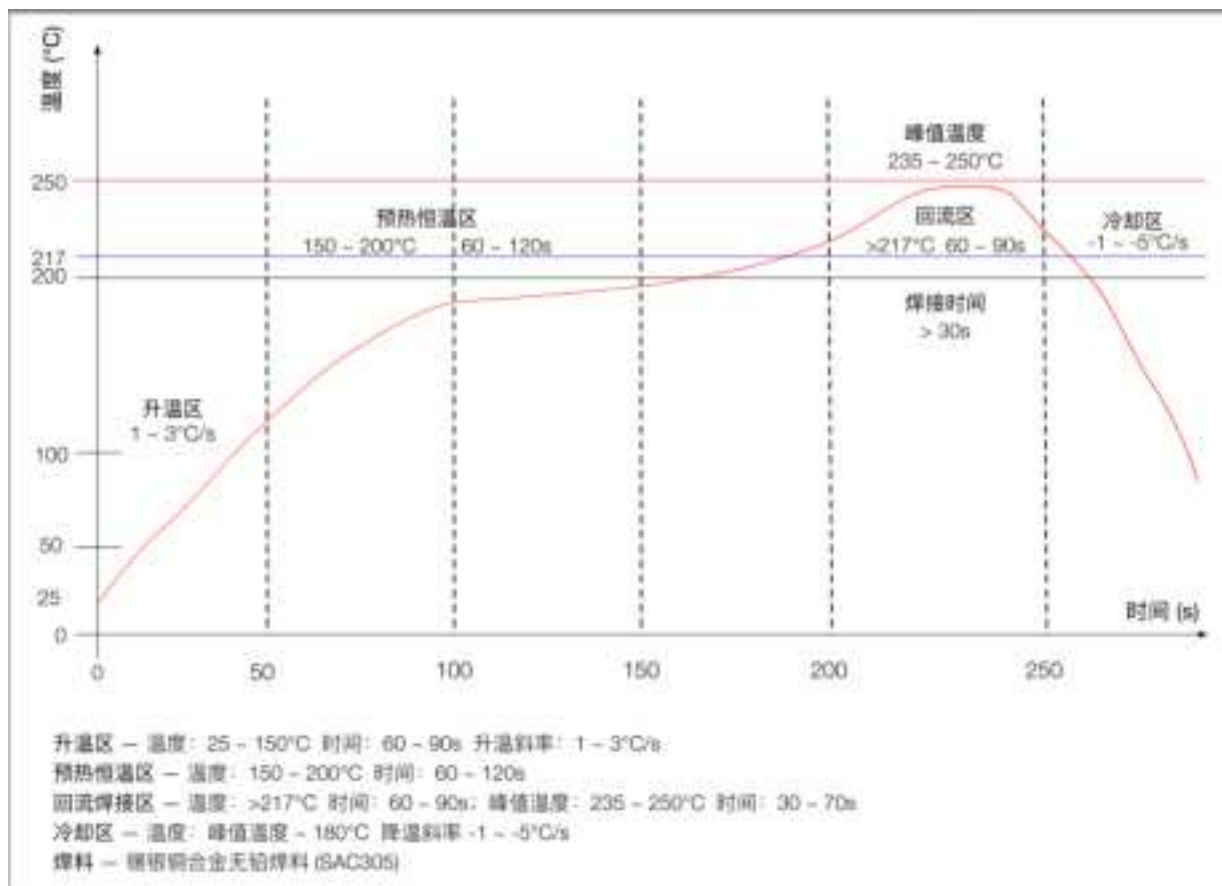
(2) For the up-and-down drawing of the special io-port, reference will be made to the use description of the specification, which will affect the start-up configuration of the module.

(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

8. Reflow Welding Curve



9. Package Information

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



10. 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



OEM/Integrators Installation Manual

Important Notice to OEM integrators

INTEGRATION INSTRUCTIONS

FCC rules

The ESP-13U is an Wi-Fi Module with frequency hopping. It operates on the 2400 ~2500 MHz band and, therefore, is within U.S. FCC part 15.247 standard.

Modular installation instruction

1,ESP-13U Integrates high-speed GPIO and peripheral interface. Please pay attention to the installation direction (pin direction).

2,Antenna could not be in no-load state when module is working. During debugging, it is suggested to add 50 ohms load to the antenna port to avoid damage or performance degradation of the module under long-time no-load condition.

3,When the module needs to output 15dBm or more power, it needs a voltage supply of 3.6V or more to achieve the expected output power.

4,When working at full load, it is recommended that the entire bottom surface of the module be attached to the housing or heat dissipation plate, and it is not recommended to conduct heat dissipation through air or screw column heat conduction.

5,UART1 and UART2 are serial ports with the same priority. The port which receives commands returns information.

Trace antenna designs

Not Applicable

Antennas

The ESP-13U is an BT Module beams signals and communicates with its antenna, which is FPCB Antenna. The FPCB Antenna gain is 0.5dBi

LABEL OF THE END PRODUCT

The final end product must be labeled in a visible area with the following:

Host must Contains FCC ID: 2ATP0-ESP13U. If the size of the end product is larger than 8x10cm, then the following FCC part 15.19 statement has to also be available on the label: This device complies with Part 15 of FCC rules. Operation is subject to the following two conditions:

- (1) this device may not cause harmful interference and
- (2) this device must accept any interference received, including interference that may cause undesired operation.

Information on test modes and additional testing requirements

Data transfer module demo board can control the EUT work in RF test mode at specified test channel.

Additional testing, Part 15 Subpart B disclaimer

The module without unintentional-radiator digital circuit, so the module does not required an evaluation by FCC Part 15 Subpart B. The host should be evaluated by the FCC Subpart B.

ATTENTION

This device is intended only for OEM integrators under the following conditions:

1) The antenna

must be installed such that 20 cm is maintained between the antenna and users, and

2) This device and its antenna(s) must not be co - located with any other transmitters except in accordance with FCC multi - transmitter product procedures. Referring to the multi - transmitter policy, multiple transmitter(s) and module(s) can be operated simultaneously without C2P.

3) For all products market in US, OEM has to limit the Operating Frequency: 2400 ~2500MHz by supplied firmware programming tool. OEM shall not supply any tool or info to the end - user regarding to Regulatory Domain change.

USERS MANUAL OF THE END PRODUCT:

In the user manual of the end product, the end user has to be informed to keep at least 20cm separation with the antenna while this end product is installed and operated. The end user has to be informed that the FCC radio - frequency exposure guidelines for an uncontrolled environment can be satisfied. The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

If the size of the end product is smaller than 8x10cm, then additional FCC part 15.19 statement is required to be available in the users manual: This device complies with Part 15 of FCC rules.

Operation is subject to the following two conditions:

(1) this device may not cause harmful interference and

(2) this device must accept any interference received, including interference that may cause undesired operation.

FCC WARNING

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generate, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be

determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.