MuYu

ESP-12F

2.4GHz Wi-Fi and BLE5.0 Coexistence Module

Version 1.0

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Release Recode

Version	Date	Comments
1.0	2020/06/01	Initial version

Content

1 Introduction

1.1 Overview

ESP-12F module adopts the cost-effective chip ESP8266EX. The chip integrates an enhanced version of Tensilica's L106 Diamond Series 32-bit core processor with on-chip SRAM in a smaller package. ESP8266 has a complete Wi-Fi network function, which can be used independently or as a slave on other host MCUs. When the ESP8266 hosts the application, it can be started directly from the external Flash. The built-in cache memory helps to improve system performance and optimize the storage system. In addition, ESP-12F only needs to be used as a Wi-Fi adapter through the SPI/SDIO interface or I2C/UART port, and can be applied to any microcontroller-based design.

ESP-12F module supports the standard IEEE802.11 b/g/n/e/i protocol and the complete TCP/IP protocol stack. User can use it to add the Wi-Fi function for the installed devices, and also can be viewed as an independent network controller.

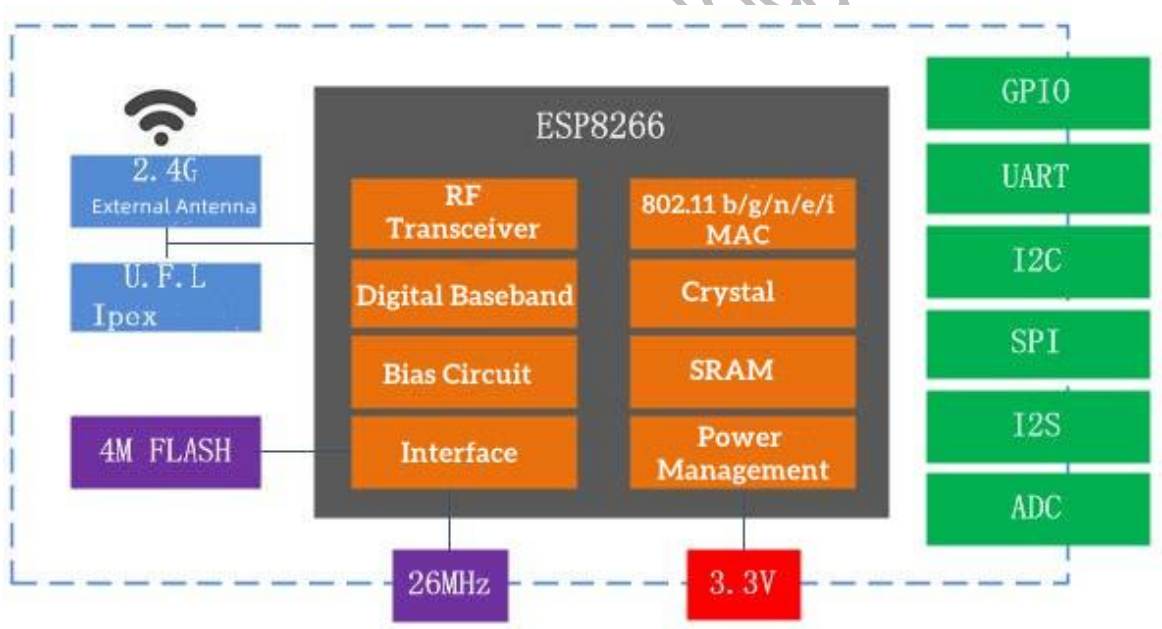


Fig.1.1 ESP-F12 Module Structure

1.2 Features

SOC Feature:

- Built-in Tensilica L106 ultra-low power consumption 32-bit microprocessor, the main frequency supports 80MHz and 160MHz, and supports RTOS
- Built-in TCP/IP protocol stack
- Built-in 1 channel 10 bit high-precision ADC
- Peripheral interface HSPI, UART, I2C, I2S, IR Remote Control, PWM, GPIO

- Deep sleep hold current is 20uA, shutdown current is less than 5uA
- Wake up, connect and deliver data packets within 2 ms
- The standby power consumption is less than 1.0mW (DTIM3)

Wi-Fi Features:

- Support 802.11 b/g/n/e/i
- Support Station, SoftAP, SoftAP+STA mode
- Support Wi-Fi Direct(P2P)
- Support CCMP (CBC-MAC, counter mode), TKIP (MIC, RC4), WAPI (SMS4), WEP (RC4), CRC hardware acceleration
- P2P discovery, P2P GO mode/GC mode and P2P power management
- WPA/PA2 PSK and WPS
- 802.11i security features: pre-authentication and TSN
- Support 802.11n (2.4 GHz)
- 802.1h/RFC1042 frame encapsulation
- Seamless roaming support
- Support AT remote upgrade and cloud OTA upgrade
- Support Android and iOS device SmartConfig function

Peripheral Interface:

2xUART
1xADC
1xEn
1x wake-up pin
1xHSPI
1xI2C
1xI2S
Up to 11xGPIOs
4M bytes SPI Flash

Working Temperature: -40℃-85℃

Module Size: 16*24mm

Applications:

- Household appliances
- Home automation
- Smart home
- Mesh network
- Baby monitors
- IP cameras
- Sensor Networks
- Wearable Electronics
- Secure ID Tags
- Wireless Location Awareness
- Wireless Location System Beacons
- Industrial Wireless Control

Module Type:

Name	Antenna Type
ESP-12F	PCB ANT

- Technical parameters for ESP-12F are listed as follows.

Table.1.1 ESP-12F Parameters

Type	Item	Parameter
Wi-Fi	Frequency	2.4G~2.5G (2412M~2484M)
	Transmit power	802.11b: +20dBm
		802.11g: +17 dBm
		802.11n: +14 dBm
	Receiver sensitivity	802.11b: -91 dBm (11Mbps)
		802.11g: -75 dBm（54Mbps）
		802.11n: -72dBm（MCS7）
	Antenna	PCB antenna
Hardware	CPU	Tensilica L106 32 bit CPU
	Interface	UART/SDIO/SPI/I2C/IR/GPIO/ADC/PWM/I2S
	Working voltage	3.0V ~ 3.6V
	Working temperature	-40°C ~ 85°C
	Environment temperature	-40°C ~ 125°C
	Shape	16mm x 24mm x 3mm
Software	Wi-Fi working mode	Station/SoftAP/SoftAP+Station
	Security mode	WPA / WPA2
	Update firmware	UART Download/OTA
	Software develop	Non-RTOS/RTOS/Arduino IDE, etc,.
	Network protocol	IPv4, TCP/UDP/HTTP/FTP/MQTT
	User Configuration	AT Command/ Cloud Server/ Android/ios APP

2 Interface Definition

ESP-12F module interface definition is shown as below.

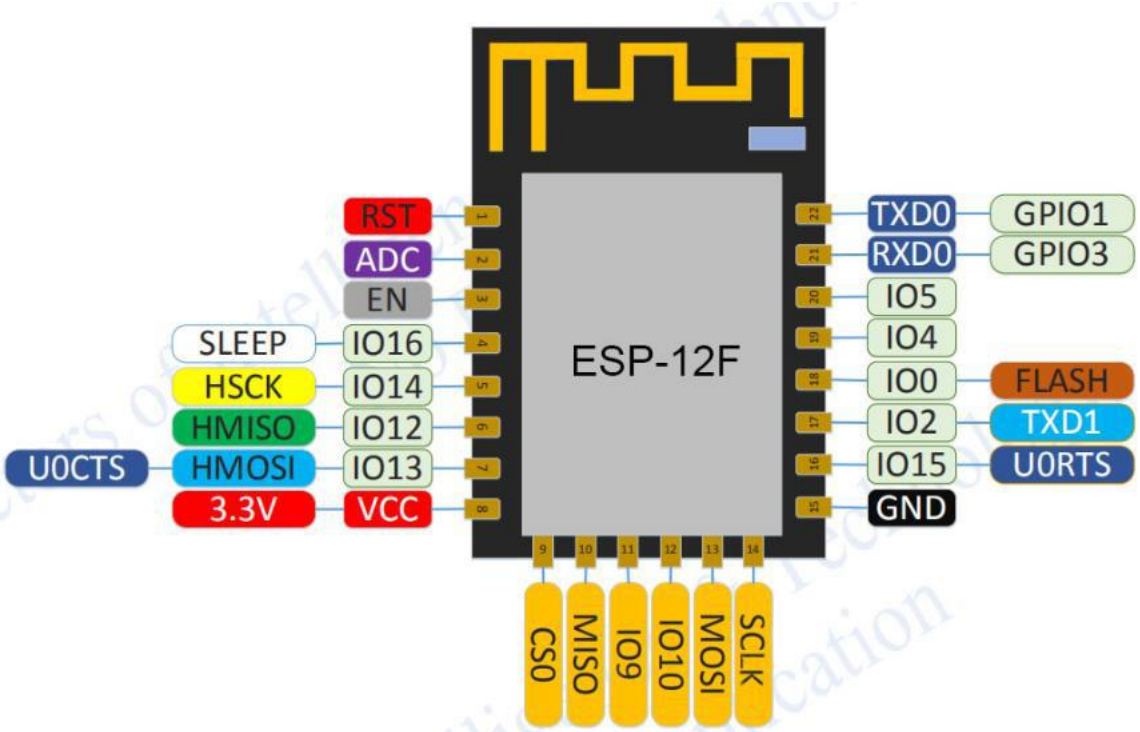


Fig.2.1 ESP-12F Pins Definition

Working modes and pins function is shown in Table 2.1.

Table.2.1Working Mode

Mode	GPIO15	GPIO0	GPIO2
UART Download Mode	LOW	LOW	HIGH
Flash Boot Mode	LOW	HIGH	HIGH

Table.2.2 Pins Function Definition

Num.	Pin Name	Type	Function

1	RST	I	External reset signal (active low), reset the module
2	ADC	I	A/D conversion pin. Input voltage range 0~1V, value range: 0~1024
3	EN	I/O	Chip enable terminal. High level: valid; low level: invalid, the chip is turned off
4	IO16	I/O	Wake up from deep sleep
5	IO14	I/O	GPIO14; HSPI_CLK
6	IO12	I/O	GPIO12; HSPI_MISO
7	IO13	I/O	GPIO13;HSPI_MOSI; UART0_CTS
8	VCC	P	Power, 3.3V/500mA Recommended
9	CS0	I/O	GPIO11; SD_CMD; SPI_CS0
10	MISO	I/O	GPIO7; SD_D0, SPI_MSIO
11	IO9	I/O	GPIO9; SD_D2 PIHD; HSPIHD
12	IO10	I/O	GPIO10; SD_D3; SPIWP; HSPIWP1
13	MOSI	I/O	GPIO8; SD_D1; SPI_MOSI1
14	SCLK	I/O	GPIO6; SD_CLK; SPI_CLK
15	GND	P	GND
16	IO15	I/O	GPIO15; MTDO;HSPICS;UART0_RTS
17	IO2	I/O	GPIO2; UART1_TXD
18	IO0	I/O	GPIO0; SPI_CS2
19	IO4	I/O	GPIO4
20	IO5	I/O	GPIO5
21	RXD	I/O	GPIO3; can be used as UART Rx when programming Flash
22	TXD	I/O	GPIO1; can be used as UART x when programming Flash

3 Size and Layout

The module dimensions: 16 x 24 x 3mm (as shown). The Flash capacity used by this module is 32Mbits (4M Bytes)

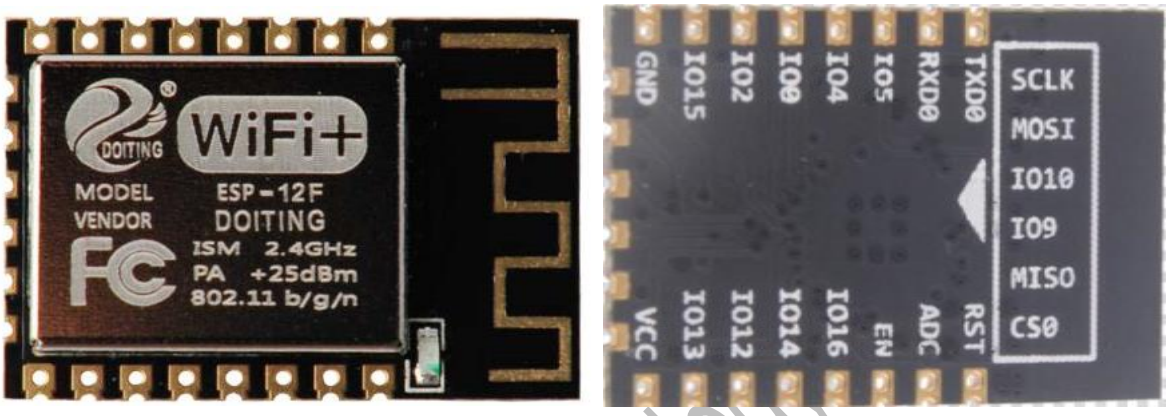
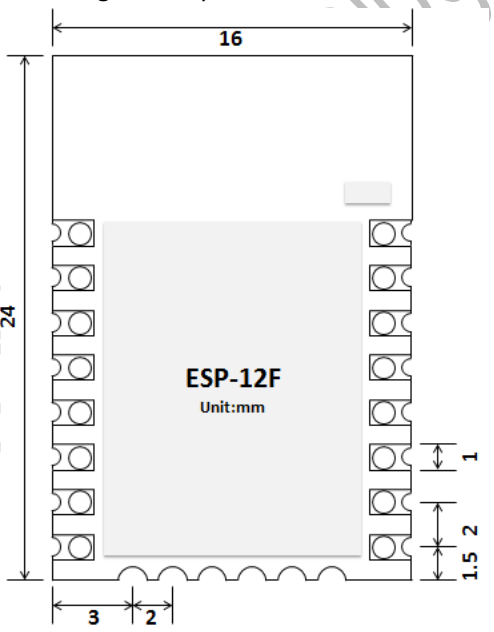


Fig.3.1 Shape for ESP-12F 12E



(a)Vertical View

（b）Side View

Fig.3.2 Size for ESP-12F

Length	Width	Height	PAD size (bottom)	Pin spacing
16mm	24mm	3mm	0.9*1.7mm	2mm

4 Electronica Characteristics

Table.4.1 Electronica Characteristics

Parameters		Condition	Min	Classical	Max	Unit
Store Temperature		-	-40	Normal	125	℃
Sold Temperature		IPC/JEDEC J-STD-020	-	-	260	℃
Working Voltage		-	2.5	3.3	3.6	V
V	VIL/ VIH	-	-0.3/0.75VIO	-	0.25VIO/3.6	V
	VOL/ VOH	-	N/0.8VIO	-	0.1VIO/N	
	IMAX	-	-	-	12	mA
Electrostatic Release Quantity (Human model)		TAMB=25℃	-	-	2	KV
Electrostatic Release Quantity (Machine model)		TAMB=25℃	-	-	0.5	KV

5 Power Consumption

Table.5.1 Power Consumption

Parameters	Min	Classical	Max	Unit
Tx802.11b, CCK 11Mbps, POUT=+17dBm	-	170	-	mA
Tx802.11g, OFDM 54 Mbps, POUT =+15dBm		-140	-	mA
Tx802.11n,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-sleep①	-	15	-	mA
Light-sleep②	-	0.9	-	mA

Deep-sleep③	-	20	-	uA
Turn off	-	0.5	-	uA

Note ①: Modem-Sleep mode is used in scenarios that require the CPU to be working all the time, such as PWM or I2S applications. When maintaining the Wi-Fi connection, if there is no data transmission, according to the 802.11 standard (such as U-APSD), the Wi-Fi Modem circuit can be turned off to save power. For example, in DTIM3, keep sleeping for 300ms, wake up at intervals of 3ms to receive AP Beacon packets, then the current is about 15mA.

Note ②: Light-Sleep mode is used for applications where the CPU can be suspended, such as Wi-Fi switch. When maintaining the Wi-Fi connection, if there is no data transmission, according to the 802.11 standard (such as U-APSD), turn off the Wi-Fi Modem circuit and suspend the CPU to save power. For example, in DTIM3, keep sleeping for 300ms, and wake up every 3ms to receive the Beacon packet of the AP, then the overall average current is about 0.9mA.

Note ③: Deep-Sleep mode is used in scenarios that do not need to keep Wi-Fi connection all the time, and applications that only send data packets for a long time (such as sensors that measure temperature every 100 seconds), it takes 0.3 minutes after waking up every 300s If the s-1s is connected to the AP, the overall average current can be much less than 1mA.

6 Wi-Fi RF Characteristics

The data in the following table is gotten when voltage are 3.3V and 1.1V in the indoor temperature environment.

Table.6.1 Wi-Fi TX Characteristics

Parameters	Min	Classical	Max	Unit
Input frequency	2412	-	2484	MHz
Input resistance	-	50	-	Ω
Input reflection	-	-	-10	dB
72.2Mbps, PA output power consumption	15.6	16.5	17.5	dBm
11b mode, PA output power consumption	19.5	20.5	21.5	dBm
Sensitivity	-	-	-	-
DSSS, 1Mbps	-	-98	-	dBm
CCK11, Mbps	-	-91	-	dBm
6Mbps(1/2 BPSK)		-93		dBm
54Mbps(3/4 64-QAM)		-75		dBm

HT20, MCS7(65 Mbps, 72.2 Mbps)		-72		dBm
Adjacent channel inhibition				
OFDM, 6Mbps		37		dB
OFDM, 54Mbps		21		dB
HT20, MCS0		37		dB
HT20, MCS7		20		dB

7 Recommended Sold Temperature Curve

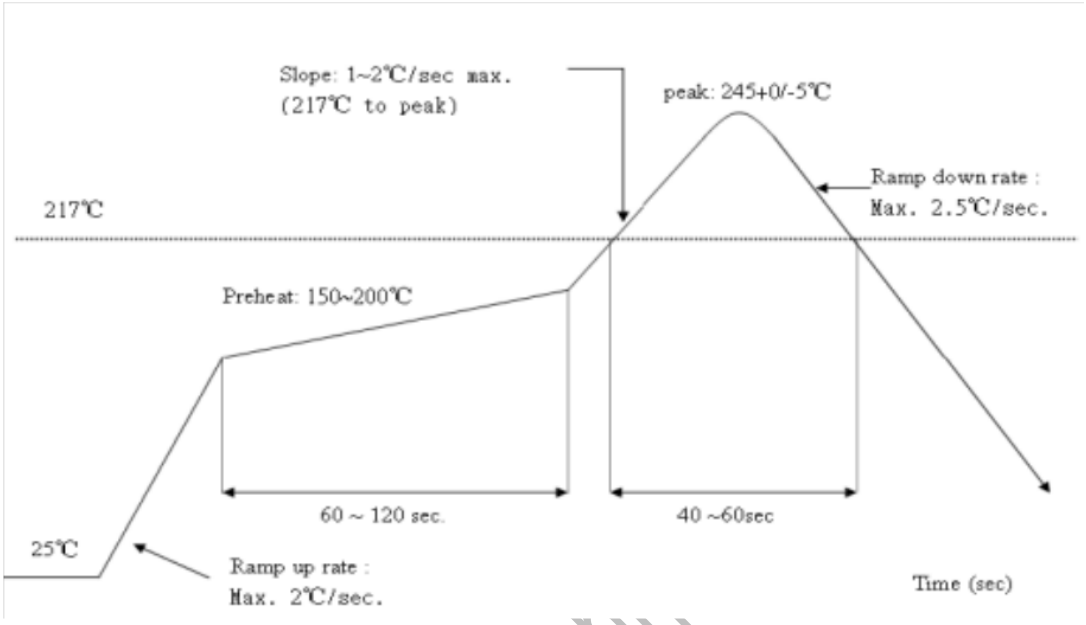
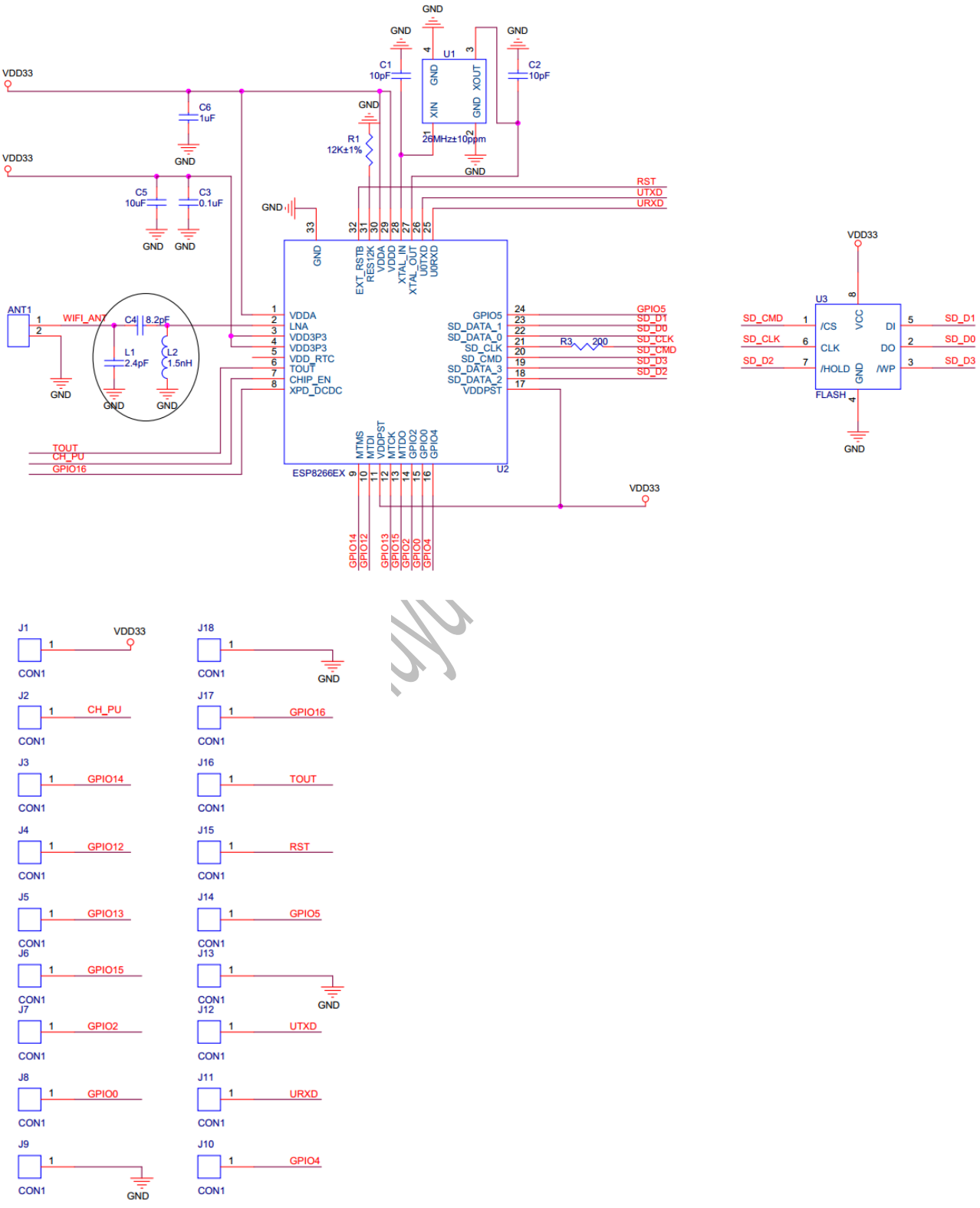
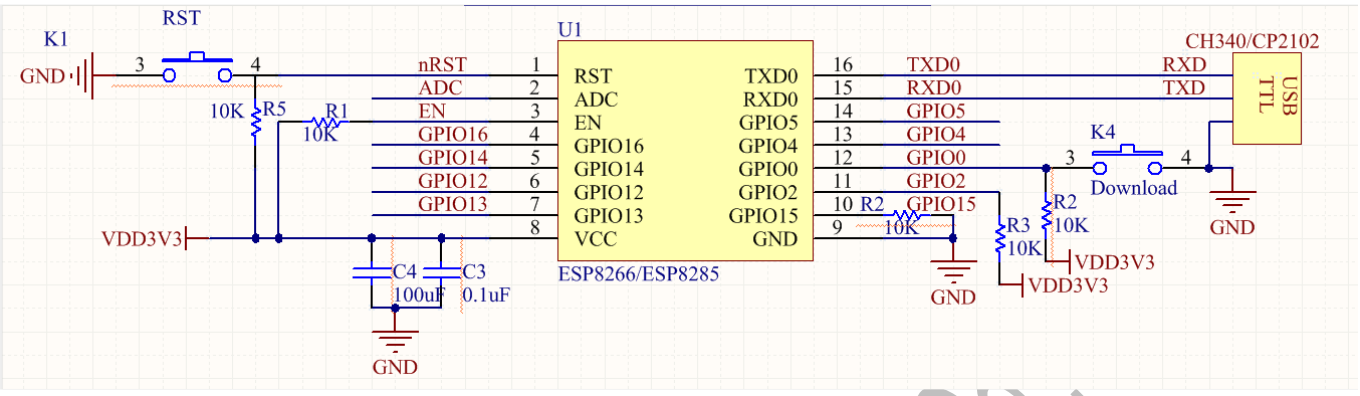


Fig.7.1 Recommended Reflow Profile

8 Module Internal Schematic



9 Modular Minimal System



Note:

(1) The power supply voltage of the module is DC 3.3V;

(2) The maximum output current of the Wi-Fi module IO is 12mA;

(2) The NRST pin of the Wi-Fi module is active at low level; the EN enable pin is active at high level;

(4) The Wi-Fi module enters the upgrade mode: GPIO0 is at low level, then the module is reset and powered on; the Wi-Fi module enters the normal working mode: GPIO0 is at high level, the module is reset and powered on.

(5) The RXD of the Wi-Fi module is connected to the TXD of the external MCU, and the TXD of the Wi-Fi module is connected to the RXD of the external MCU.

10 Recommended PCB design (take ESP M2 as an example)

The Wi-Fi module can be directly soldered to the PCB board. In order to obtain the best radio frequency performance of your terminal product, please pay attention to the reasonable design of the placement of the module and antenna on the bottom plate according to this guideline. For the PCB antenna version module, there are three options to choose from.

Option 1: Optimal solution: place the WiFi module near the board, and the antennas are all exposed, and there is no metal substance around the antenna, including wires, metal casings, weight plates, etc.

Solution 2: Second-best solution: place the WiFi module near the edge of the board, hollow out the bottom of the antenna and reserve a gap of no less than 5mm with the surrounding PCB, and there is no metal substance around the antenna, including wires, metal casings, and weight plates.

Solution 3: General solution: place the WiFi module near the edge of the board, and the PCB area under the antenna is clear, and copper cannot be laid.

Note: The WiFi module cannot be placed in the middle of the motherboard, and it is not recommended to have other metal objects around it.

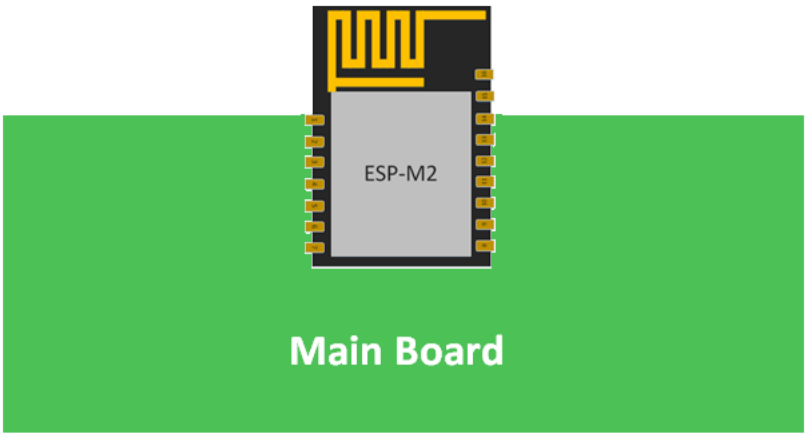


Fig 10.2 Solution 1 - Antenna outside the board frame

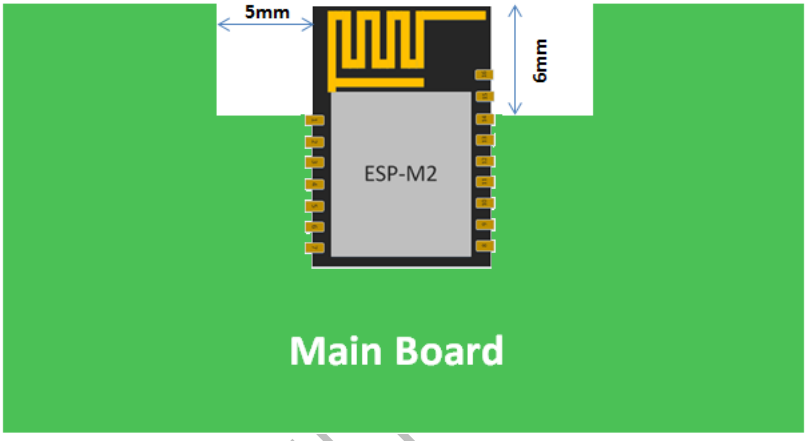


Fig 10.3 Scheme 2 - The antenna is placed along the edge of the board and hollowed out below

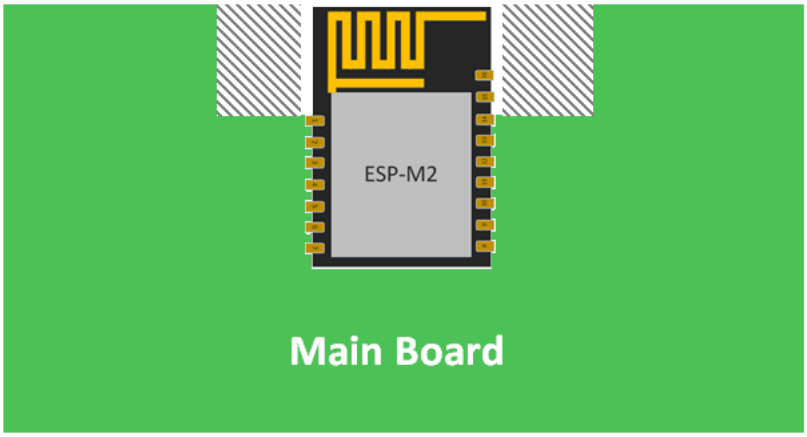


Fig 10.4 Scheme 3 - The antenna is placed along the edge of the board and there is no copper underneath

11 Peripheral Routing Recommendations

The Wi-Fi module integrates high-speed GPIO and peripheral interfaces, which may generate severe switching noise. If

some applications require high power consumption and EMI characteristics, it is recommended to connect a 10~100 ohm resistor in series with the digital I/O line. This suppresses overshoot and stabilizes the signal when switching power supplies, and it also prevents electrostatic discharge (ESD) to a certain extent.