ESP-F1 WiFi Module

Features

- **SOC characteristics**
  - Built-in Tensilica L106 ultra-low power consumption 32-bit cpu, the main frequency can be 80MHz and 160MHz, also support RTOS;
  - Built-in TCP/IP protocol stack;
  - Built-in 1 channel 10-bit high precision ADC;
  - The outside interfaces have HSPI, UART, I2C, I2S, IR Remote Control, PWM, GPIO;
  - The deep-sleep current is about 10uA, and the cut-off current is smaller than 5uA;
  - Can be wake-up within 2 ms, and connect to transmit data package;
  - the consume power is smaller than 1.0mW (DTIM3) when at standby status;
- **Wi-Fi characteristics**
  - Support 802.11 b/g/n/e/i
  - Support three modes: Station, SoftAP, and SoftAP+STA;
  - SupportWi-Fi Direct(P2P);
  - Support hardware acceleration for CCMP (CBC-MAC, computation mode), TKIP (MIC, RC4), WAPI(SMS4), WEP(RC4), CRC;
  - P2P find, P2P GO mode/GC mode and P2P power management;
  - WPA/PA2 PSK and WPS;
  - Support 802.11 i security: pre-certification and TSN;
  - Support 802.11n (2.4 GHz);
  - 802.1h/RFC1042 frame encapsulation;
  - Support seamless roam;
  - Support AT remote updation and cloud OTA updation;
  - Support SmartConfig function for Android and iOS device SmartConfig.

Peripheral for Module

- 2*UART;
- 1*En;
- 1*ADC
- 1*wakeup pin
- 1*HSPI
- 1*I2C
- 1*I2S
- 4M byte Flash
- MAX 11* GPIOs;

- **Working temperature:** -40℃-85℃
- **Module size**: 16mm*24mm;

Applications

- Serial Transparent transmission;
- WiFi prober;
- Smart power plug/Smart LED light;
- Mesh networks;
- Sensor networks;
- Wearable electronics;
- Securit ID label;
- Wireless location recognition;
- Wireless location system beacon;
- Industrial wireless control.

Module Type

Name	Antenna Type
ESP-F1	IPEX antenna

Antenna Information

Type of antenna: Dipole Antenna
Gain of the antenna (Max.): 2 dBi
Frequency range: 2400-2500MHz.

Achieve Update

Date	Version	Update
Mar, 21, 2017	V1.0	Ver 1.0

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Context

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1. Introduction

The WiFi module ESP-F1 is manufactured by using a high-performance chip ESP8266EX. This small chip is encapsulated an enhanced Tensilica'sL106 diamond series 32-bit kennel CPU with a SRAM. Thus, ESP8266 has the complete function Wi-Fi function; it not only can be applied independently, but can be used as a slaver working with other host CPU. When ESP8266 is applied as a slaver, it can start from the onboard Flash. The built-in high-speed buffer is not only benefit to improve the system performance, but optimize the store system. In addition, ESP8266 can be used as Wi-Fi adapter by SPI/SDIO or I2C/UART interface, when it is applied to other MCU design.

The ESP-F1 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 WiFi function for the installed devices, and also can be viewed as a independent network controller. Anyway, ESP-F module provides many probabilities with the best price.

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Parameters for ESP-F are listed as follows.

Table 1.1 Parameters for ESP-F1

Types	Items	Parameters
Wi-Fi	Frequency scope	2.4G~2.5G(2400M~2483.5M)
	Transmit power	802.11b: +20 dBm
		802.11g: +17 dBm
		802.11n: +14 dBm
	Receiving sensitivity	802.11b: -91 dbm (11Mbps)
		802.11g: -75 dbm（54Mbps）
		802.11n: -72 dbm（MCS7）
	Antenna	PCB onboard antenna
Hardware	CPU	Tensilica L106 32 bit MCU
	Perpherl	UART/SDIO/SPI/I2C/I2S/IR control
		GPIO/ADC/PWM/SPI/I2C/I2S
	Working voltage	2.5V ~ 3.6V
	Working current	Average current: 80 mA
	Working temperature	-40°C ~85°C
	Environment temperature	-40°C ~ 85°C
	Size	16mm x 24mm x 3mm
Software	Wi-Fi mode	Station/SoftAP/SoftAP+Station
	Security mode	WPA/WPA2
	Encryption type	WEP/TKIP/AES
	Update firmware	UART Download/OTA (by internet)
	Software develop	Non-RTOS/RTOS/Arduino IDE etc.
	Network protocol	IPv4, TCP/UDP/HTTP/FTP/MQTT
	User configuration	AT+ command/cloud sever/ Android/iOS APP

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2. Interface Definition

Interface definition of ESP-F can be shown in the following.

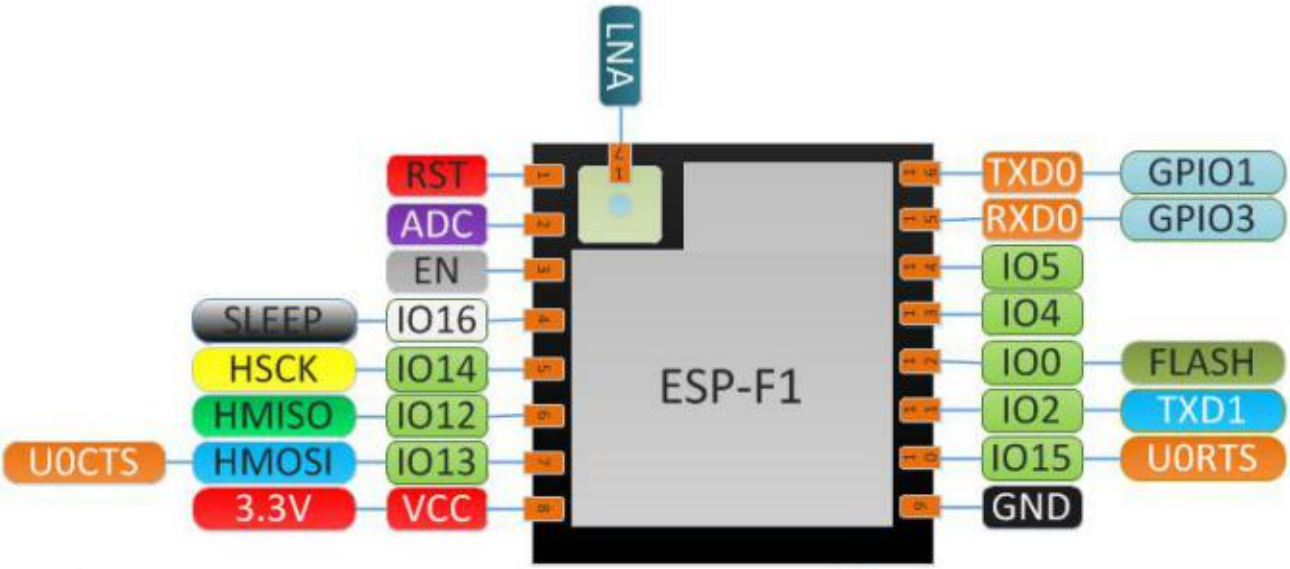

Fig. 2.1 ESP-F1 Definition for Pins

Working mode and definition of pins:

Table 2.1 Pin Modes

Mode	GPIO15	GPIO0	GPIO2
UART download	low	low	high
FlashBoot mode	low	high	high

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Table 2.2 Function Definition of Module Pins

Num	Pin	Type	Function
1	RST	I	Reset the signal outside (enable with low), Reset module
2	ADC	I	A/D pin. Input voltage 0~1V, value: 0~1024
3	EN	I	Enable, high level: chip work normally; low level: chip closes with small current.
4	IO16	I/O	deep sleep/wakeup
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	Module working voltage: 3.3V
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; used to build in Flash as UART Rx
22	TXD	I/O	GPIO1; used to build in Flash as UART Tx

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3. Shape and Size

Shape and size for this module can be shown as follows. Its size is 16mm*24mm*3mm, and the Flash is 4M bytes (32Mbits).

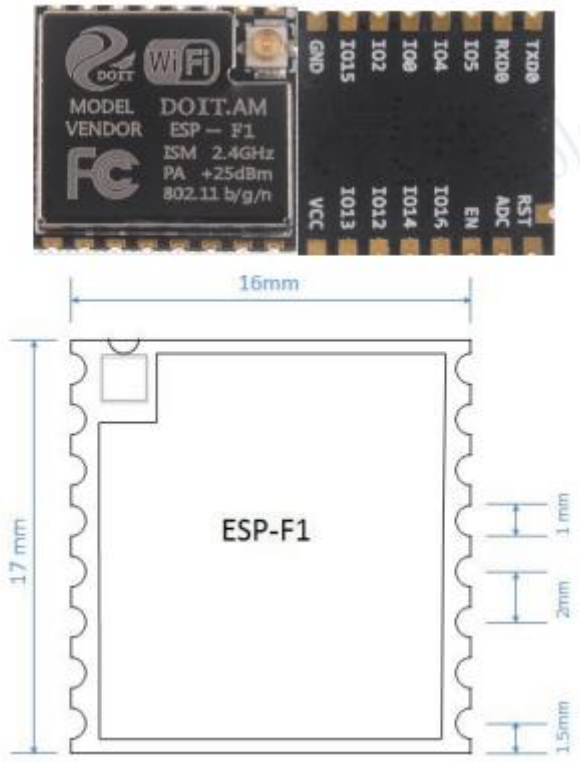

Fig. 3.1 Shape for ESP-F

(b) Side View

Fig. 3.2 Size for ESP-F1

Table 3.1Size for ESP-F1

Length	Width	Height	PAD	Distance between Pins
16mm	17mm	3mm	0.9*1.7mm	2mm

4. Electronical Characteristics

Table 4.1 Electronics

Parameters		Condition	Min	Classical	Max	Unite
Store Temperature		-	-40	Normal	125	℃
Sold Temperature		IPC/JEDEC J-STD-020	-	-	260	℃
Working Voltage		-	2.5	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	
	I_{MAX}	-	-	-	12	mA
Electrostatic release quantity (Human model)		TAMB=25℃	-	-	2	KV
Electrostatic release quantity (Human model)		TAMB=25℃	-	-	0.5	KV

5. Power Consumption

Table 5.1 Power Consumption

Parameters	Min	Classical	Max	Unite
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, -80dBm	-	50	-	mA
Rx 802.11g，1024 Bytes, -70dBm	-	56	-	mA
Rx 802.11n，1024 Bytes, -65dBm	-	56	-	mA
Modem-sleep①	-	15	-	mA
Light-sleep②	-	0.9	-	mA
Deep-sleep③	-	20	-	μA
close	-	0.5	-	μA

Note

①: Modem-Sleep mode can be used for the case that CPU is always working, e.g., PWM or I2S etc. If WiFi is connected and no data is to transmitted, in this case, WiFi modem can be closed to save power energy. For example, if at DTIM3 status, keep asleep at 300ms, Then, the module can wake up to receive the Beacon package within 3ms and the current being 15mA.

②: Light-Sleep mode can used for the case that CUP can stop the application temporally, e.g., Wi-Fi Switch . If Wi-Fi is connected and there is no data packet to transmitted, by the 802.11 standard (e.g., U-

APSD), module can close Wi-Fi Modem and stop CPU to save power. For example, at DTIM3, keep up sleeping at 300ms, it would receive the Beacon package from AP after each 3ms, then the whole average current is about 0.9mA.

③ Deep-Sleep mode is applied to the case that Wi-Fi is not necessary to connect all the time, just send a data packet after a long time (e.g., transmit one temperate data each 100s) . it just need 0.3s-1s to connect AP after each 300s, and the whole average current is much smaller 1mA.

6. Wi-Fi RF Characteristics

The data in the following Table is gotten when voltage is 3.3V and1.1V in the indoor temperature environment.

Table 6.1 Wi-Fi RF Characteristics

Parameters	Min	Classical	Max	Unite
Input frequencey	2412	-	2484	MHz
Input impedance	-	50	-	Ω
Input reflection	-	-	-10	dB
At 72.2Mbps, output power consumption for PA	15.5	16.5	17.5	dBm
At 11b mode, output power consumption for PA	19.5	20.5	21.5	dBm
Sensibility	-	-	-	-
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 Inhibition				
OFDM, 6Mbps	-	37	-	dB
OFDM, 54Mbps	-	21	-	dB
HT20, MCS0	-	37	-	dB
HT20, MCS7	-	20	-	dB

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7. The Recommended Sold Temperature Curve

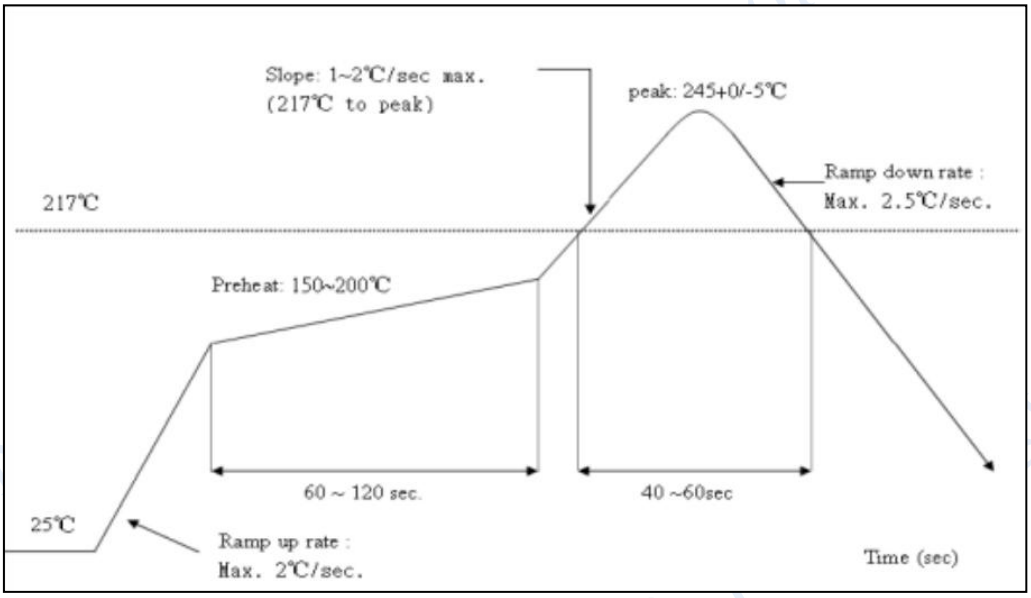

Fig. 7.1 Temperature Curve when Sold

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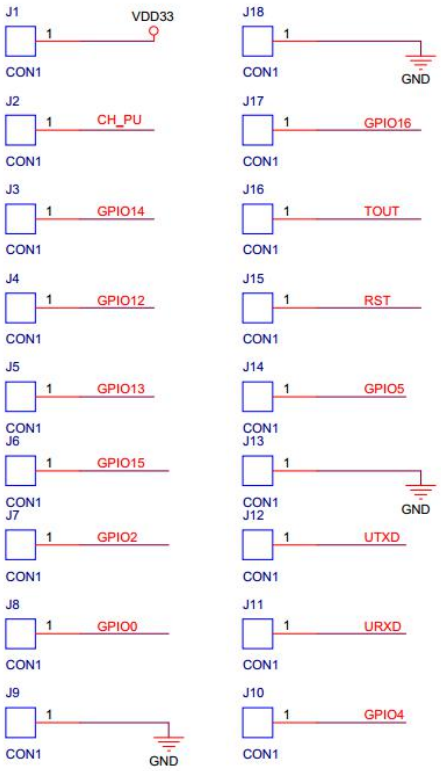

Fig. 8.1 Schematics for ESP-F1

9. Minimum System

This module can work just at 3.3V working voltage.

Note

(1) the working voltage for module is DC 3.3V;

(2) the max current from IO of this module is 12mA;

(3) RST Pin is enabled when it is low level; and EN pin is enabled when it is high level;

(4) WiFi module is at update mode: GPIO0 is low level, then module reset to power; Wi-Fi module is at working mode: GPIO0 is at high level, and then reset to power;

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

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10. Peripheral Line Suggestion

Wi-Fi module is already integrated into high-speed GPIO and Peripheral interface, which may be generated the switch noise. If there is a high request for the power consumption and EMI characteristics, it is suggested to connect a serial 10~100 ohm resistance, which can suppress overshoot when switching power supply, and can smooth signal. At the same time, it also can, to a certain extent, prevent electrostatic discharge (ESD).

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Appendix.

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This device complies with part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
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 generates, 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.
The device has been evaluated to meet general RF exposure requirement.

FCC ID: 2AL3B-ESPF1

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 C2PC.

3) For all products market in US, OEM has to limit the operation channels in CH1 to CH11 for 2.4G band 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 users 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.

LABEL OF THE END PRODUCT: The final end product must be labeled in a visible area with the following " Contains FCCID: 2AL3B-ESPF1". 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 15of 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.

-OEM integratoris responsible for ensuring that the end-user has no manual instructions to remove or install module.

-That module is limited to installation in mobile or fixed applications, according to Part 2.1091(b)

-Separate approval is required for all other operating configurations, including portable configurations with respect to Part 2.1093 and different antenna configurations