



## ESP WIFI Module

### Features:

- 802.11 b/g/n
- integrated low power 32-bit MCU
- Integrated 10-bit ADC
- Integrated TCP/IP protocol stack
- Integrated TR switch, balun, LNA, power amplifier and matching network
- Integrated PLL, regulators, and power management units
- Supports antenna diversity
- Wi-Fi 2.4 GHz, support WPA/WPA2
- Support STA/AP/STA+AP operation modes
- Support Smart Link Function for both Android and iOS devices
- SDIO 2.0, (H) SPI, UART, I2C, I2S, IRDA, PWM, GPIO
- STBC, 1x1 MIMO, 2x1 MIMO
- A-MPDU & A-MSDU aggregation and 0.4s guard interval
- Deep sleep power <10uA, Power down leakage current < 5uA
- Wake up and transmit packets in < 2ms
- Standby power consumption of < 1.0mW (DTIM3)
- +20dBm output power in 802.11b mode
- Operating temperature range -40C ~ 85C



### Description

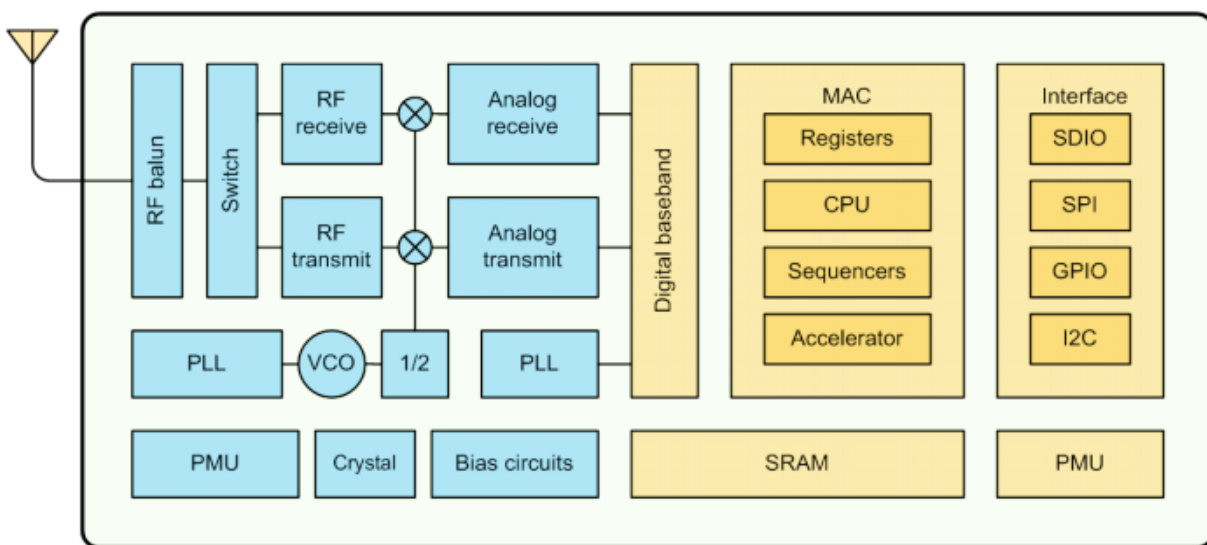
The ESP-12S is a self contained 802.11 b/g/n WiFi enabled microcontroller featuring the ESP8266 SOC.

Pin for pin compatible with other boards in the ESP-12 range but with improved stability and wireless capability. This board has up to 13 usable GPIO pins (inc 5 dual purpose) and an ADC input. It has 4Mbyte flash memory and software updates can be rolled out to it over-the-air. Use it as a cheap and easy way to add WiFi to your Arduino / Raspberry Pi etc, or use it as a powerful standalone WiFi enabled MCU in its own right.

ESP-12S WiFi module is developed by AI-Thinker Co, Ltd, core processor ESP8266 in smaller sizes of the module encapsulates Tensilica L106 integrates industry-leading ultra low power 32-bit MCU micro, with the 16-bit short mode, clock speed support 80 MHz, 160 MHz, supports the RTOS, integrated Wi-Fi MAC/BB/RF/PA/LNA, on-board antennas.

The module supports standard IEEE802.11 b/g/n agreement, complete TCP/IP protocol stack. Users can use the add modules to an existing device networking, or building a separate network controller.

ESP8266 is high integration wireless SOCs, designed for space and power constrained mobile platform designers. It provides unsurpassed ability to embed Wi-Fi capabilities within other systems, or to function as a standalone application, with the lowest cost, and minimal space requirement.



ESP8266EX offers a complete and self-contained Wi-Fi networking solution; it can be used to host the application or to offload Wi-Fi networking functions from another application processor.

When ESP8266EX hosts the application, it boots up directly from an external flash. It has integrated cache to improve the performance of the system in such applications.

Alternately, serving as a Wi-Fi adapter, wireless internet access can be added to any micro controller based design with simple connectivity (SPI/SDIO or I2C/UART interface).

ESP8266EX is among the most integrated WiFi chip in the industry; it integrates the antenna switches, RF balun, power amplifier, low noise receive amplifier, filters, power management modules, it requires minimal external circuitry, and the entire solution, including front-end module, is designed to occupy minimal PCB area.

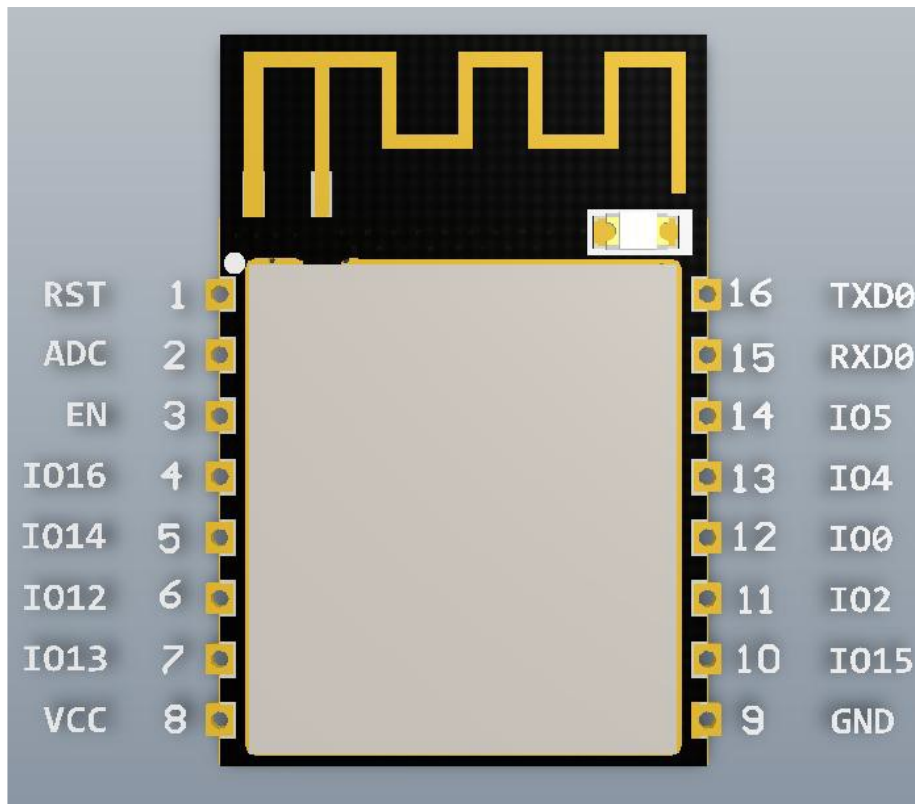
ESP8266EX also integrates an enhanced version of Tensilica's L106 Diamond series 32-bit processor, with on-chip SRAM, besides the Wi-Fi functionalities. ESP8266EX is often integrated with external sensors and other application specific devices through its GPIOs; codes for such applications are provided in examples in the SDK.

## Parameters

The below table describes the major parameters.

Categories	Items	Values
<b>WiFi Parameters</b>	WiFi Protocols	802.11 b/g/n
	Frequency Range	2.4GHz-2.5GHz (2400M-2483.5M)
<b>Hardware Parameters</b>	Peripheral Bus	UART/HSPI/I2C/12S/Ir Remote Control
		GPIO/PWM
	Operating Voltage	3.3V
	Operating Current	Average value: 80mA
	Operating Temperature Range	-40°~125°
	Ambient Temperature Range	Normal temperature
	Package Size	18mm*20mm*3mm
	External Internal	N/A
<b>Software Parameters</b>	WiFi-mode	Station/softAP/SoftAP+station
	Security	WPA/WPA2
	Encryption	WEP/TKIP/AES
	Firmware Upgrade	UART Download / OTA (Via network) / download and write firmware via host
	Software Development	Supports Cloud Server Development / SDK for custom firmware development
	Network Protocols	IPv4, TCP/UDP/HTTP/FTP
	User Configuration	AT Instruction Set, Cloud Server, Android/iOS APP

## Pinout



Pin Number	Pin Name	Function
1	RST	Reset module
2	ADC	A/d conversion result. Input voltage range 0~1V, value range:
3	EN	Chip enable pin. Active high
4	GPIO16	GPIO16; can be used to wake up the chipset from deep sleep mode
5	GPIO14	GPIO14;HSPI_CLK
6	GPIO12	GPIO12;HSPI_MISO
7	GPIO13	GPIO13;HSPI_MOSI; UART0_CTS
8	VCC	3.3V power supply (VDD)

9	GND	GND
10	GPIO15	GPI15; MTDO; HSPICS; UARTTO_RTS
11	GPIO2	GPIO2; UART1_TXD
12	GPIO0	GPIO0
13	GPIO4	GPIO4
14	GPIO5	GPIO5
15	RXD0	UARTTO_RXD; GPIO3
16	TXD0	UARTO_TXD; GPIO1

## Interfaces

Interface	Pin Name	Description
HSPI	IO12(MISO), IO13(MISO) IO14(CLK), IO15(CS)	SPI Flash, display screen, and MCU can be connected using HSPI interface
PWM	IO129(R) IO15(G), IO13(B)	Currently the PWM interface has four channels, but users can extend the channels according to their own needs. PWM interface can be used to control LED light, buzzers, relays, electronic machines,
IR Remote Control	IO14(IR_T), IO5(IR_R)	The functionality of Infrared remote control interface can be implemented via software programming. NEC coding, modulation, and demodulation are used by this interface. The frequency of modulated carrier
ADC	TOUT	ESP8266EX integrates a 10-bit analog ADC. It can be used to test the power supply voltage of VDD3P3 (Pin3 and Pin4) and the input power voltage of TOUT (Pin6). However, these two functions cannot be used simultaneously. This interface is typically used in sensor

I2C	IO14(SCL), IO2(SDA)	I2C Interface can be used to connect external sensor products and display screens, etc.
UART	UART0: TXD(U0TXD), RXD(U0RXD), IO15(RTS) IO13(CTS) IO2(TXD)	<p>Devices with UART interfaces can be connected with the module.</p> <p>Downloading: U0TXD+U0RXD or GPIO2+U0RXD</p> <p>Communicating: UART0: U0TXD, U0RXD, MTDO (U0RTS), MTCK (U0CTS)</p> <p>Debugging: UART1_TXD (GPIO2) can be used to print</p> <hr/> <p>By default, UART0 will output some printed information when the device is powered on and is booting up. If this issue exerts influence on some specific applications, users can exchange the inner pins of UART when initializing, that is to say, exchange U0TXD, U0TXD with U0RTS, U0CTS.</p>
I2S	I2S Input: IO12 (I2SI_DATA); IO13 (I2SI_BCK); IO14 (I2SI_WS);	I2S interface is mainly used for collecting, processing and transmission of audio data.
	I2S Output: IO15 (I2SO_BCK); IO3 (I2SO_DATA); IO2 (I2SO_WS).	

## Pin Mode

Mode	GPIO15	GPIO0	GPIO2
UART	Low	Low	High
Flash Boot	Low	High	High

## Antenna Interface

ESP-12S Modules through the PIEX interface to connect to external antenna.

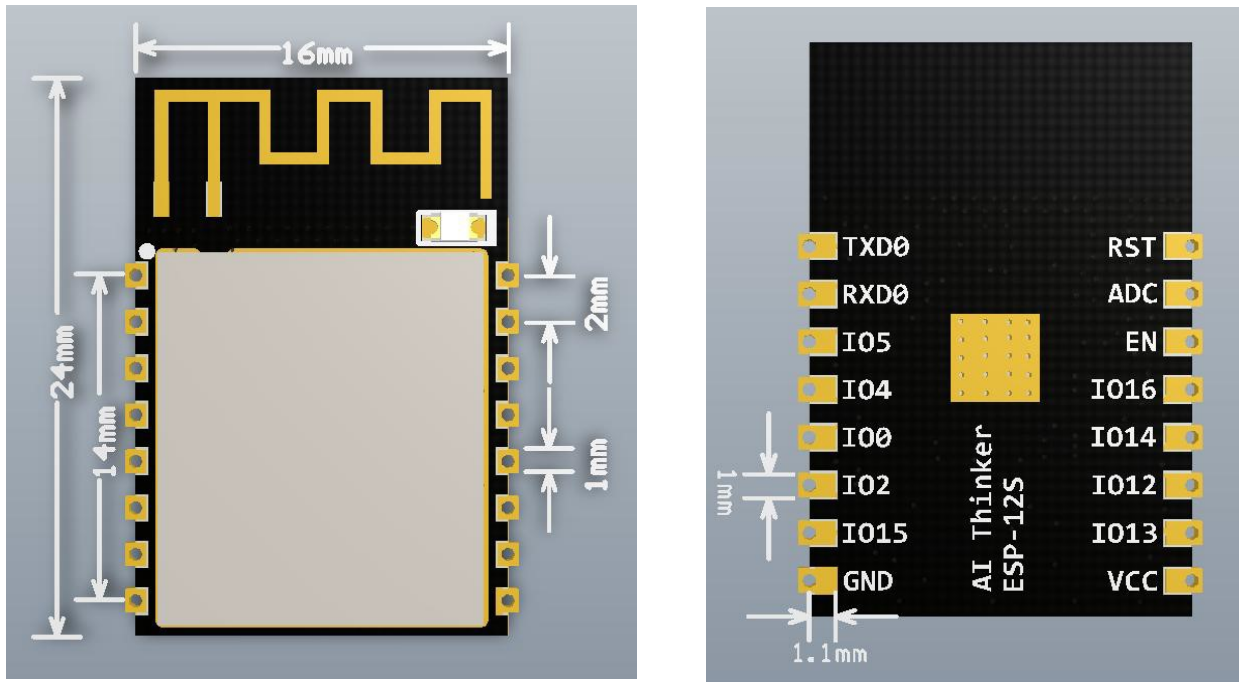
The antenna must be in line with the 802.11g/802.11b IEEE standard, and the antenna parameters are shown in the following table:

Rating	Value
Frequency Range	2.4~2.4825GHz
Impedance	5Ω

## Package information/installation method

The external size of the ESP-12S is 16mm\*17mm\*3mm, as is illustrated in figure 4 below:

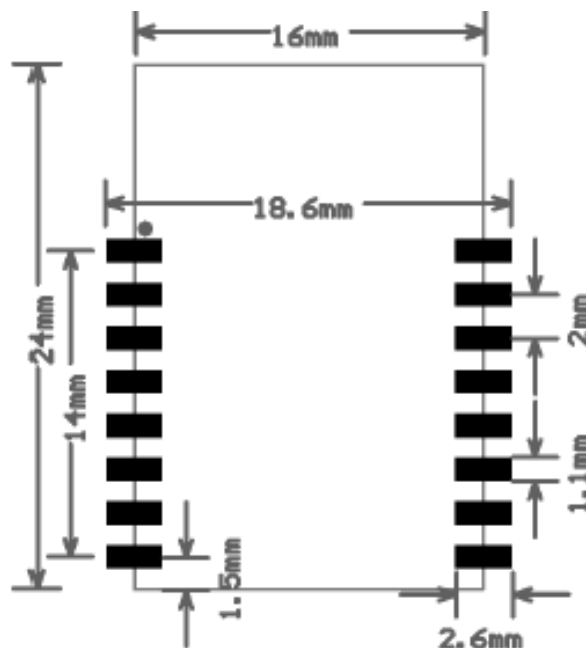




Length	Width	Height	PAD Size (Bottom)	Pin Pitch
16 mm	17 mm	3 mm	1 mm x 1.2 mm	2 mm

## Package

ESP-12S use a half hole patch package, Module PCB Footprint shown in the following figure:

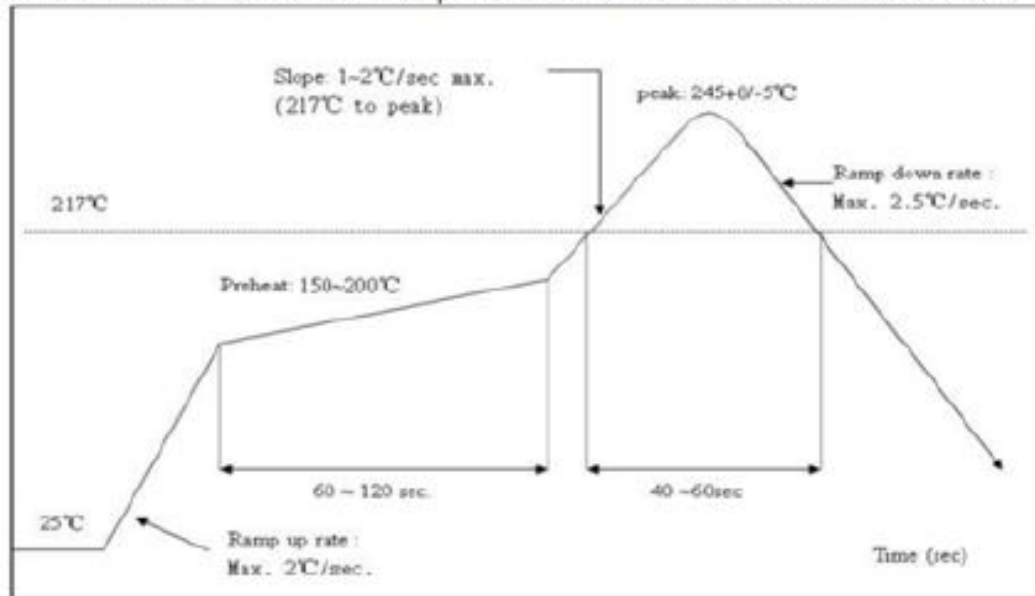




## Installation method

Using ESP-12S. modules direction is best with the antenna close to the edge of the board. When soldering the module, you must not be in a high temperature environment. We recommend the reflow soldering temperature curve as shown in figure 6:

Refer to IPC/JEDEC standard: Peak Temperature : <math><250^{\circ}\text{C}</math> : Number of Times:  $\leq 2$  times :



## Absolute Maximum figures

Rating	Condition	Value	Unit
Storage Temperature		-40 to 125	°C
Maximum Soldering Temperature		260	°C
Supply Voltage	IPC/JEDEC J-STD-020	+3.0 to +3.6	V

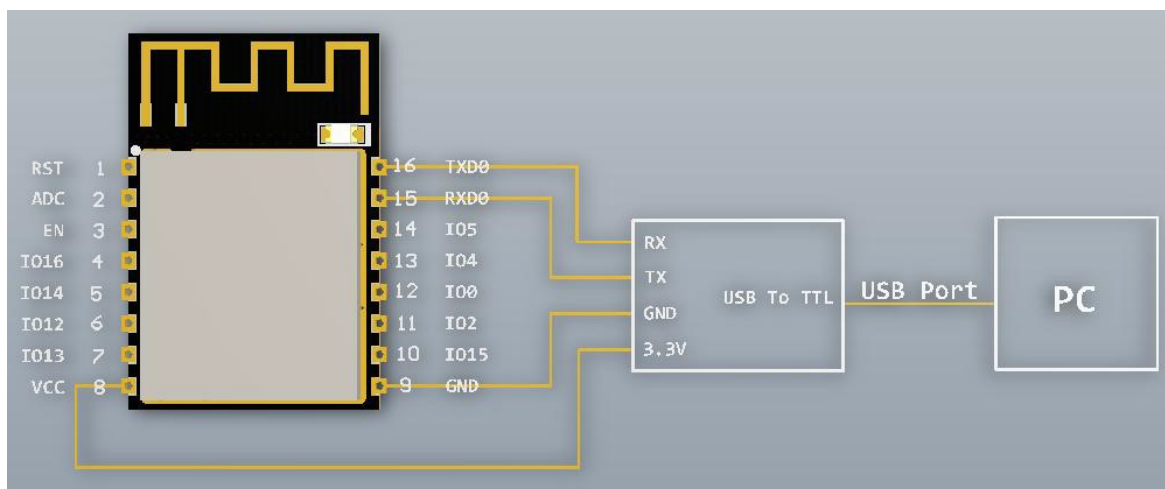
## Recommended Operating Conditions

Operating Condition	Symbol	Min	Typ	Max	Unit
Operating Temperature		-40	20	125	°C
Supply voltage	VDD	3.0	3.3	3.6	V

## AT Command Testing

### 1. Hardware connection

As shown in figure 7, ESP-12S via a USB to TTL Tool connected to the computer, software tool through the serial port on the computer can be AT instruction test.



## AT Command

Espressif AT instruction set functions and methods of use

AT commands set is divided into: Basic AT commands, WiFi related AT commands, TCP / IP AT

## Command Description

Type	Command Format	Description
Test	AT+<x>=?	Query the Set command or internal parameters and its range values.
Query	AT+<x>?	Returns the current value of the parameter.
Set	AT+<x>=<...>	Set the value of user-defined parameters in commands and run.
Execute	AT+<x>	Runs commands with no user-defined parameters.

### Notes:

1. Not all AT Command has four commands.
2. [] = default value, not required or may not appear
3. String values require double quotation marks, for example:  
AT+CWSAP="ESP756290","21030826",1,4
4. Baudrate = 115200
5. AT Commands has to be capitalized, and end with "/r/n"

## Basic AT Command Set

The ESP8266 wireless WiFi modules can be driven via the serial interface using the standard AT commands. Here is a list of some basic AT commands that can be used.

Basic	
Command	Description
AT	Test AT Startup
AT + RST	Restart module
AT + GMR	View version info
AT + GSLP	Enter deep-sleep mode
ATE	AT commands echo or not
AT + RESTORE	Factory rest
AT + UART	UART configuration, [ <a href="#">@deprecated</a> ]
AT + UART_CUR	UART current configuration

AT + UART_DEF	UART default configuration, save to
AT + SLEEP	Sleep Mode
AT + RFPOWER	Set Maximum value of RF TX power
AT + RFVDD	Set RF TX Power according to VDD33

## AT – Test AT startup

The type of this command is "executed". It's used to test the setup function of your wireless WiFi module.

AT—Test AT Startup	
Response	OK
Parameters	Null

## AT+GMR – View version info

This AT command is used to check the version of AT commands and SDK that you are using, the type of which is "executed".

AT+GMR - View version info	
Response	<p>&lt;AT version info&gt;                      &lt;SDK version info&gt;                      &lt;compile time&gt;</p> <p>OK</p>
Parameters	<p>&lt;AT version info&gt; information about AT version                      &lt;SDK version info&gt; information about SDK version                      &lt;compile time&gt; time of the bin was compiled</p>

## AT+GSLP – Enter deep-sleep mode

This command is used to invoke the deep-sleep mode of the module, the type of which is "set". A minor adjustment has to be made before the module enter this deep sleep mode, i.e., connect XPD\_DCDC with EXT\_RSTB via **OR**.

AT+GSLP=<time>	
Response	<time> OK
Parameters	The time unit of <time> is ms. ESP8266 will wake up after deep sleep <time> ms.

## ATE – AT commands echo

This command ATE is an AT trigger command echo. It means that entered commands can be echoed back to the sender when ATE command is used. Two parameters are possible. The command returns "OK" in normal cases and "ERROR" when a parameter other than 0 or 1 was specified.

ATE - AT commands echo	
Response	OK
Parameters	ATE0: Switch echo off ATE1: Switch echo on

## AT+RESTORE – Factory reset

This command is used to reset all parameters saved in flash (according to appendix), restore the factory default settings of the module. The chip will be restarted when this command is executed.

AT+RESTORE - Factory reset	
Response	OK
Notes	Restore factory default settings. The chip will restart.

Detailed instruction test, please refer to the Esp8266 AT Instruction Set, can be downloaded to shun official website.

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