ESP-WROOM-5C

User Manual

Version 0.1
Espressif Systems

About This Guide

This document provides introduction to the specifications of ESP-WROOM-5C hardware.

Release Notes

Date	Version	Release notes
2019.01	V0.1	For certification only.

Documentation Change Notification

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1. Overview

Espressif now offers a side-mounted module ESP-WROOM-5C based on ESP8285.

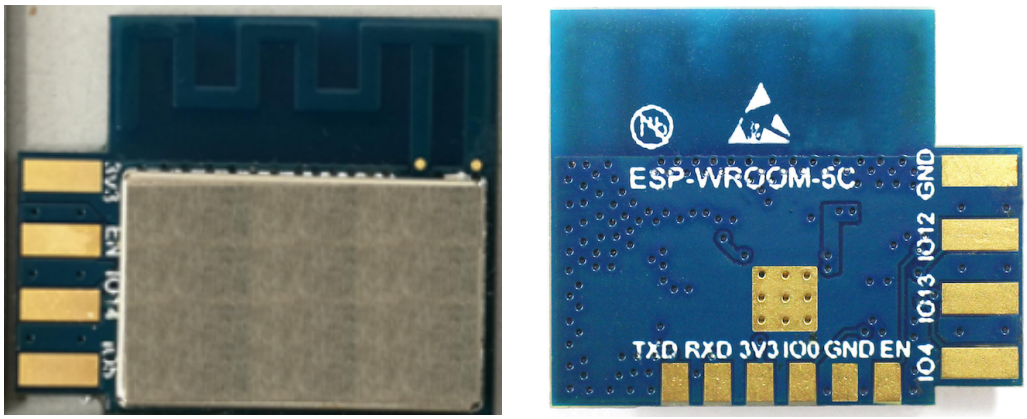


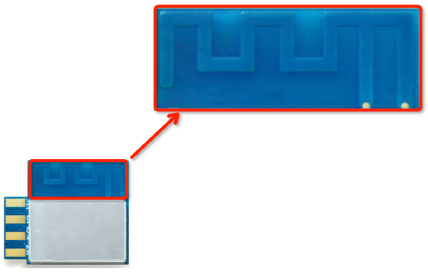
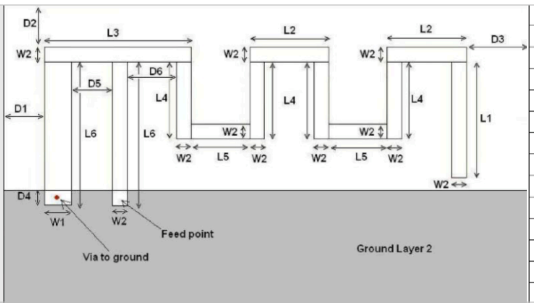
Figure 1-1. ESP-WROOM-5C Module

Table 1-1. ESP-WROOM-5C Specifications

Categories	Items	Specifications
Test	Reliablity	HTOL/HTSL/uHAST/TCT/ESD
Wi-Fi	Wi-Fi protocols	802.11 b/g/n20
	Frequency range	2412 MHz ~ 2462MHz
Hardware	Peripheral interface	I2C/IR Remote Control
		GPIO/PWM
	Operating voltage	2.7V ~ 3.6V
	Operating current	Average: 80 mA
	Minimum current delivered by power supply	500 mA
	Operating temperature range	-40°C ~ 105°C
	Storage temperature	-40°C ~ 105°C
	External interface	-
Software	Wi-Fi mode	Station/SoftAP/SoftAP + Station
	Security	WPA/WPA2
	Encryption	WEP/TKIP/AES
	Firmware upgrade	UART Download/OTA (via network)

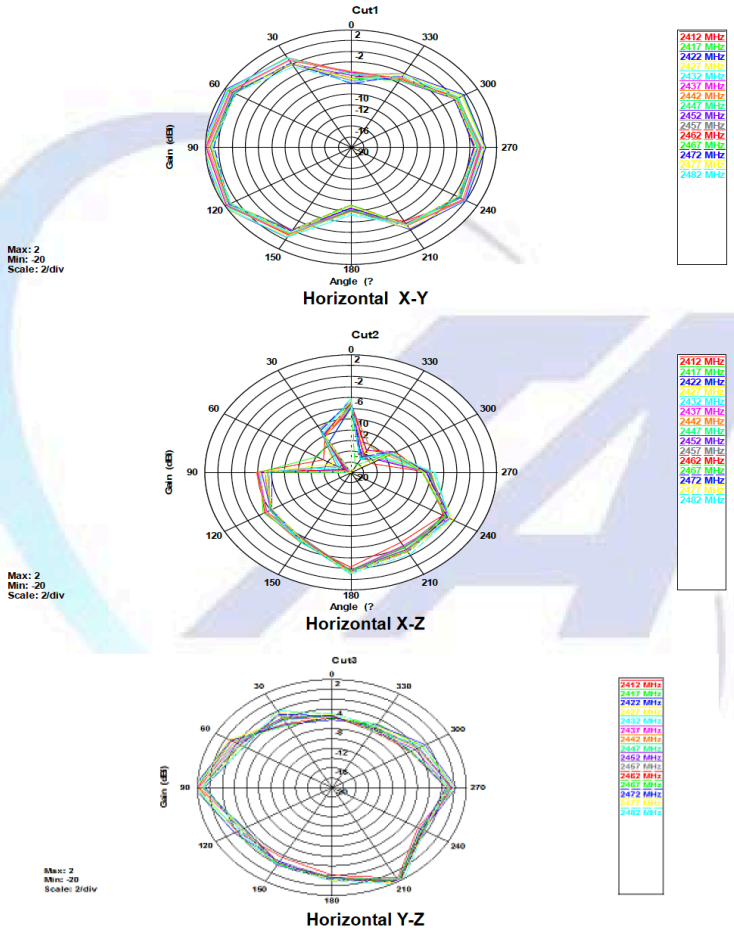
Categories	Items	Specifications
	Software development	Supports Cloud Server Development/SDK for custom firmware development
	Network protocols	IPv4, TCP/UDP/HTTP
	User configuration	Cloud Server, Android/iOS app

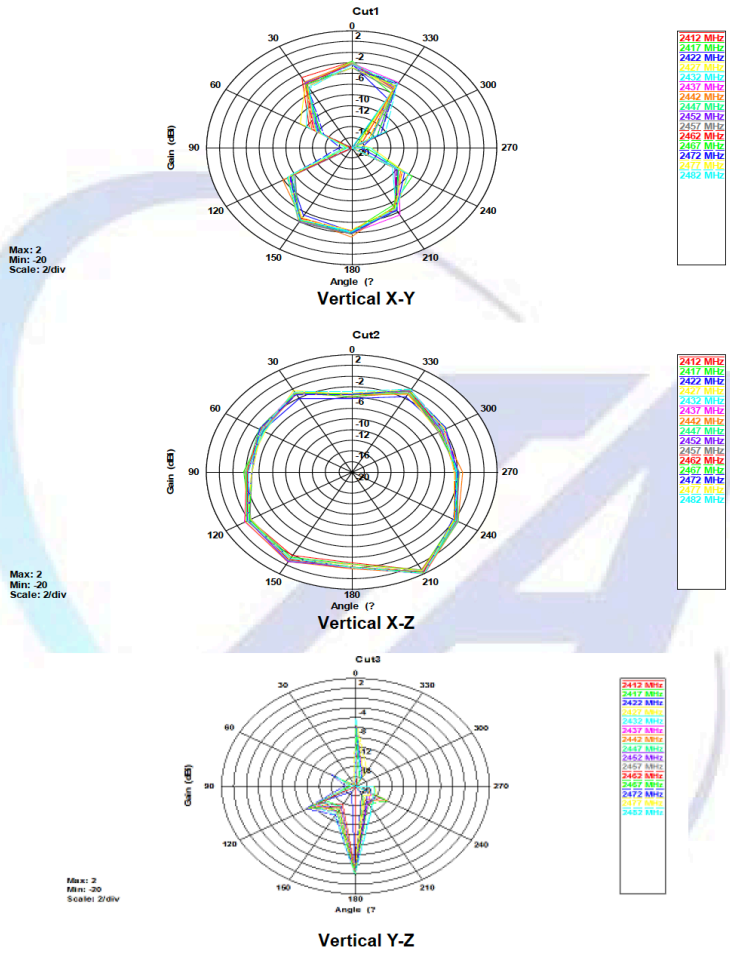
Table 1-2. Antenna Specifications

Parameter	Description	Image
Model	ESP ANT B	
Type	PCB	
Assembly	PTH	
Gain	See table below	
Dimensions unit:mm		

Frequency (MHz)	Efficiency (%)	Gain (dB)
2412	73.79	2.39
2417	77.04	2.97
2422	79.83	2.80
2427	81.19	2.89
2432	80.54	3.04
2437	76.86	2.86
2442	76.17	2.99
2447	73.99	2.96
2452	72.00	2.80
2457	70.71	2.72
2462	71.31	2.94
2467	71.32	3.12
2472	72.03	3.28
2477	72.71	3.24
2482	75.42	3.42

L1	3.94
L2	2.70
L3	5.00
L4	2.64
L5	2.00
L6	4.90
W1	0.90
W2	0.50
D1	0.50
D2	0.30
D3	0.30
D4	0.50
D5	1.40
D6	1.70

Parameter	Description	Image
Pattern Plots		

Parameter	Description	Image
Pattern Plots		

2. Pin Description

Figure 2-1 and Figure 2-2 show the pin distribution of the ESP-WROOM-5C.

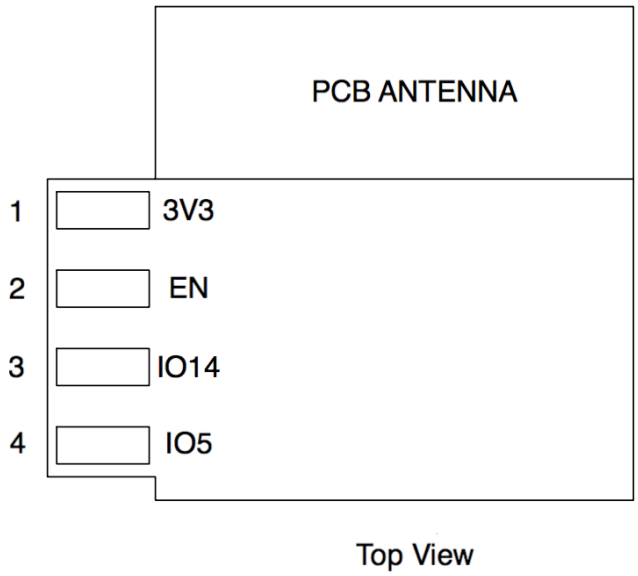


Figure 2-1. ESP-WROOM-5C Pin Layout (Top View)

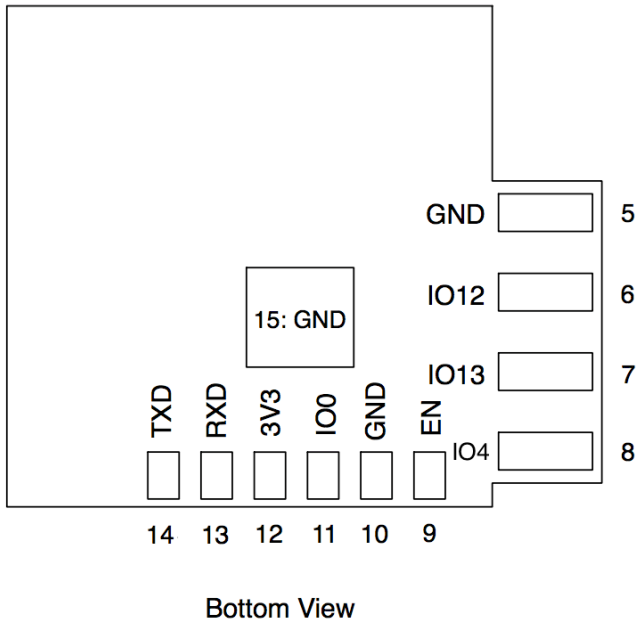


Figure 2-2. ESP-WROOM-5C Pin Layout (Bottom View)

ESP-WROOM-5C has 15 pins. Please see the pin definitions in Table 2-1.

Table 2-1. ESP-WROOM-5C Pin Definitions

No.	Pin Name	Functional Description
1	3V3	3.3V power supply (VDD) 📖 ***Note:*** *It is recommended the maximum output current a power supply provides be of 500 mA or above.*
2	EN	Chip enable pin. Active high.
3	IO14	GPIO14
4	IO5	GPIO5
5	GND	GND
6	IO12	GPIO12
7	IO13	GPIO13
8	IO4	GPIO4
9	EN	Chip enable pin. Active high.
10	GND	GND
11	IO0	GPIO0 • UART download: pull down. • Flash boot: floating or pull up.
12	3V3	3.3V power supply (VDD) 📖 ***Note:*** *It is recommended the maximum output current a power supply provides be of 500 mA or above.*
13	RXD	UART0_RXD, receive end in UART download; GPIO3
14	TXD	UART0_TXD, transmit end in UART download, floating or pull up; GPIO1
15	GND	GND

📖 ***Note:***

Pins 1 ~ 8 are pluggable pads that can be welded to your own development board, while pins 9 ~ 15 are reserved for testing and cannot be welded to the development board.

3. Functional Description

3.1. CPU

The ESP8285 integrates a Tensilica L106 32-bit RISC processor, which achieves extra- low power consumption and reaches a maximum clock speed of 160 MHz. The Real-Time Operating System (RTOS) and Wi-Fi stack allow 80% of the processing power to be available for user application programming and development. The CPU includes the interfaces as below:

- Programmable RAM/ROM interfaces (iBus), which can be connected with memory controller, and can also be used to visit flash;
- Data RAM interface (dBus), which can connected with memory controller;
- AHB interface which can be used to visit the register.

3.2. Memory

3.2.1. Internal SRAM and ROM

ESP8285 SoC integrates the memory controller including ROM and SRAM. MCU can access the memory controller through iBus, dBus, and AHB interfaces. All memory units can be accessed upon request. A memory arbiter determines the running sequence in the arrival order of requests.

3.2.2. SPI Flash

ESP8285 has a built-in SPI flash to store user programs.

- Memory size: 1 MB
- SPI mode: Dual SPI

3.3. Crystal Oscillator

ESP-WROOM-5C uses a 26-MHz crystal oscillator. The accuracy of the crystal oscillator should be ±10 PPM.

When using the download tool, please select the right type of crystal oscillator. In circuit design, capacitors C1 and C2 which connect to the earth are added to the input and output terminals of the crystal oscillator respectively. The values of the two capacitors can be flexible, ranging from 6 pF to 22 pF, however, the specific capacitive values depend on further testing of, and adjustment to, the overall performance of the whole circuit. Normally, the capacitive values of C1 and C2 are within 10 pF for the 26-MHz crystal oscillator.

3.4. Interface Description

Table 3-1. Interface Description

Interface	Pin	Functional Description
PWM	IO12 (R), IO15 (G), IO13 (B)	Currently the PWM interface has four channels, but users can extend it to five channels. PWM interface can realize the control of LED lights, buzzers, relays, electronic machines, etc.
IR	IO14 (IR_T), IO5 (IR_R)	The functionality of the infrared remote control interface can be realized via software programming. The interface uses NEC coding, modulation, and demodulation. The frequency of the modulated carrier signal is 38 kHz. (You can configure this interface to other GPIO)
I2C	IO14 (SCL), IO5 (SDA)	Connects to external sensors and display screens, etc. (You can configure this interface to other GPIO)
UART	UART0: IO15 (U0TXD), IO13 (U0RXD)	Communicates with the UART device. Downloading: U0TXD + U0RXD or GPIO2 + U0RXD Communicating (UART0): You need to exchange the inner pins of UART in the software before use IO15 (U0TXD) and IO13 (U0RXD).

4. Electrical Characteristics

> 📖 ***Note:***
>
> *Unless otherwise specified, measurements are based on VDD = 3.3V, TA = 25°C.*

4.1. Electrical Characteristics

Table 4-1. Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit
Storage temperatue	-	–40	Normal	105	°C
Operating temperature	-	–40	20	105	°C
Maximum soldering temperature (Condition: IPC/JEDEC J-STD-020)	-	-	-	260	°C
Supply voltage	VDD	2.7	3.3	3.6	V
Input logic level low	V_{IL}	–0.3	-	0.25 VDD	V
Input logic level high	V_{IH}	0.75 VDD	-	VDD + 0.3	V
Output logic level low	V_{OL}	-	-	0.1 VDD	V
Output logic level high	V_{OH}	0.8 VDD	-	-	V

4.2. Wi-Fi Radio

Table 4-2. Wi-Fi Radio Characteristics

Description	Min	Typ	Max	Unit
Input frequency	2412	-	2462	MHz
Input reflection	-	-	–10	dB
Output Impedance	-	50	-	Ω
Output Power				
RF output power	802.11b:18.09dBm 802.11g:22.84dBm 802.11n20:22.68dBm			
Sensitivity				
DSSS, 1 Mbps	-	–96	-	dBm

CCK, 11 Mbps	-	–87	-	dBm
6 Mbps (1/2 BPSK)	-	–90	-	dBm
54 Mbps (3/4 64-QAM)	-	–73	-	dBm
HT20, MCS7 (65 Mbps, 72.2 Mbps)	-	–69	-	dBm
Adjacent channel rejection				
OFDM, 6 Mbps	-	37	-	dB
OFDM, 54 Mbps	-	21	-	dB
HT20, MCS0	-	37	-	dB
HT20, MCS7	-	20	-	dB

4.3. Power Consumption

The following power consumption data were obtained from the tests with a 3.3V power supply and a voltage stabilizer, in 25°C ambient temperature. All data are based on 50% duty cycle in continuous transmission mode.

Table 4-3. Power Consumption

Modes	Min	Typ	Max	Unit
Tx 802.11b, CCK 11 Mbps, POUT = +17 dBm	-	170	-	mA
Tx 802.11g, OFDM 54 Mbps, POUT = +15 dBm	-	140	-	mA
Tx 802.11n, MCS7, POUT = +13 dBm	-	120	-	mA
Rx 802.11b, 1024 bytes packet length , –80 dBm	-	50	-	mA
Rx 802.11g, 1024 bytes packet length , –70 dBm	-	56	-	mA
Rx 802.11n, 1024 bytes packet length , –65 dBm	-	56	-	mA
Modem-sleep①	-	15	-	mA
Light-sleep②	-	0.9	-	mA
Deep-sleep③	-	20	-	µA
Power Off	-	0.5	-	µA

> 📖 ***Notes:***
>
> ① ***Modem-sleep*** *mode is used in the applications that require the CPU to be working, as in PWM or I2S applications. According to 802.11 standards (like U-APSD), it shuts down the Wi-Fi Modem circuit while maintaining a Wi-Fi connection with no data transmission to optimize power consumption. E.g. in DTIM3, maintaining a sleep of 300 ms with a wakeup of 3 ms cycle to receive AP's Beacon packages at interval requires about 15 mA current.*
>
> ② *During* ***Light-sleep*** *mode, the CPU may be suspended in applications like Wi-Fi switch. Without data transmission, the Wi-Fi Modem circuit can be turned off and CPU suspended to save power consumption according to the 802.11 standards (U-APSD). E.g. in DTIM3, maintaining a sleep of 300 ms with a wakeup of 3 ms to receive AP's Beacon packages at interval requires about 0.9 mA current.*
>
> ③ *During* ***Deep-sleep*** *mode,Wi-Fi is turned off. For applications with long time lags between data transmission, e.g. a temperature sensor that detects the temperature every 100s, sleeps for 300s and wakes up to connect to the AP (taking about 0.3 ~ 1s), the overall average current is less than 1 mA. The current of 20 µA is acquired at the voltage of 2.5V.*

4.4. Reflow Profile

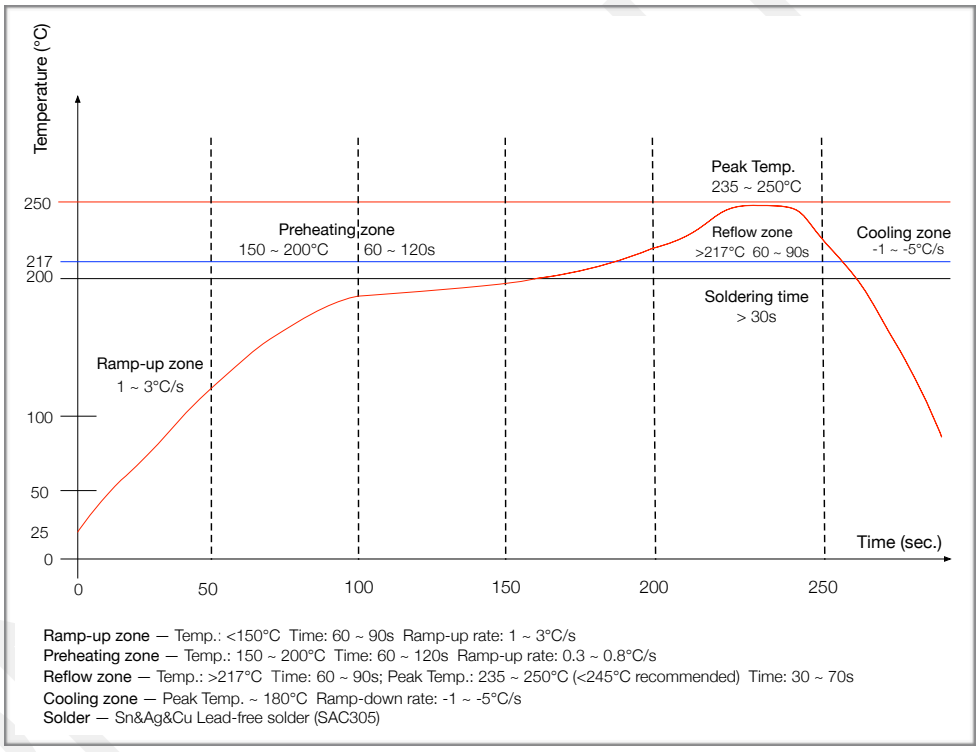


Figure 4-1. ESP-WROOM-5C Reflow Profile

4.5. Electrostatic Discharge

Table 4-4. Electrostatic Discharge Parameters

Name	Symbol	Reference	Level	Max	Unit
Electrostatic Discharge (Human - Body Model)	V_{ESD} (HBM)	Temperature: 23 ± 5°C Based on ANSI/ESDA/JEDEC JS - 001 - 2014	2	2000	V
Electrostatic Discharge (Charged - Device Model)	V_{ESD} (CDM)	Temperature: 23 ± 5°C Based on JEDEC EIA/JESD22 - C101F	C2	500	

5. Dimensions

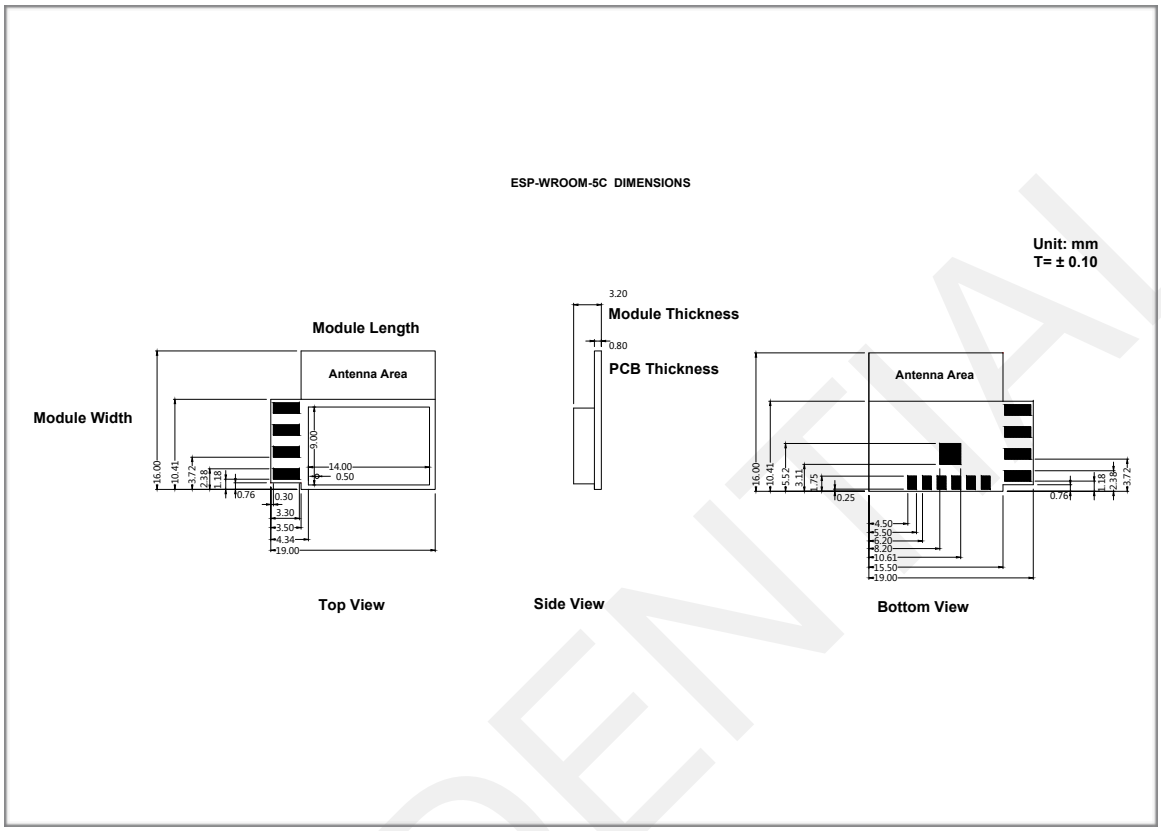


Figure 7-1. ESP-WROOM-5C Dimensions

6. Recommended PCB Land Pattern

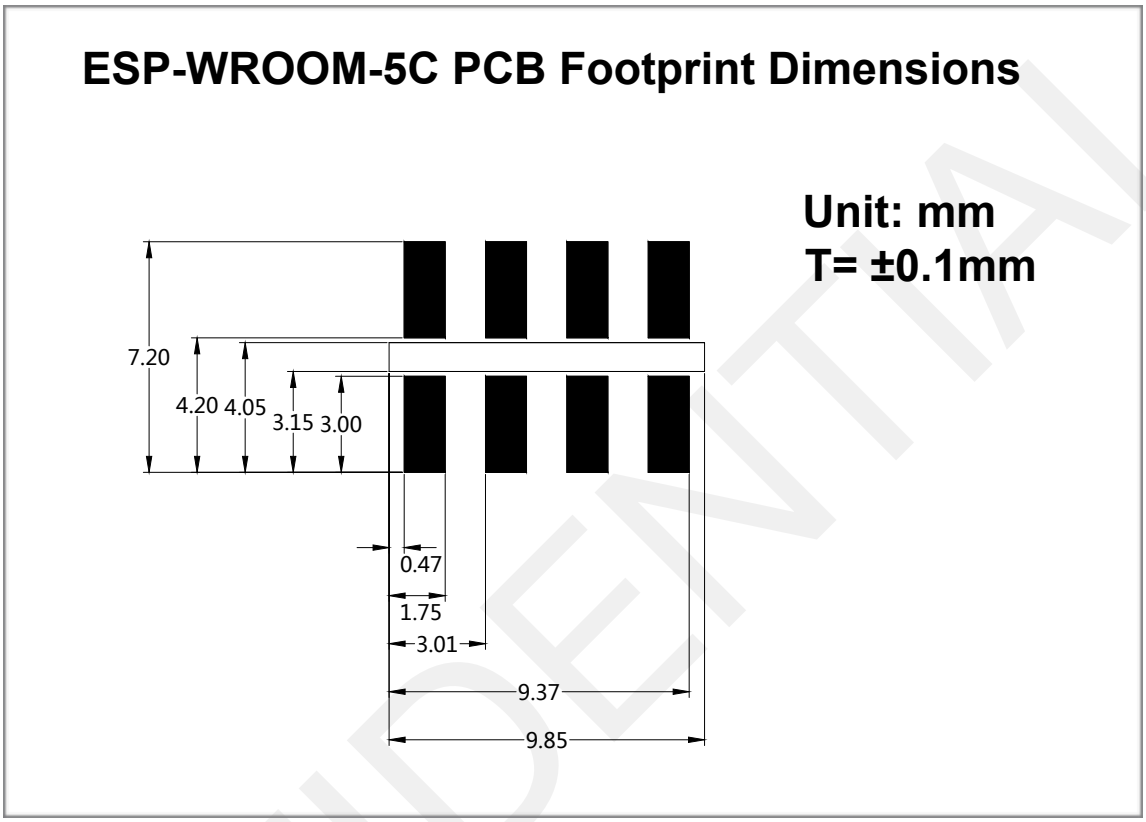


Figure 8-1. Recommended PCB Land Pattern of ESP-WROOM-5C

FCC Statement

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

This device complies with part 15 of the 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 Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment .This equipment should be installed and operated with minimum distance 20cm between the radiator& your body.

FCC Label Instructions:

The outside of final products that contains this module device must display a label referring to the enclosed module. This exterior label can use wording such as: "Contains Transmitter Module FCC ID: 2AC7Z-ESPWROOM5C",or "Contains FCC ID: 2AC7Z-ESPWROOM5C", Any similar wording that expresses the same meaning may be used.

Regulatory Module Integration Instructions

This device complies with part 15.247 of the FCC Rules.

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The antenna is integral PCB Antenna and maximum gain is 3.42dBi .

This Wi-Fi module has been granted modular approval for mobile applications. OEM integrators for host products may use the module in their final products without additional FCC certification if they meet the following conditions. Otherwise, additional FCC approvals must be obtained.

The host product with the module installed must be evaluated for simultaneous transmission requirements.

The user's manual for the host product must clearly indicate the operating requirements and conditions that must be observed to ensure compliance with current FCC RF exposure guidelines.

To comply with FCC regulations limiting both maximum RF output power and human exposure to RF radiation, use this module only with the included onboard antenna.

The final host / module combination may also need to be evaluated against the FCC Part 15B criteria for unintentional radiators in order to be properly authorized for operation as a Part 15 digital device.

Espressif IoT Team

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