Product Specification

DT-ESP-C05

——2.4GHz Wi-Fi and BLE5.0 Coexistence Module

Version: 1.0 Date: Apr.16, 2021

Features

- **General**
  - Chip: ESP32-C3F
  - Module Size:16mm*20mm*3mm
  - 4MB embedded flash
  - 384KB ROM
  - 400KB SRAM
- **Wi-Fi Features**
  - IEEE 802.11 b/g/n-compliant
  - Center frequency range of operating channel: 2412 ~ 2484 MHz
  - Supports 20 MHz, 40 MHz bandwidth in 2.4 GHz band
  - 1T1R mode with data rate up to 150 Mbps
  - TX/RX A-MPDU, TX/RX A-MSDU
  - Immediate Block ACK
  - Fragmentation and defragmentation
  - Automatic Beacon monitoring (hardware TSF)
  - 4 X virtual Wi-Fi interfaces
  - Simultaneous support for Infrastructure BSS in Station mode, Soft-AP mode, Station + Soft-AP mode, and promiscuous mode
- **Bluetooth Features**
  - Bluetooth LE: Bluetooth 5, Bluetooth mesh
  - Speed: 125 Kbps, 500 Kbps, 1 Mbps, 2 Mbps
  - Advertising extensions
  - Multiple advertisement sets
  - Channel selection algorithm #2
- **Peripheral Interfaces**
  - GPIO * 14;
  - UART;
  - IIC ;
  - SPI;
  - EN ;
  - PWM ;
  - ADC;
  - USB;
- **Working temperature:** -40℃-85℃
- **Working temperature:** -40℃-105℃ (optional)

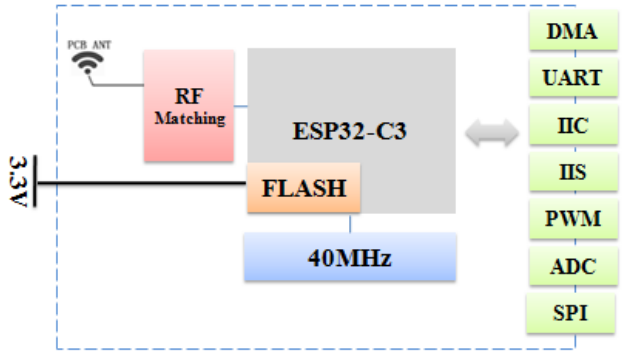
Application

- Serial transparent transmission;
- Wi-Fi prober;
- Smart power plug/Smart LED light;
- Mesh networks;
- Sensor networks;
- Over-the-top (OTT) devices;
- Wireless location system beacon;
- Industrial field bus;

Module Type

Name	Antenna Type
DT-ESP-C05	PCB ANT

Module Structure



Update Record

Date	Version	Update
2021-04-19	V1.0	First released

Table of Contents

1. Introduction

DT-ESP-C05 Wi-Fi and BLE coexistence Module is a highly integrated single-chip low power 802.11n Wireless LAN (WLAN) network controller. It combines an RISC CPU, WLAN MAC, a 1T1R capable WLAN baseband, RF, and Bluetooth in a single chip. It also provides a bunch of configurable GPIO, which is configured as digital peripherals for different applications and control usage.

DT-ESP-C05 Wi-Fi Module use ESP32-C3 as Wi-Fi and BLE coexistence SOC chip.

DT-ESP-C05 Wi-Fi Module integrates internal memories for complete WI-FI protocol functions. The embedded memory configuration also provides simple application developments.

DT-ESP-C05 Wi-Fi 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 a independent network controller. Anyway, DT-ESP-C05 Wi-Fi module provides many probabilities with the best price.

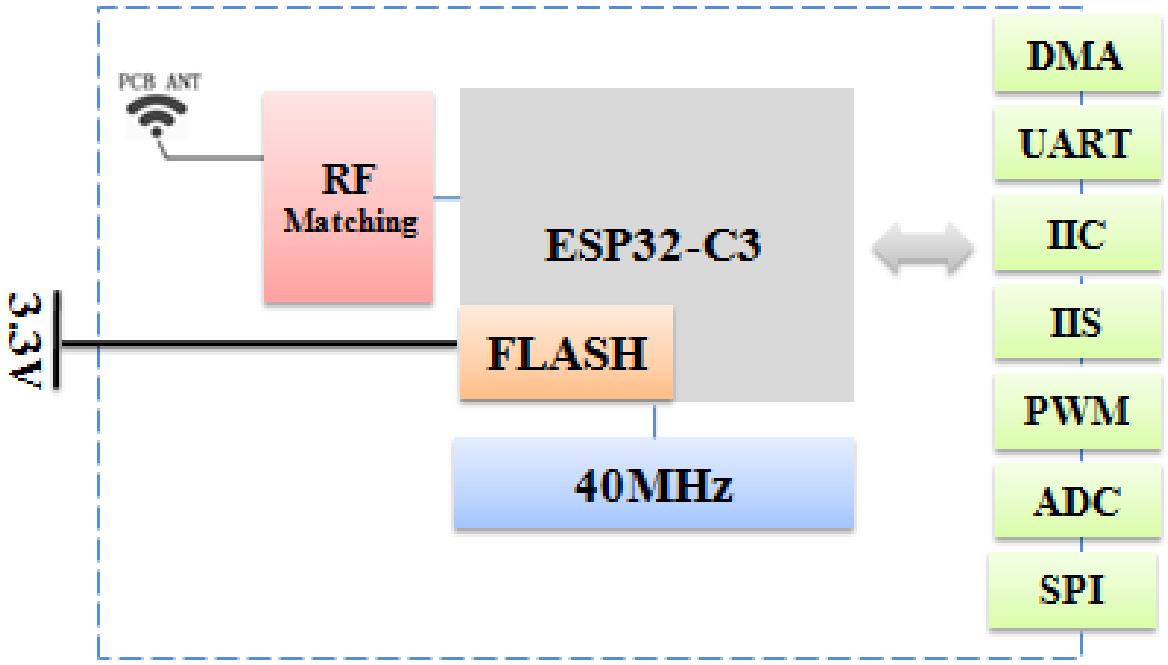


Fig.1.1 DT-ESP-C05 Module Structure

Technical parameters for DT-ESP-C05 are listed as follows.

Table 1.1 DT-ESP-C05 Parameters

Type	Items	Parameters
Wi-Fi	Frequency	2.4G~2.5G(2412M~2484M)
	Transmit power	802.11b: +20.5 dBm
		802.11g: +19dBm
		802.11n: +17.5 dBm
	Receiver sensitivity	802.11b: -89 dBm (11Mbps)
		802.11g: -77 dBm（54Mbps）
		802.11n: -74 dBm（MCS7）
	EVM	-25dB @802.11b,11Mbps@21dBm
		-28dB @802.11n,54Mbps@19dBm
		-30.5dB@802.11n,HT40,MCS7@18.5dBm
	Antenna	PCB antenna
BLE	RF power control range	-27~18dBm
Hardware	CPU	32-bit RISC CPU
	Interface	UART/SDIO/SPI/I2C/GPIO/PWM
	Working voltage	3.0V ~ 3.6V
	Working temperature	-40°C ~85°C (105°C)
	Environment temperature	-40°C ~ 105°C
	Shape	16mm x 20mm x 3mm
Software	Wi-Fi working mode	STA, Soft-AP and sniffer modes
	Security mode	WPS / WEP / WPA / WPA2 / WPA3
	Update firmware	UART Download
	Software develop	SDK
	Network protocol	IPv4, TCP/UDP/HTTP/FTP/MQTT

2. Interface Definition

DT-ESP-C05 Wi-Fi & BLE module interface definition is shown as below。

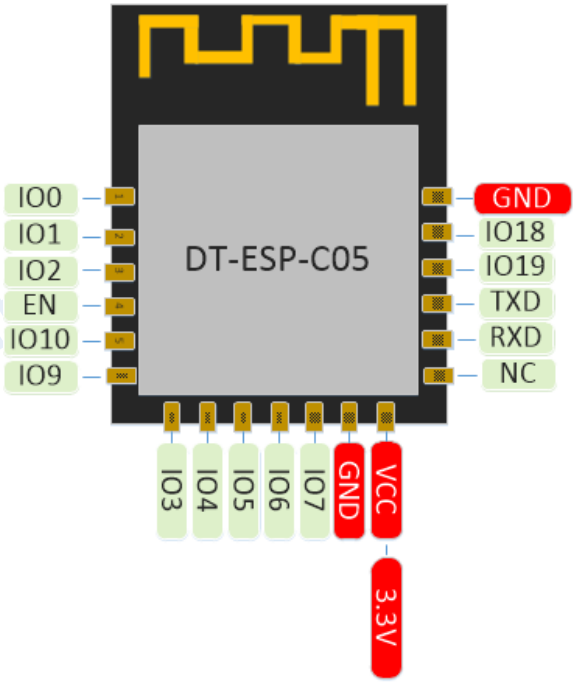


Fig.2.1DT-ESP-C05 Pins Definition

Working mode and pins function are shown in Table 2.1.

Table.2.1Working mode

Mode	GPIO9 Level
UART Download Mode	LOW
Flash Boot Mode	HIGH (default)

Table.2.2 Pins Function Definition

Num.	Pin Name	Type	Function
1	IO0	I/O	GPIO0, ADC1_CH0, XTAL_32K_P
2	IO1	I/O	GPIO1,ADC1_CH1, XTAL_32K_N
3	IO2	I/O	GPIO2,ADC1_CH2,FSPIQ
4	EN	I/O	Chip enable; Internal Pull-up. HIGH: enable the chip
5	IO10	I/O	GPIO10, FSPICS0. When the value of eFuse bit

			EFUSE_JTAG_SEL_ENABLE is 0, JTAG signals cannot be used. 1, if IO10 is 0, JTAG signals come from chip pins; if IO10 is 1, JTAG signals cannot be used
6	IO9	I/O	GPIO9
7	IO3	I/O	GPIO3,ADC1_CH3
8	IO4	I/O	GPIO4,ADC1_CH4,FSPIHD,MTMS
9	IO5	I/O	GPIO5,ADC2_CH0,FSPIWP,MTDI
10	IO6	I/O	GPIO6,FSPICLK,MTCK
11	IO7	I/O	GPIO7,FSPID,MTDO
12	GND	P	POWER GND
13	POWER	P	POWER IN, 3.3V
14	NC	-	Not Connect
15	RX0	I/O	GPIO20,U0RXD
16	TX0	I/O	GPIO21,U0TXD
17	IO19	I/O	GPIO19,USB-D+
18	IO18	I/O	GPIO18,USB-D-
19	GND	P	Power

3. Size and Layout

Size for DT-ESP-C05 can be shown as follows.

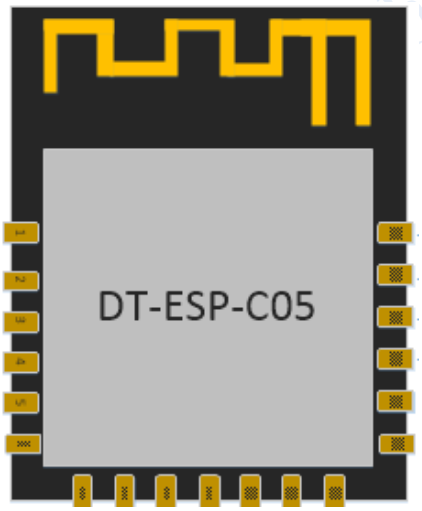
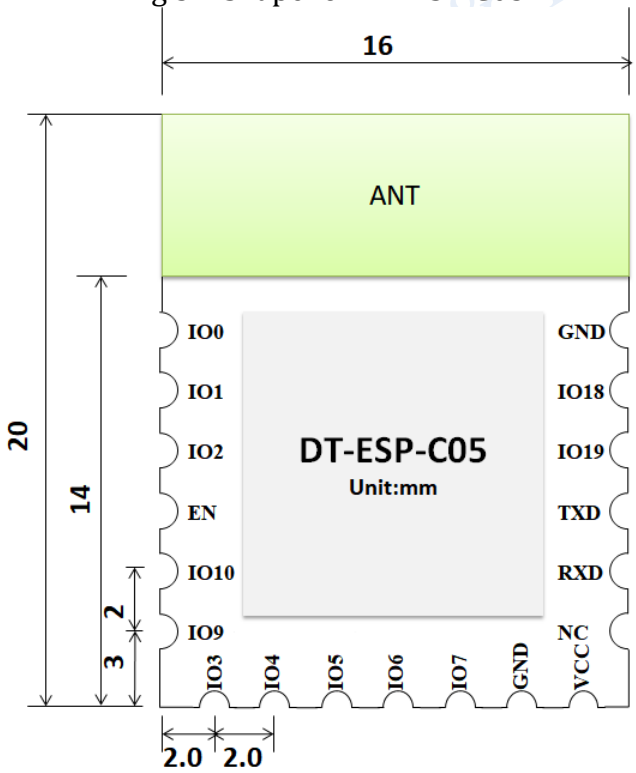


Fig.3.1 Shape for DT-ESP-C05



(a) Vertical View

(b) Side View

Fig.3.2 Size for DT-ESP-C05

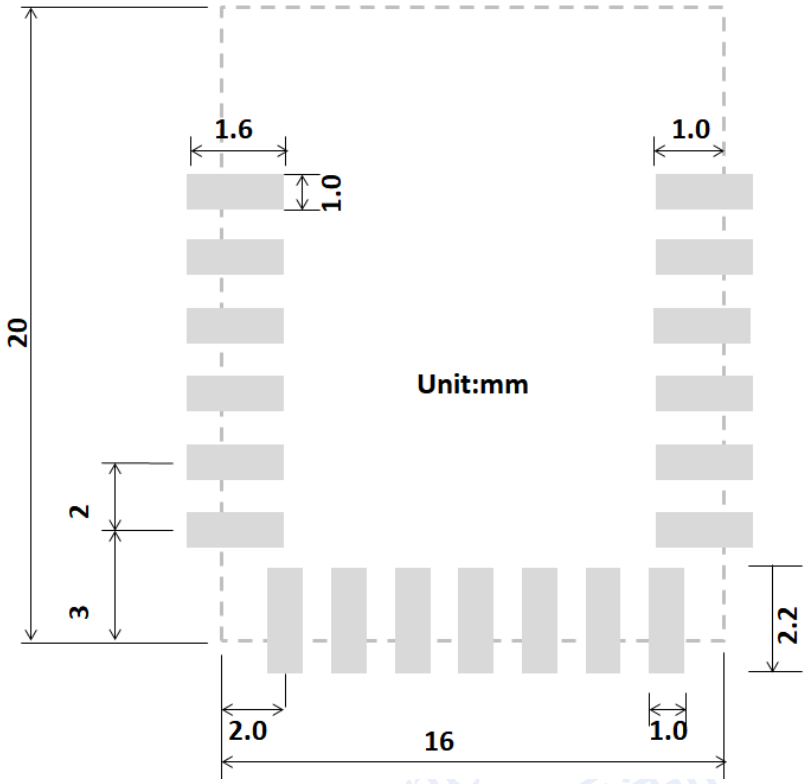


Fig.3.3 PCB Layout for DT-ESP-C05

4. Electronica Characteristics

Table.4.1 Electronica Characteristics

Parameters		Condition	Min	Classical	Max	Unite
Store Temperature		-	-40	Normal	150	℃
Sold Temperature		IPC/JEDEC J-STD-020	-	-	260	℃
Working Voltage		-	3.0	3.3	3.6	V
I/O	V_{IL}	-	-0.3	-	0.25*VDD	V
	V_{IH}	-	0.75*VDD	-	VDD+0.3	
	V_{OL}	-	-	-	0.1*VDD	
	V_{OH}	-	0.8*VDD	-	-	
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	Unit
RX 11b /g/n, HT20	-	-	82	mA

RX 11n,HT40		-	84	
TX 11b, 1Mbps@21dBm		-	350	
TX 11g, 54Mbps@19dBm	-	-	295	mA
TX 11n, HT20, MCS7, @18.5dBm	-	-	290	mA
TX 11n, HT40, MCS7, @18.5dBm	-	-	290	mA
Modem-sleep, CPU is powered on @80MHz	-	15	-	mA
Light-sleep	-	130	-	uA
Deep-sleep, RTC timer + RTC memory	-	5	-	uA
Power off, CHIP_PU is set to low level	-	1	0	uA

6. Wi-Fi RF Characteristics

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

Table.6.1 Wi-Fi TX Characteristics

Parameters	Min	Classical	Max	Unit
Input frequency	2412	-	2484	MHz
802.11b @1Mbps,11Mbps	-	20.5	-	dBm
802.11g @6Mbps	-	20.0	-	dBm
802.11g @54Mbps	-	18.0	-	dBm
802.11n,HT20 MCS0	-	19.0	-	dBm
802.11n,HT40 MCS0	-	18.5	-	dBm
EVM @11b,1Mbps@21dBm	-	-24.5	-	dBm
EVM @11g,54Mbps@19dBm	-	-28	-	dBm
EVM @11n,MCS7@18.5dBm	-	-30.5	-	dBm
EVM @11n, HT40, MCS7@18.5dBm	-	-30.5	-	dBm

Table.6.2 Wi-Fi RX Sensitivity

Parameters	Min	Classical	Max	Unit
802.11b,1Mbps	-	-98	-	dBm
802.11b,11Mbps	-	-88.	-	dBm

802.11g,6Mbps	-	-92	-	dBm
802.11g,54Mbps	-	-76	-	dBm
802.11n,HT20,MCS0	-	-92	-	dBm
802.11n,HT20,MCS3	-	-85	-	dBm
802.11n,HT20,MCS7	-	-74	-	dBm
802.11n,HT40,MCS0	-	-90	-	dBm
802.11n,HT40,MCS3	-	-81	-	dBm
802.11n,HT40,MCS7	-	-71	-	dBm

Table.6.3 Wi-Fi RX Characteristics

Parameters	Min	Classical	Max	Unit
MAX RX Level @11b,1Mbps	-	5	-	dBm
MAX RX Level @11b,11Mbps	-	5	-	dBm
MAX RX Level @11g,6Mbps	-	5	-	dBm
MAX RX Level @11g,54Mbps	-	0	-	dBm
MAX RX Level @11n,HT20,MCS0	-	5	-	dBm
MAX RX Level @11n,HT20,MCS7	-	0	-	dBm
MAX RX Level @11n,HT40,MCS0	-	5	-	dBm
MAX RX Level @11n,HT40,MCS7	-	0	-	dBm
RX Adjacent Channel Rejection@11b,1Mbps	-	35	-	dB
RX Adjacent Channel Rejection@11b,11Mbps	-	35	-	dB
RX Adjacent Channel Rejection@11g,6Mbps	-	31	-	dB
RX Adjacent Channel Rejection@11g,54Mbps	-	14	-	dB
RX Adjacent Channel Rejection@11n,HT20,MCS0	-	31	-	dB
RX Adjacent Channel Rejection@11n,HT20,MCS7	-	13	-	dB
RX Adjacent Channel Rejection@11n,HT40,MCS0	-	19	-	dB

7. Bluetooth LE Radio

Table.7.1 TX Transmitter General Characteristics

Parameters	Min	Classical	Max	Unit
Gain control power	-	3	-	dBm

RF power control range	-27	-	18	dBm
In-band emissions @F-F0±3MHz, LE 1M	-	-41.95	-	dBm
In-band emissions @F-F0±>3MHz, LE 1M	-	-44.48	-	dBm
Modulation characteristics @ △f1avg, LE 1M	-	245	-	kHz
Modulation characteristics @△f2max, LE 1M	-	208	-	kHz
Carrier frequency offset, LE 1M	-	-9	-	kHz
In-band emissions @F-F0±5MHz, LE 2M	-	-45.26	-	dBm
In-band emissions @F-F0±>5MHz, LE 2M	-	-47	-	dBm
Modulation characteristics @ △f1avg, LE 2M	-	497	-	kHz
Modulation characteristics @△f2max, LE 2M	-	398	-	kHz
Carrier frequency offset, LE 2M	-	-9	-	kHz
In-band emissions @F-F0±3MHz, LE 500K	-	-41.3	-	dBm
In-band emissions @F-F0±>3MHz, LE 500K	-	-42.8	-	dBm
Modulation characteristics @ △f1avg, LE 500K	-	220	-	kHz
Modulation characteristics @△f2max, LE 500K	-	205	-	kHz
Carrier frequency offset, LE 500K	-	-11.9	-	kHz
Maximum received signal @30.8% PER	-	10	-	dBm

Table.7.2 RX Transmitter General Characteristics

Parameters		Min	Classical	Max	Unit
1M	Sensitivity @30.8% PER	-	-96	-	dBm
	Maximum received signal @30.8% PER	-	10	-	dBm
	Co-channel C/I	-	8	-	dB
	Image frequency	-	-29	-	dB
	Adjacent channel to image frequency @F =F_{image}+1	-	-38	-	dB
	Adjacent channel to image frequency @F =F_{image}-1	-	-34	-	dB
	Adjacent channel selectivity@ F =F0+1	-	-4	-	dB
	Adjacent channel selectivity@ F =F0-1	-	-3	-	dB
	Adjacent channel selectivity@ F ≥F0+3	-	-	-	dB
	Adjacent channel selectivity@ F ≤F0-3	-	-39	-	dB

2M	Sensitivity @30.8% PER	-	-93	-	dBm
	Maximum received signal @30.8% PER	-	0	-	dBm
	Co-channel C/I	-	10	-	dB
	Image frequency	-	-27	-	dB
	Adjacent channel to image frequency @F =F_{image}+2	-	-39	-	dB
	Adjacent channel to image frequency @F =F_{image}-2	-	-	-	dB
	Adjacent channel selectivity@ F =F0+2	-	-7	-	dB
	Adjacent channel selectivity@ F =F0-2	-	-7	-	dB
	Adjacent channel selectivity@ F ≥F0+6	-	-39	-	dB
	Adjacent channel selectivity@ F ≤F0-6	-	-39	-	dB
125K	Sensitivity @30.8% PER	-	-104	-	dBm
	Maximum received signal @30.8% PER	-	10	-	dBm
	Co-channel C/I	-	2	-	dB
	Image frequency	-	-34	-	dB
	Adjacent channel to image frequency @F =F_{image}+1	-	-44	-	dB
	Adjacent channel to image frequency @F =F_{image}-1	-	-37	-	dB
	Adjacent channel selectivity@ F =F0+2	-	-40	-	dB
	Adjacent channel selectivity@ F =F0-2	-	-42	-	dB
	Adjacent channel selectivity@ F ≥F0+3	-	-	-	dB
	Adjacent channel selectivity@ F ≤F0-3	-	-46	-	dB

8. The Recommended Sold Temperature Curve

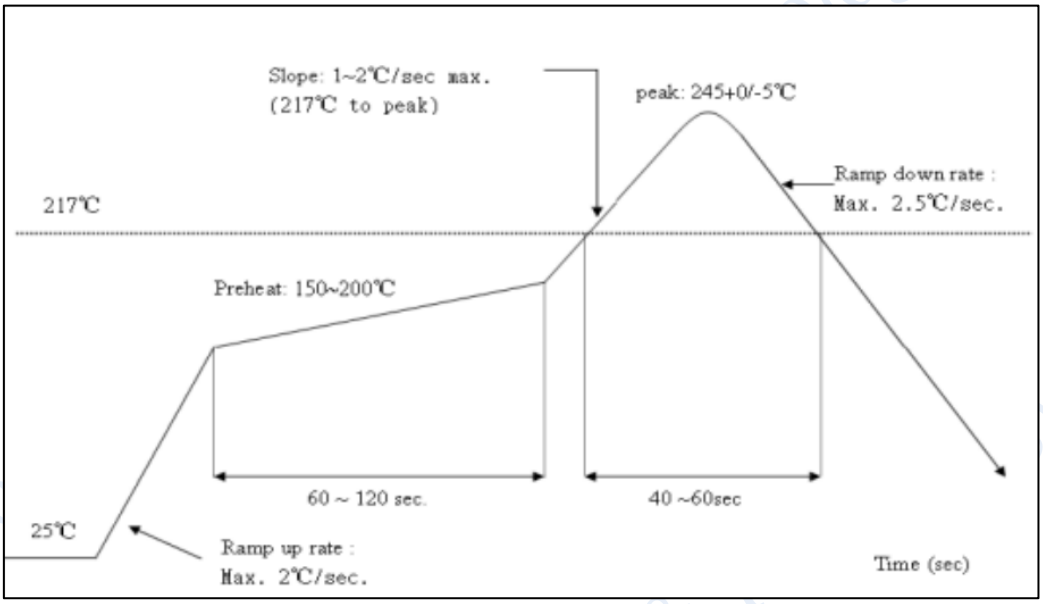


Fig.8.1 Temperature Curve when Sold

9. Minimum User System

This module can work just at 3.3V working voltage:

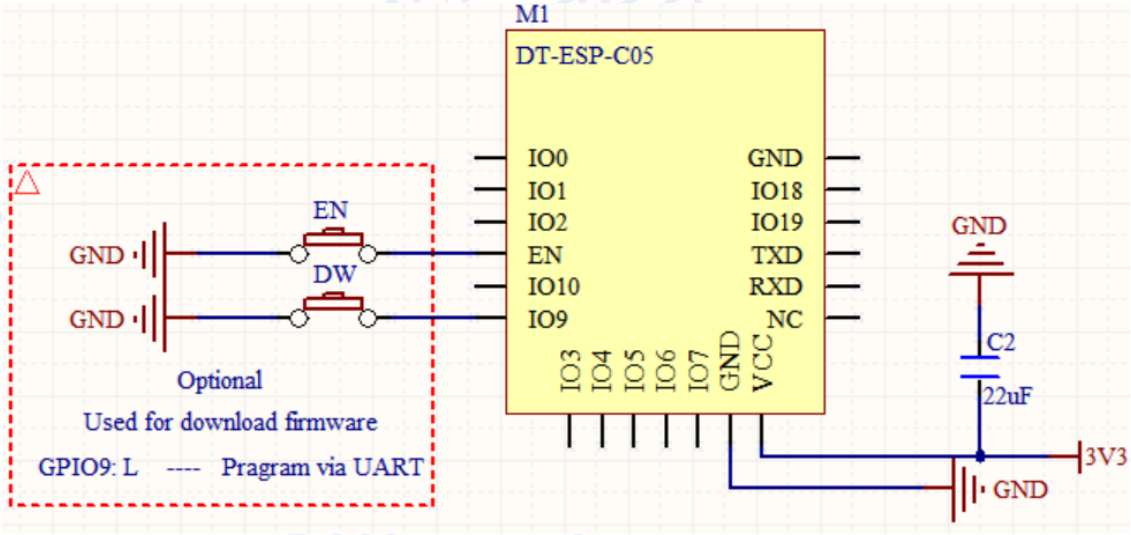


Fig.9.1 Minimum System

Note

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

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

(3) Wi-Fi module is at download mode: D9 is LOW level, then module reset to power;

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

10. The Recommended PCB Design

DT-ESP-C05Wi-Fi module can be sold on PCB board directly. For the high RF performance for the device, please notice the placement of the module. There are three ways to use the module for Wi-Fi Module with PCB antenna.

Solution 1: optical solution. The Wi-Fi module is placed on the side of the board, and the antennas are all exposed, and there is no metal material around the antenna, including wires, metal casings, weight plates, and the like.

Solution 2: sub-optical solution. The Wi-Fi module is placed on the side of the board, and the antenna below is hollowed out. There is a gap of not less than 5 mm reserved with the PCB, and there is no metal material around the antenna, including wires, metal casings, weight plates, and the like.

Solution 3: The Wi-Fi module is placed on the side of the board, and the PCB area under the antenna is empty, and copper cannot be laid.

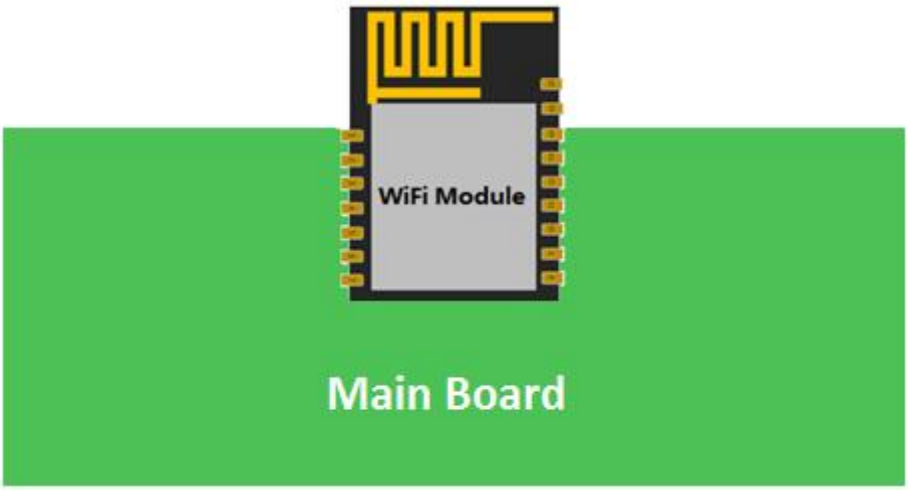


Fig.10.1 Solution 1

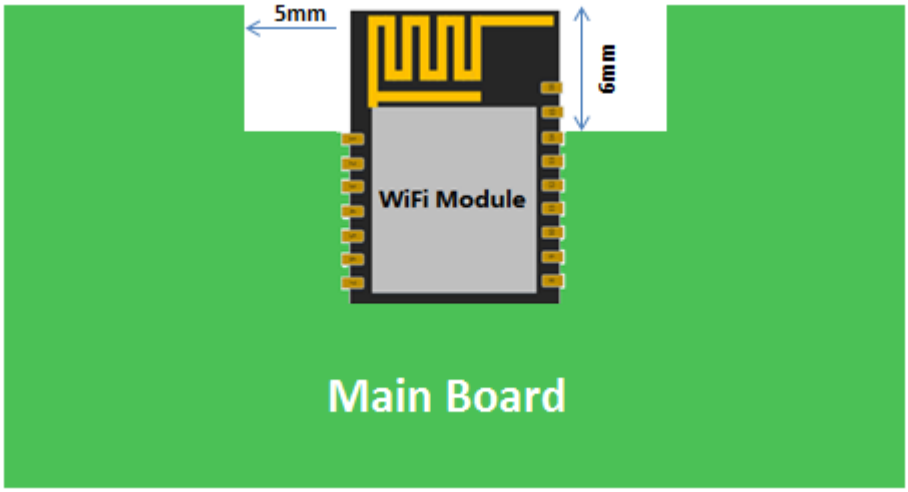


Fig.10.2 Solution 2

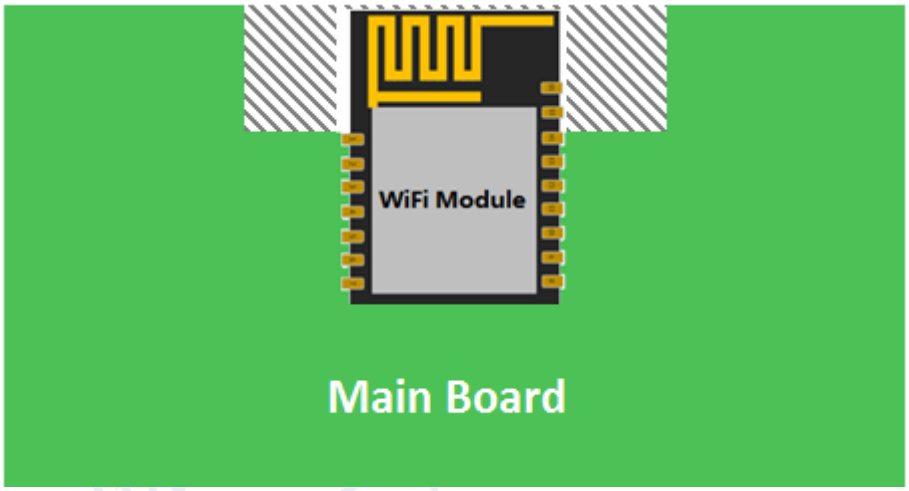


Fig.10.3 Solution 3

11. Peripheral Design 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 prevent electrostatic discharge (ESD).