XH-C3F

User Mannual

VER:V1.0 2021 年 08 月 18 日 NUM：XH00C3FEN

Features

- **General**
  - Chip: ESP32-C3.ESP32-C3 is a single-core Wi-Fi and Bluetooth 5 (LE) microcontroller SoC, based on the open-source RISC-V architecture
  - 32-bit RISC-V single-core processor with a four-stage pipeline that operates at up to 160 MHz
  - Built-in 4MB SPI flash byte;
  - Module Size:16mm*24mm*3mm
  - 400 KB of SRAM (16 KB for cache) and 384 KB of ROM on the chip
- **WiFi Features**
  - A complete Wi-Fi subsystem that complies with IEEE 802.11b/g/n protocol and supports Station mode, SoftAP mode, SoftAP + Station mode, and promiscuous mode
  - 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, SoftAP mode, Station + SoftAP mode, and promiscuous mode
- **Bluetooth Features**
  - A Bluetooth LE subsystem that supports features of Bluetooth 5 and Bluetooth mesh
  - 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 * 15;
  - 2xUART;
  - I2C ;
  - I2S;
  - SPI;
  - PWM ;
  - ADC;
  - USB;
- **Working temperature:** -40℃-85℃
- **Working temperature:** -40℃-105℃ (optional)

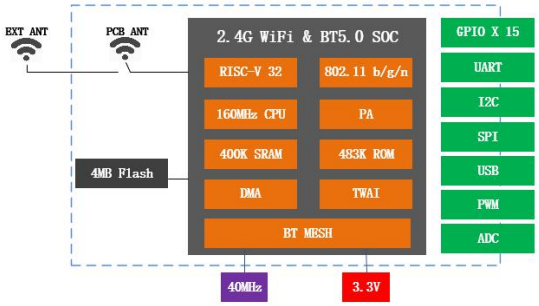
Application

- Smart Home;
- Industrial Automation;
- Health Care;
- Consumer Electronics;
- Smart Agriculture;
- Audio Devices;
- Generic Low-power IoT Sensor Hubsn;
- Generic Low-power IoT Data Loggers.

Module Typ

Name	AntennaType
XH-C3F	PCB ANT

Module Structure



Update Record

Date	Version	Update
2021-8-18	V1.0	First released

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1. Introduction

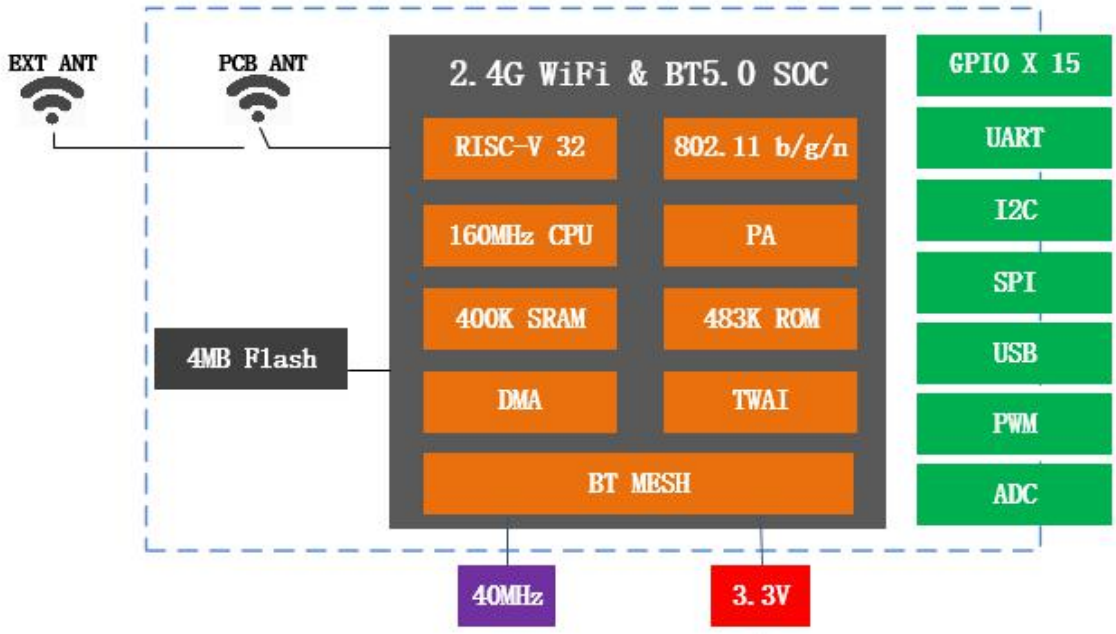
XH-C3F Wi-Fi and BLE coexistence Module is a highly integrated single-chip low power 802.11n Wireless LAN (WLAN) network controller. It combines an RISC CPU , WLAN MAC, a lT1R capable WLAN baseband, RF, and Bluetooth in a single chip. It also provides a bunch of configurable GPIO, w hich areconfigured as digital peripherals for different applications and control usage.

XH-C3F WiFi Module use ESP32-C3FH4 as Wi-Fi and BLE coexistence soc chip.

XH-C3F WiFi Module integrates internal memories for complete WIFI protocol functions. The embedded memory configuration also provides simple application developments.

XH-C3F WiFi 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, XH-C3F WiFi module provides many probabilities with the best price.

Fig. 1.1XH-C3F Module Structure



Technicalparameters for XH-C3F are listed as follows.

Table 1.1 XH-C3F Parameters

Types	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
	Environment temperature	-40°C ~ 105°C
	Shape	16mm x 24mm x 3mm
Software	Wi-Fi working mode	STA, SoftAP 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

XH-C3F WiFi&BLE module interface definition is shown as below。

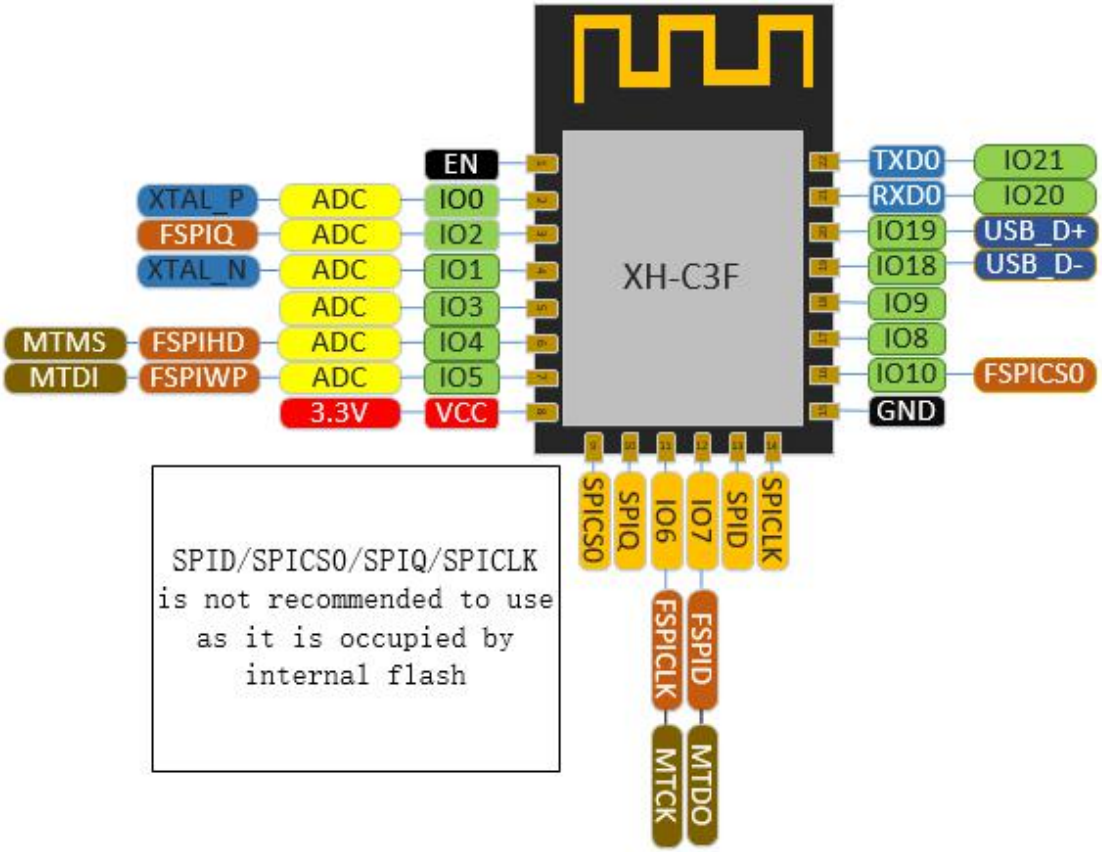


Fig. 2.1XH-C3F Pin Definition

Working mode and pin function is shown in Table 2.1.

Table 2.1Working mode

Mode	GPIO9 Level
UART Download Mode	LOW
FlashBootMode	HIGH(default)

Table 2.2 Pin Function Definition

Num	Pin Name	Type	Function
1	EN	I/O	Chip enable; Internal Pull-up. HIGH:enable the chip
2	IO0	I/O	GPIO0, ADC1_CH0, XTAL_32K_P
3	IO2	I/O	GPIO2,ADC1_CH2,FSPIQ
4	IO1	I/O	GPIO1, ADC1_CH1, XTAL_32K_N
5	IO3	I/O	GPIO3,ADC1_CH3
6	IO4	I/O	GPIO4,ADC1_CH4,FSPIHD,MTMS
7	IO5	I/O	GPIO5,ADC2_CH0,FSPIWP,MTDI
8	VCC	P	3V3 Power
9	SPICS0	I/O	This pin is occupied by FLASH
10	SPIQ	I/O	This pin is occupied by FLASH
11	IO6	I/O	GPIO6, FSPICLK, MTCK
12	IO7	I/O	GPIO7, FSPID, MTDO
13	SPID	I/O	This pin is occupied by FLASH
14	SPICLK	I/O	This pin is occupied by FLASH
15	GND	p	Ground
16	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
17	IO8	I/O	GPIO8,Internal Pull-up. When the value of eFuse bit UART_PRINT_CONTROL is 0, print is enabled and not controlled by IO8. 1, if IO8 is 0, print is enabled; if IO8 is 1, it is disabled
18	IO9	I/O	GPIO9
19	IO18	I/O	GPIO18, USB_D-
20	IO19	I/O	GPIO19, USB_D+
21	RXD0	I/O	GPIO20, U0RXD

22	TXD0	I/O	GPIO21, U0TXD

3. Size and Layout

Size for XH-C3F can be shown as follows.

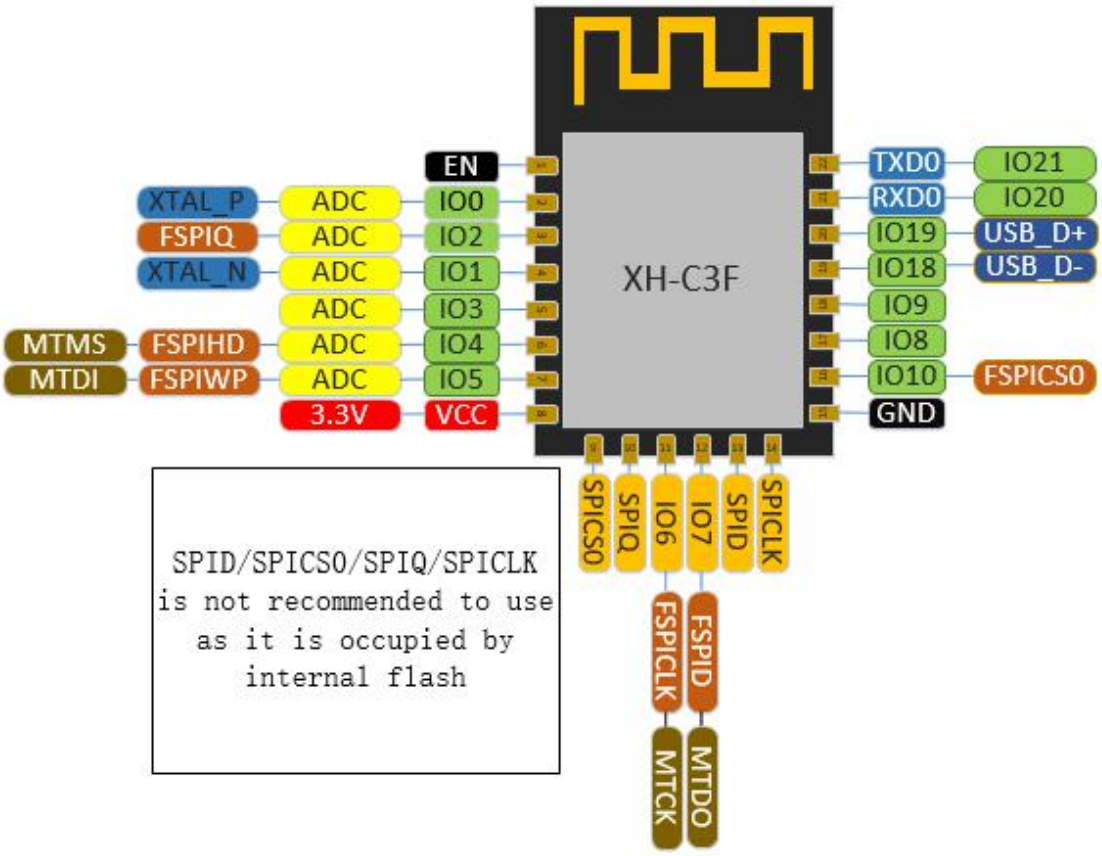
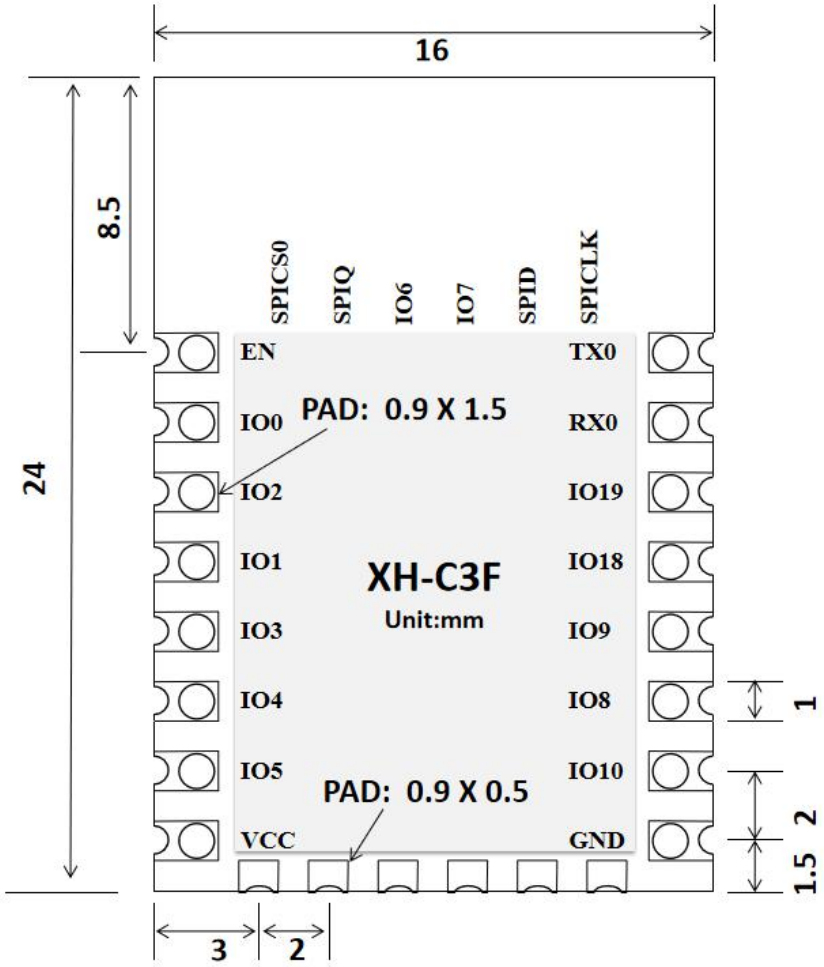
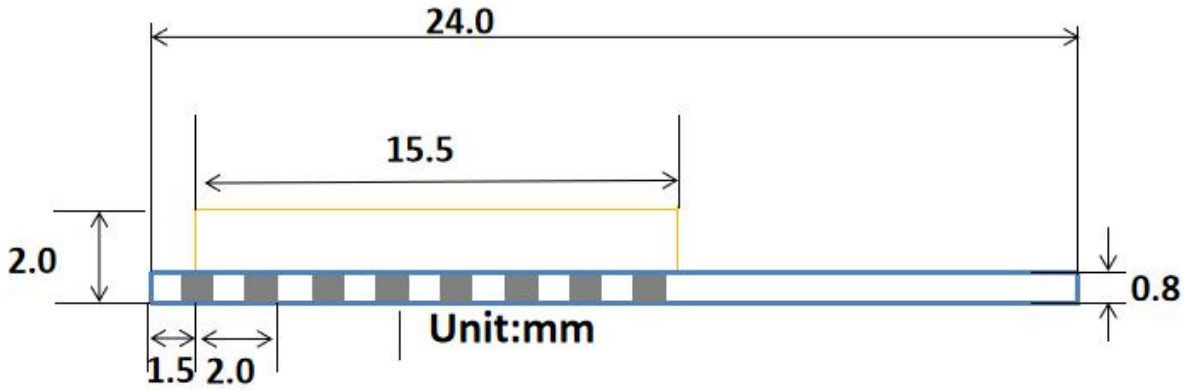


Fig. 3.1 Shape for XH-C3F



(a) Vertical View



(b) Side View

Fig. 3.2 Size for XH-C3F

4. Electronical Characteristics

Table 4.1 Electronical 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 frequencey	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

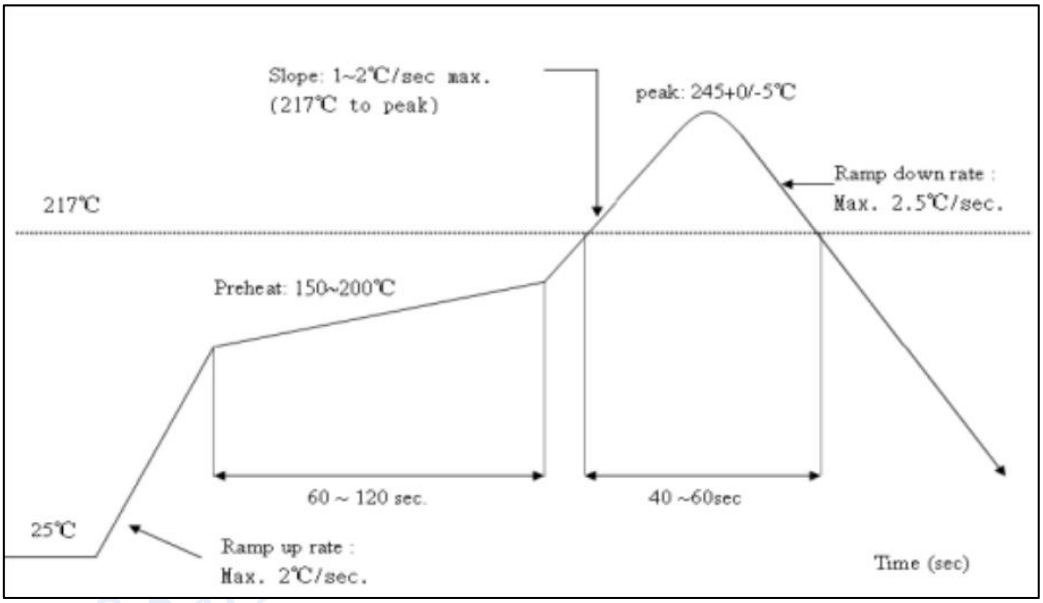


图 7. 1Temperature Curve when sold

9. Minimum User System

This module can work just at 3.3V working voltage:

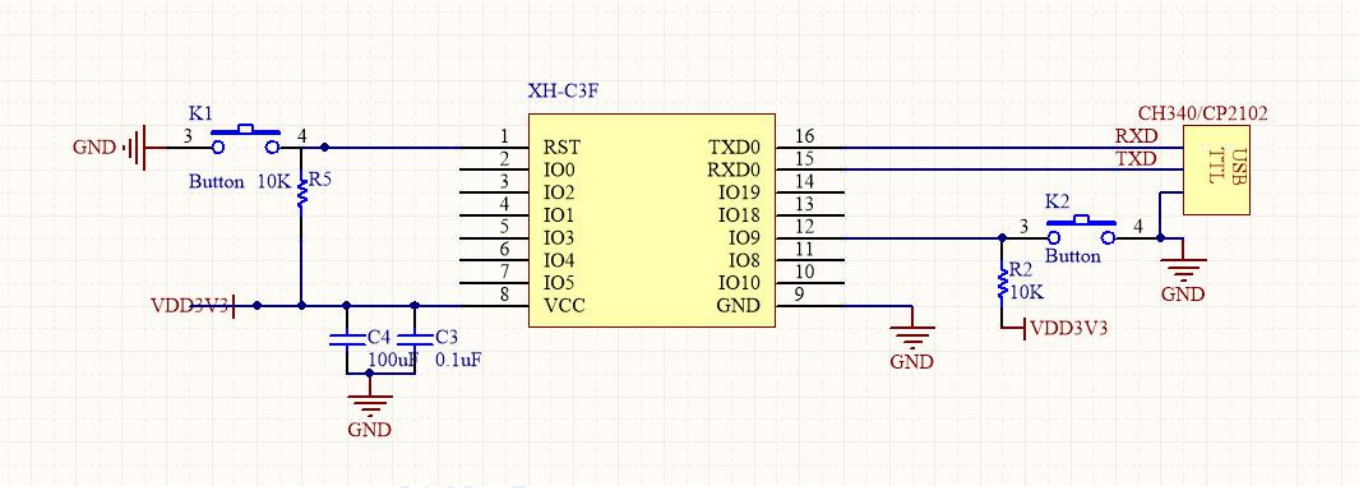


Fig.8.1 Minimum System

Note

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

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

(3) WiFi module is at download mode: io9 are 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

XH-C3FWi-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 WiFi Module with PCB antenna.

Solution 1:optical solution. The WiFi 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:suboptical solution.The WiFi 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 mmreserved with the PCB, and there is no metal material around the antenna, including wires, metal casings, weight plates, and the like.

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

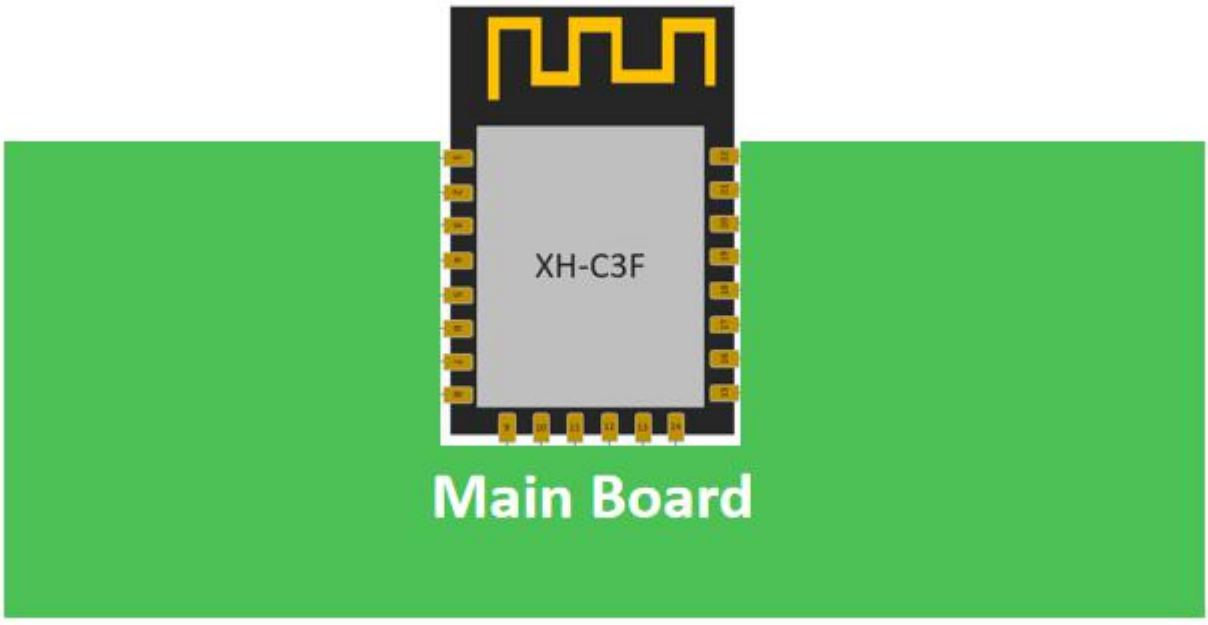


Fig.9.1 Solution 1

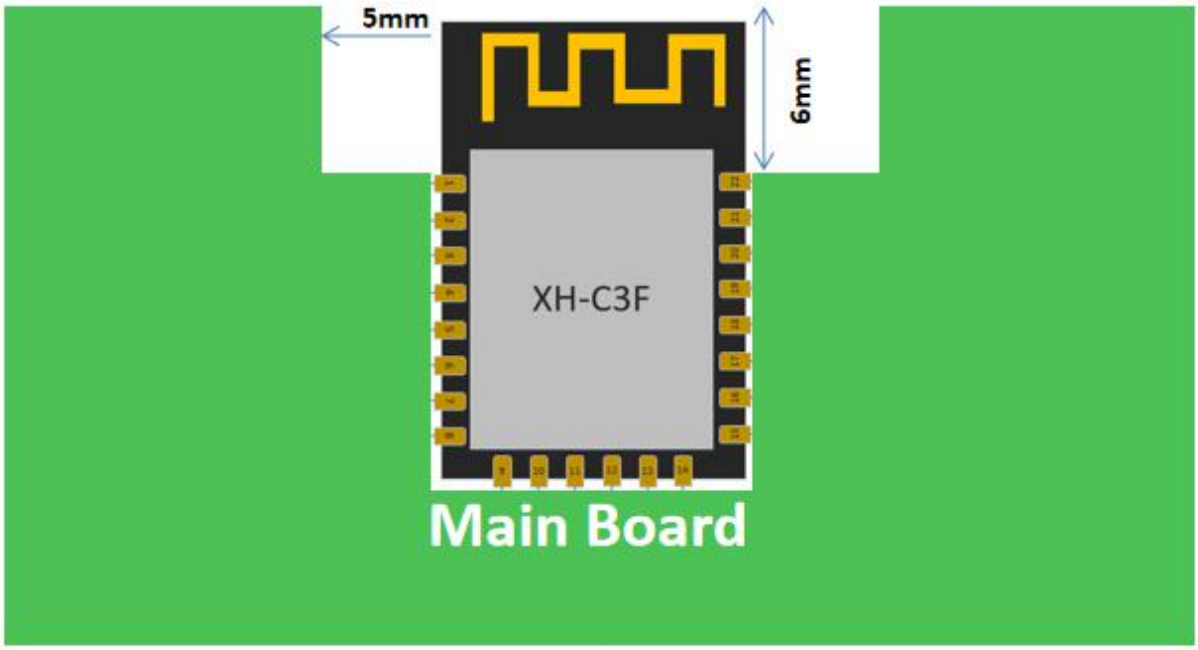


Fig.9.2 Solution 2

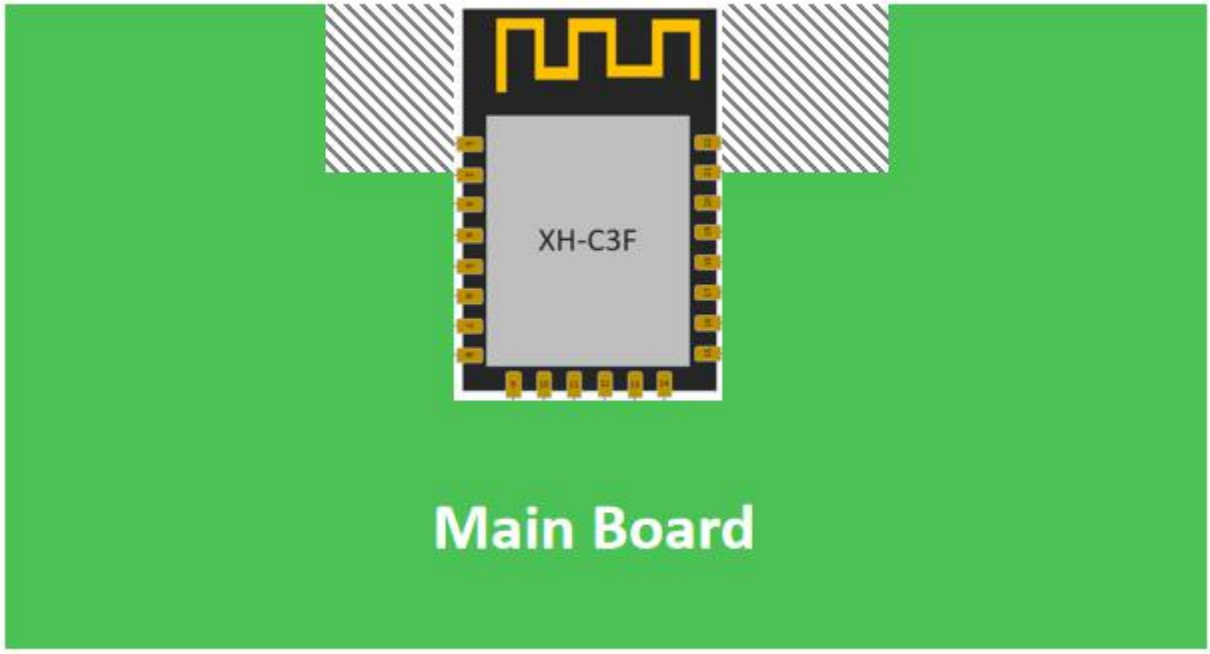


Fig.9.3 Solution 3

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).

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The company was established in 2014. At the beginning of its establishment, it was adhering to the concept of "science and technology change lives, and products enter thousands of households". After just a few years, the company has continuously launched the market's cost-effective 2.4G WiFi module, 2.4G&5G WiFi module, BLE+2.4G&5G WiFi module, MESH Bluetooth module, and quickly won unanimous praise in the market.

In 2018, the company established a smart home department, focusing on the smart electrical lighting industry. The company's products are exported to the Americas, Europe and other regions, and continue to receive praise from customers.