

ESP32-C3-MINI-1

ESP32-C3-MINI-1U

Datasheet Version 2.0

Small-sized 2.4 GHz Wi-Fi (802.11b/g/n) and Bluetooth® 5 module

Built around ESP32-C3 series of SoCs, RISC-V single-core microprocessor

4 MB flash in chip package

15 GPIOs

On-board PCB antenna or external antenna connector



ESP32-C3-MINI-1



ESP32-C3-MINI-1U



1 Module Overview

Note:

Check the link or the QR code to make sure that you use the latest version of this document:

https://www.espressif.com/documentation/esp32-c3-mini-1_datasheet_en.pdf



1.1 Features

CPU and On-Chip Memory

- ESP32-C3FH4 embedded, 32-bit RISC-V single-core processor, up to 160 MHz
- 384 KB ROM
- 400 KB SRAM (16 KB for cache)
- 8 KB SRAM in RTC
- 4 MB flash in chip package

Wi-Fi

- 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
 - Wi-Fi Multimedia (WMM)
 - TX/RX A-MPDU, TX/RX A-MSDU
 - Immediate Block ACK
 - Fragmentation and defragmentation
 - Transmit opportunity (TXOP)
 - Automatic Beacon monitoring (hardware TSF)
 - 4 × virtual Wi-Fi interfaces
 - Simultaneous support for Infrastructure BSS in Station mode, SoftAP mode, Station + SoftAP mode, and promiscuous mode
- Note that when the chip scans in Station mode, the SoftAP channel will change along with the Station channel*

- 802.11mc FTM

Bluetooth®

- Bluetooth LE: Bluetooth 5, Bluetooth mesh
- Speed: 125 Kbps, 500 Kbps, 1 Mbps, 2 Mbps
- Advertising extensions
- Multiple advertisement sets
- Channel selection algorithm #2
- Internal co-existence mechanism between Wi-Fi and Bluetooth to share the same antenna

Peripherals

- Up to 15 GPIOs
 - 3 strapping GPIOs
- SPI, UART, I2C, I2S, remote control peripheral, LED PWM controller, general DMA controller, TWAI® controller (compatible with ISO 11898-1, i.e. CAN Specification 2.0), USB Serial/JTAG controller, temperature sensor, SAR ADC, general-purpose timers, watchdog timers

Note:

* Please refer to [ESP32-C3 Series Datasheet](#) for detailed information about the module peripherals.

Integrated Components on Module

- 40 MHz crystal oscillator

Antenna Options

- ESP32-C3-MINI-1: On-board PCB antenna

- ESP32-C3-MINI-1U: External antenna via a connector

Operating Conditions

- Operating voltage/Power supply: 3.0 ~ 3.6 V
- Operating ambient temperature:
 - 85 °C version module: –40 ~ 85 °C
 - 105 °C version module: –40 ~ 105 °C

Certification

- RF certification: See [certificates](#)
- Green certification: RoHS/REACH

Test

- HTOL/HTSL/uHAST/TCT/ESD/Latch-up

1.2 Series Comparison

ESP32-C3-MINI-1 and ESP32-C3-MINI-1U are two general-purpose Wi-Fi and Bluetooth LE modules. The rich set of peripherals and a small size make the two modules an ideal choice for smart homes, industrial automation, health care, consumer electronics, etc.

ESP32-C3-MINI-1 comes with a PCB antenna. ESP32-C3-MINI-1U comes with an external antenna connector. A wide selection of module variants are available as shown in Table 1 and 2.

The series comparison for the two modules is as follows:

Table 1: ESP32-C3-MINI-1 (ANT) Series Comparison¹

Ordering Code ⁵	Flash ⁴	Ambient Temp. ² (°C)	Embedded Chip Revision ⁶	Size ³ (mm)
ESP32-C3-MINI-1-N4X (Recommended)	4 MB (Quad SPI)	–40 ~ 85	v1.1	13.2 × 16.6 × 2.4
ESP32-C3-MINI-1-H4X (Recommended)		–40 ~ 105	v1.1	
ESP32-C3-MINI-1-N4 (NRND)		–40 ~ 85	v0.4	
ESP32-C3-MINI-1-H4 (NRND)		–40 ~ 105	v0.4	
ESP32-C3-MINI-1-H4-AZ (NRND)		–40 ~ 105	v0.4	

¹ This table shares the same notes presented in Table 2 below.

Table 2: ESP32-C3-MINI-1U (CONN) Series Comparison

Ordering Code ⁵	Flash ^{4, 7}	Ambient Temp. ² (°C)	Embedded Chip Revision ⁶	Size ³ (mm)
ESP32-C3-MINI-1U-N4X (Recommended)	4 MB (Quad SPI)	-40 ~ 85	v1.1	13.2 × 12.5 × 2.4
ESP32-C3-MINI-1U-H4X (Recommended)		-40 ~ 105	v1.1	
ESP32-C3-MINI-1U-N4 (NRND)		-40 ~ 85	v0.4	
ESP32-C3-MINI-1U-H4 (NRND)		-40 ~ 105	v0.4	

² Ambient temperature specifies the recommended temperature range of the environment immediately outside the Espressif module.

³ For details, refer to Section [10.1 Module Dimensions](#).

⁴ The flash is integrated in the chip's package. The flash supports:

- More than 100,000 program/erase cycles
- More than 20 years data retention time

⁵ All modules can be pre-programmed with [AWS IoT ExpressLink](#) firmware. Modules with such firmware have suffix "-A" in their ordering codes, e.g. ESP32-C3-MINI-1-N4-A. Since AWS IoT ExpressLink firmware enables flash encryption and secure boot, joint download boot mode will be disabled, and it will no longer be possible to program firmware through the UART or USB port into the modules.

⁶ All chip revisions have the same SRAM size, but chip revision v1.1 has around 10 KB more available space for users than chip revision v0.4. Chip revision v1.1 depends on specific ESP-IDF versions, as detailed in [Compatibility Advisory for ESP32-C3 Chip Revision v1.1](#). For how to identify chip revisions, please refer to [ESP32-C3 Series SoC Errata](#).

⁷ By default, the SPI flash on the module operates at a maximum clock frequency of 80 MHz and does not support the auto suspend feature. If you have a requirement for a higher flash clock frequency of 120 MHz or if you need the flash auto suspend feature, please [contact us](#).

Both ESP32-C3-MINI-1 and ESP32-C3-MINI-1U has two operating ambient temperature options: -40 ~ 85 °C variants and -40 ~ 105 °C variants, all embedded with the ESP32-C3FH4 chip. ESP32-C3-MINI-1 has one more variant: ESP32-C3-MINI-1-H4-AZ embedded with the ESP32-C3FH4AZ chip. For this chip, SPI0/SPI1 pins for flash connection are not bonded. For more information about the differences between chips embedded, please refer to Section *Chip Series Comparison* in [ESP32-C3 Series Datasheet](#).

1.3 Applications

- Smart Home
- Industrial Automation
- Health Care
- Consumer Electronics
- Smart Agriculture
- POS Machines
- Service Robot
- Audio Devices
- Generic Low-power IoT Sensor Hubs
- Generic Low-power IoT Data Loggers

Contents

1	Module Overview	2
1.1	Features	2
1.2	Series Comparison	3
1.3	Applications	4
2	Block Diagram	9
3	Pin Definitions	10
3.1	Pin Layout	10
3.2	Pin Description	10
4	Boot Configurations	12
4.1	Chip Boot Mode Control	13
4.2	ROM Messages Printing Control	14
5	Peripherals	15
5.1	Peripheral Overview	15
5.2	Peripheral Description	15
5.2.1	Connectivity Interface	15
5.2.1.1	UART Controller	15
5.2.1.2	SPI Controller	15
5.2.1.3	I2C Controller	16
5.2.1.4	I2S Controller	17
5.2.1.5	USB Serial/JTAG Controller	17
5.2.1.6	Two-wire Automotive Interface	18
5.2.1.7	LED PWM Controller	18
5.2.1.8	Remote Control Peripheral	18
5.2.2	Analog Signal Processing	19
5.2.2.1	SAR ADC	19
5.2.2.2	Temperature Sensor	19
6	Electrical Characteristics	20
6.1	Absolute Maximum Ratings	20
6.2	Recommended Operating Conditions	20
6.3	DC Characteristics (3.3 V, 25 °C)	20
6.4	Current Consumption Characteristics	21
6.4.1	Current Consumption in Active Mode	21
6.4.2	Current Consumption in Other Modes	22
7	RF Characteristics	23
7.1	Wi-Fi Radio	23
7.1.1	Wi-Fi RF Transmitter (TX) Characteristics	23
7.1.2	Wi-Fi RF Receiver (RX) Characteristics	24

7.2	Bluetooth 5 (LE) Radio	25
7.2.1	Bluetooth LE RF Transmitter (TX) Characteristics	25
7.2.2	Bluetooth LE RF Receiver (RX) Characteristics	27
8	Module Schematics	30
9	Peripheral Schematics	32
10	Physical Dimensions	33
10.1	Module Dimensions	33
10.2	Dimensions of External Antenna Connector	34
11	PCB Layout Recommendations	35
11.1	PCB Land Pattern	35
11.2	Module Placement for PCB Design	36
12	Product Handling	37
12.1	Storage Conditions	37
12.2	Electrostatic Discharge (ESD)	37
12.3	Reflow Profile	37
12.4	Ultrasonic Vibration	38
	Related Documentation and Resources	39
	Revision History	40

List of Tables

1	ESP32-C3-MINI-1 (ANT) Series Comparison ¹	3
2	ESP32-C3-MINI-1U (CONN) Series Comparison	4
3	Pin Definitions	11
4	Default Configuration of Strapping Pins	12
5	Description of Timing Parameters for the Strapping Pins	13
6	Chip Boot Mode Control	13
7	UART0 ROM Message Printing Control	14
8	USB Serial/JTAG ROM Message Printing Control	14
9	Absolute Maximum Ratings	20
10	Recommended Operating Conditions	20
11	DC Characteristics (3.3 V, 25 °C)	20
12	Current Consumption for Wi-Fi (2.4 GHz) in Active Mode	21
13	Current Consumption for Bluetooth LE in Active Mode	21
14	Current Consumption in Modem-sleep Mode	22
15	Current Consumption in Low-Power Modes	22
16	Wi-Fi RF Characteristics	23
17	TX Power with Spectral Mask and EVM Meeting 802.11 Standards	23
18	TX EVM Test ¹	23
19	RX Sensitivity	24
20	Maximum RX Level	25
21	RX Adjacent Channel Rejection	25
22	Bluetooth LE RF Characteristics	25
23	Bluetooth LE - Transmitter Characteristics - 1 Mbps	26
24	Bluetooth LE - Transmitter Characteristics - 2 Mbps	26
25	Bluetooth LE - Transmitter Characteristics - 125 Kbps	26
26	Bluetooth LE - Transmitter Characteristics - 500 Kbps	27
27	Bluetooth LE - Receiver Characteristics - 1 Mbps	27
28	Bluetooth LE - Receiver Characteristics - 2 Mbps	28
29	Bluetooth LE - Receiver Characteristics - 125 Kbps	28
30	Bluetooth LE - Receiver Characteristics - 500 Kbps	28

List of Figures

1	ESP32-C3-MINI-1 Block Diagram	9
2	ESP32-C3-MINI-1U Block Diagram	9
3	Pin Layout (Top View)	10
4	Visualization of Timing Parameters for the Strapping Pins	13
5	ESP32-C3-MINI-1 Schematics	30
6	ESP32-C3-MINI-1U Schematics	31
7	Peripheral Schematics	32
8	ESP32-C3-MINI-1 Physical Dimensions	33
9	ESP32-C3-MINI-1U Physical Dimensions	33
10	Dimensions of External Antenna Connector	34
11	ESP32-C3-MINI-1 Recommended PCB Land Pattern	35
12	ESP32-C3-MINI-1U Recommended PCB Land Pattern	36
13	Reflow Profile	37

2 Block Diagram

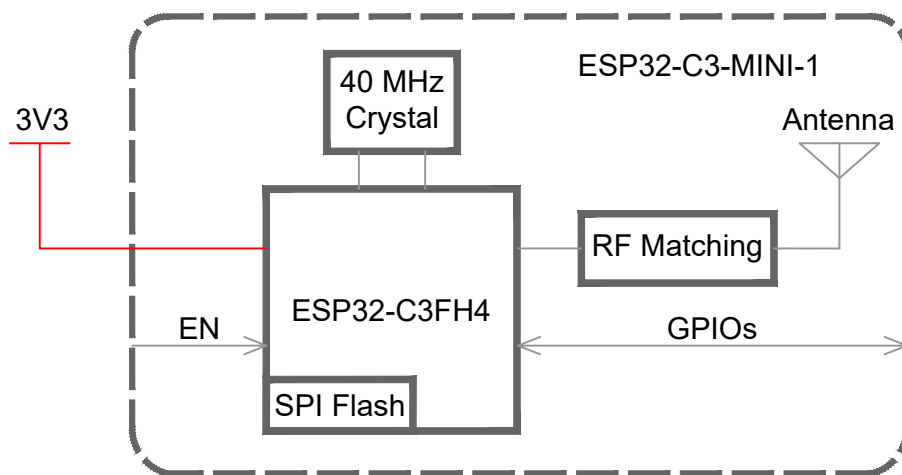


Figure 1: ESP32-C3-MINI-1 Block Diagram

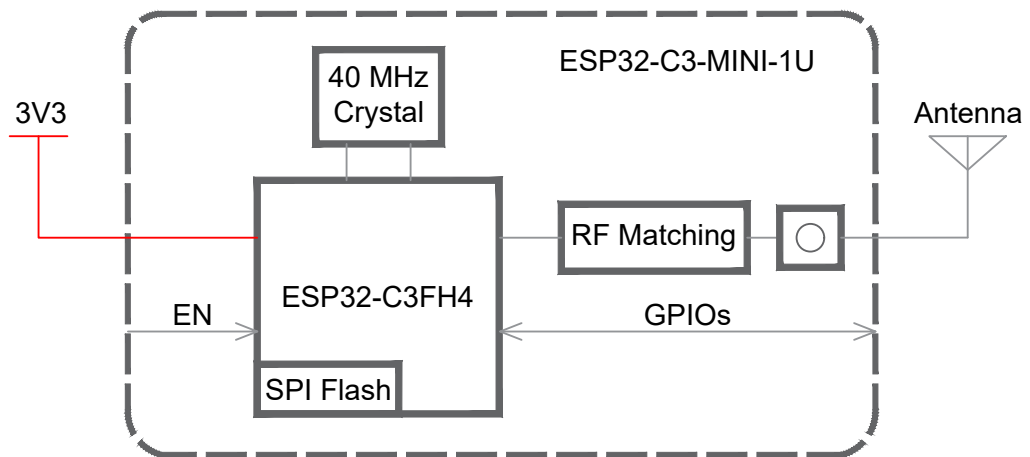


Figure 2: ESP32-C3-MINI-1U Block Diagram

3 Pin Definitions

3.1 Pin Layout

The pin diagram below shows the approximate location of pins on the module. For the actual diagram drawn to scale, please refer to Figure 10.1 *Module Dimensions*.

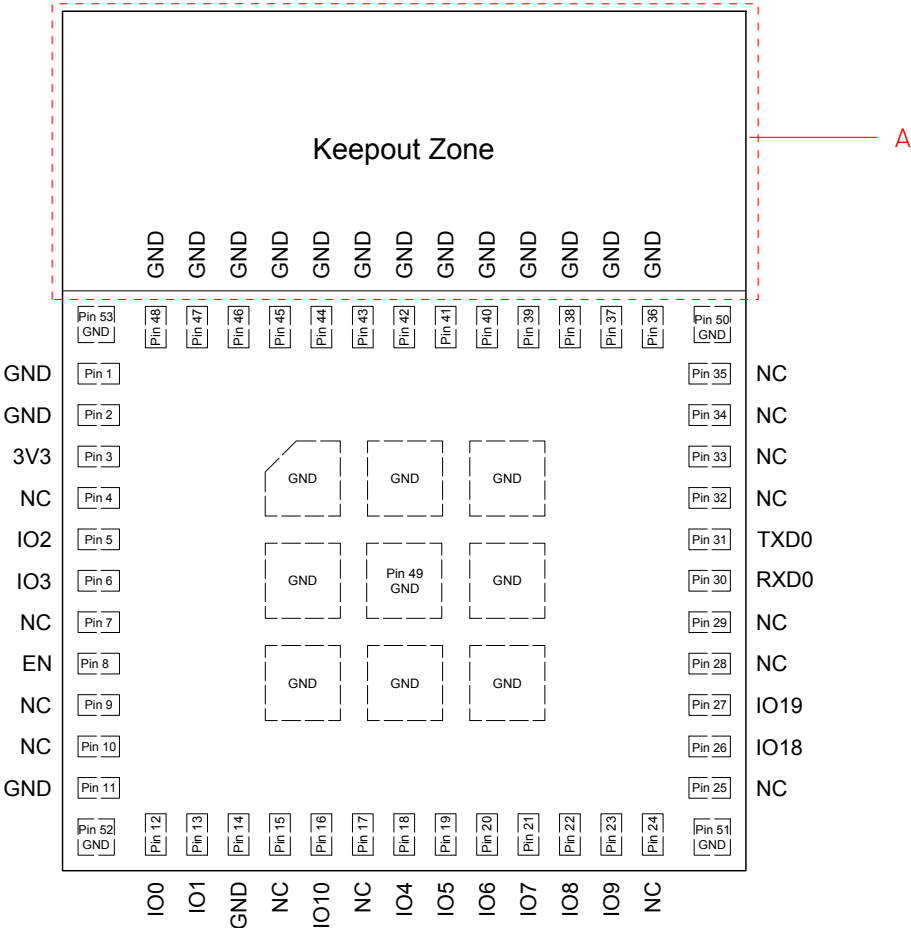


Figure 3: Pin Layout (Top View)

Note A:
The zone marked with dotted lines is the antenna keepout zone. The pin diagram is applicable to ESP32-C3-MINI-1 and ESP32-C3-MINI-1U, but the latter has no antenna keepout zone.
To learn more about the keepout zone for module's antenna on the base board, please refer to [ESP32-C3 Hardware Design Guidelines](#) > Section *Positioning a Module on a Base Board*.

3.2 Pin Description

The module has 53 pins. See pin definitions in Table 3 *Pin Definitions*.
For peripheral pin configurations, please refer to Section 5.2 *Peripheral Description*.

Table 3: Pin Definitions

Name	No.	Type ¹	Function
GND	1, 2, 11, 14, 36-53	P	Ground
3V3	3	P	Power supply
NC	4, 7, 9, 10, 15, 17, 24, 25, 28, 29, 32-35	—	NC
IO2	5	I/O/T	GPIO2, ADC1_CH2, FSPIQ
IO3	6	I/O/T	GPIO3, ADC1_CH3
EN	8	I	High: on, enables the chip. Low: off, the chip powers off. Note: Do not leave the EN pin floating.
IO0	12	I/O/T	GPIO0, ADC1_CH0, XTAL_32K_P
IO1	13	I/O/T	GPIO1, ADC1_CH1, XTAL_32K_N
IO10	16	I/O/T	GPIO10, FSPICSO
IO4	18	I/O/T	GPIO4, ADC1_CH4, FSPIHD, MTMS
IO5	19	I/O/T	GPIO5, ADC2_CH0, FSPIWP, MTDI
IO6	20	I/O/T	GPIO6, FSPICLK, MTCK
IO7	21	I/O/T	GPIO7, FSPID, MTDO
IO8	22	I/O/T	GPIO8
IO9	23	I/O/T	GPIO9
IO18	26	I/O/T	GPIO18, USB_D-
IO19	27	I/O/T	GPIO19, USB_D+
RXD0	30	I/O/T	GPIO20, U0RXD
TXD0	31	I/O/T	GPIO21, U0TXD

¹ P: power supply; I: input; O: output; T: high impedance.

4 Boot Configurations

Note:

The content below is excerpted from [ESP32-C3 Series Datasheet](#) > Section *Boot Configurations*. For the strapping pin mapping between the chip and modules, please refer to Chapter 8 *Module Schematics*.

The chip allows for configuring the following boot parameters through strapping pins and eFuse bits at power-up or a hardware reset, without microcontroller interaction.

- **Chip boot mode**

- Strapping pins: GPIO2, GPIO8, and GPIO9

- **ROM message printing**

- Strapping pin: GPIO8
- eFuse parameters: EFUSE_UART_PRINT_CONTROL and EFUSE_USB_PRINT_CHANNEL

The default values of all the above eFuse bits are 0, which means that they are not burnt. Given that eFuse is one-time programmable, once an eFuse bit is programmed to 1, it can never be reverted to 0. For how to program eFuse bits, please refer to [ESP32-C3 Technical Reference Manual](#) > Chapter *eFuse Controller*.

The default values of the strapping pins, namely the logic levels, are determined by pins' internal weak pull-up/pull-down resistors at reset if the pins are not connected to any circuit, or connected to an external high-impedance circuit.

Table 4: Default Configuration of Strapping Pins

Strapping Pin	Default Configuration	Bit Value
GPIO2	Floating	–
GPIO8	Floating	–
GPIO9	Weak pull-up	1

To change the bit values, the strapping pins should be connected to external pull-down/pull-up resistances. If the ESP32-C3 is used as a device by a host MCU, the strapping pin voltage levels can also be controlled by the host MCU.

All strapping pins have latches. At system reset, the latches sample the bit values of their respective strapping pins and store them until the chip is powered down or shut down. The states of latches cannot be changed in any other way. It makes the strapping pin values available during the entire chip operation, and the pins are freed up to be used as regular IO pins after reset.

The timing of signals connected to the strapping pins should adhere to the *setup time* and *hold time* specifications in Table 5 and Figure 4.

Table 5: Description of Timing Parameters for the Strapping Pins

Parameter	Description	Min (ms)
t_{SU}	Setup time is the time reserved for the power rails to stabilize before the CHIP_EN pin is pulled high to activate the chip.	0
t_H	Hold time is the time reserved for the chip to read the strapping pin values after CHIP_EN is already high and before these pins start operating as regular IO pins.	3

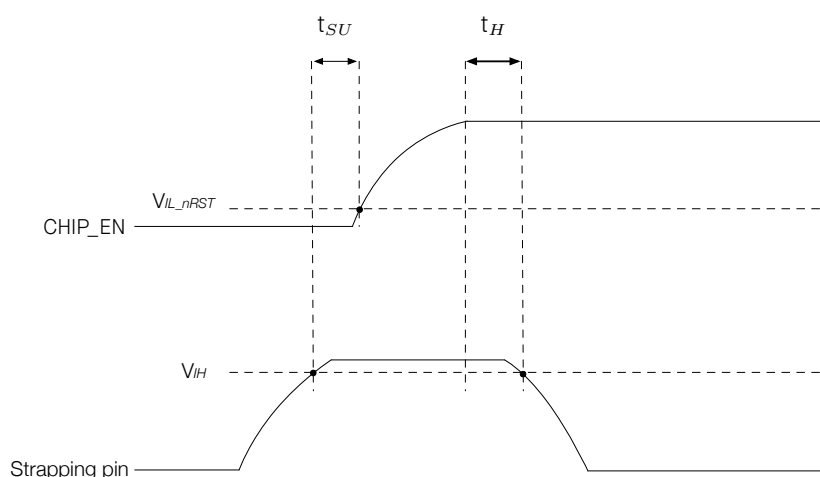


Figure 4: Visualization of Timing Parameters for the Strapping Pins

4.1 Chip Boot Mode Control

GPIO2, GPIO8, and GPIO9 control the boot mode after the reset is released. See Table 6 [Chip Boot Mode Control](#).

Table 6: Chip Boot Mode Control

Boot Mode	GPIO2 ²	GPIO8	GPIO9
SPI Boot	1	Any value	1
Joint Download Boot ³	1	1	0

¹ **Bold** marks the default value and configuration.

² GPIO2 actually does not determine SPI Boot and Joint Download Boot mode, but it is recommended to pull this pin up due to glitches.

³ Joint Download Boot mode supports the following download methods:

- USB-Serial-JTAG Download Boot
- UART Download Boot

In SPI Boot mode, the ROM bootloader loads and executes the program from SPI flash to boot the system.

In Joint Download Boot mode, users can download binary files into flash using UART0 or USB interface. It is also possible to download binary files into SRAM and execute it from SRAM.

In addition to SPI Boot and Joint Download Boot modes, ESP32-C3 also supports SPI Download Boot mode. For details, please see [ESP32-C3 Technical Reference Manual](#) > Chapter *Chip Boot Control*.

4.2 ROM Messages Printing Control

During the boot process, the messages by the ROM code can be printed to:

- (Default) UART0 and USB Serial/JTAG controller
- UART0
- USB Serial/JTAG controller

EFUSE_UART_PRINT_CONTROL and GPIO8 control ROM messages printing to **UART0** as shown in Table 7 [UART0 ROM Message Printing Control](#).

Table 7: UART0 ROM Message Printing Control

UART0 ROM Code Printing	EFUSE_UART_PRINT_CONTROL	GPIO8
Enabled	0	Ignored
	1	0
	2	1
Disabled	1	1
	2	0
	3	Ignored

¹ **Bold** marks the default value and configuration.

EFUSE_USB_PRINT_CHANNEL controls the printing to **USB Serial/JTAG controller** as shown in Table 8 [USB Serial/JTAG ROM Message Printing Control](#).

Table 8: USB Serial/JTAG ROM Message Printing Control

USB Serial/JTAG ROM Code Printing	EFUSE_DIS_USB_SERIAL_JTAG ²	EFUSE_USB_PRINT_CHANNEL
Enabled	0	0
Disabled	0	1
	1	Ignored

¹ **Bold** marks the default value and configuration.

² EFUSE_DIS_USB_SERIAL_JTAG controls whether to disable USB Serial/JTAG.

5 Peripherals

5.1 Peripheral Overview

ESP32-C3FH4 integrates a rich set of peripherals including SPI, UART, I2C, I2S, remote control peripheral, LED PWM controller, TWAI® controller, USB Serial/JTAG controller, temperature sensor, SAR ADC

To learn more about on-chip components, please refer to [ESP32-C3 Series Datasheet](#) > Section *Functional Description*.

Note:

The content below is sourced from [ESP32-C3 Series Datasheet](#) > Section *Peripherals*. Some information may not be applicable to ESP32-C3-MINI-1 and ESP32-C3-MINI-1U as not all the IO signals are exposed on the module.

To learn more about peripheral signals, please refer to [ESP32-C3 Technical Reference Manual](#) > Section *Peripheral Signal List*.

5.2 Peripheral Description

This section describes the chip's peripheral capabilities, covering connectivity interfaces and on-chip sensors that extend its functionality.

5.2.1 Connectivity Interface

This subsection describes the connectivity interfaces on the chip that enable communication and interaction with external devices and networks.

5.2.1.1 UART Controller

ESP32-C3 has two UART interfaces, i.e. UART0 and UART1, which support IrDA and asynchronous communication (RS232 and RS485) at a speed of up to 5 Mbps. The UART controller provides hardware flow control (CTS and RTS signals) and software flow control (XON and XOFF). Both UART interfaces connect to GDMA via UHCIO, and can be accessed by the GDMA controller or directly by the CPU.

Pin Assignment

The pins connected to transmit and receive signals (U0TXD and U0RXD) for **UART0** are multiplexed with GPIO21 ~ GPIO20 via IO MUX. Other signals can be routed to any GPIOs via the GPIO matrix.

For more information about the pin assignment, see [ESP32-C3 Series Datasheet](#) > Section *IO Pins* and [ESP32-C3 Technical Reference Manual](#) > Chapter *IO MUX and GPIO Matrix*.

5.2.1.2 SPI Controller

ESP32-C3 has the following SPI interfaces:

- **SPI0** used by ESP32-C3's GDMA controller and cache to access in-package or off-package flash
- **SPI1** used by the CPU to access in-package or off-package flash
- **SPI2** is a general purpose SPI controller with access to a DMA channel allocated by the GDMA controller

Features of SPI0 and SPI1

- Supports Single SPI, Dual SPI, and Quad SPI, QPI modes
- Configurable clock frequency with a maximum of 120 MHz in Single Transfer Rate (STR) mode
- Data transmission is in bytes

Features of SPI2

- Supports operation as a master or slave
- Connects to a DMA channel allocated by the GDMA controller
- Supports Single SPI, Dual SPI, and Quad SPI, QPI
- Configurable clock polarity (CPOL) and phase (CPHA)
- Configurable clock frequency
- Data transmission is in bytes
- Configurable read and write data bit order: most-significant bit (MSB) first, or least-significant bit (LSB) first
- As a master
 - Supports 2-line full-duplex communication with clock frequency up to 80 MHz
 - Supports 1-, 2-, 4-line half-duplex communication with clock frequency up to 80 MHz
 - Provides six SPI_CS pins for connection with six independent SPI slaves
 - Configurable CS setup time and hold time
- As a slave
 - Supports 2-line full-duplex communication with clock frequency up to 60 MHz
 - Supports 1-, 2-, 4-line half-duplex communication with clock frequency up to 60 MHz

Pin Assignment

For SPI0/1, the pins are multiplexed with GPIO12 ~ GPIO17 via the IO MUX.

For SPI2, the pins are multiplexed with GPIO2, GPIO4 ~ GPIO7, GPIO10, and JTAG interface via the IO MUX.

For more information about the pin assignment, see [ESP32-C3 Series Datasheet](#) > Section *IO Pins* and [ESP32-C3 Technical Reference Manual](#) > Chapter *IO MUX and GPIO Matrix*.

5.2.1.3 I2C Controller

ESP32-C3 has an I2C bus interface which is used for I2C master mode or slave mode, depending on your configuration. The I2C interface supports:

- standard mode (100 Kbit/s)
- fast mode (400 Kbit/s)

- up to 800 Kbit/s (constrained by SCL and SDA pull-up strength)
- 7-bit and 10-bit addressing mode
- double addressing mode
- 7-bit broadcast address

Pin Assignment

The pins for I2C can be chosen from any GPIOs via the GPIO Matrix.

For more information about the pin assignment, see [ESP32-C3 Series Datasheet](#) > Section *IO Pins* and [ESP32-C3 Technical Reference Manual](#) > Chapter *IO MUX and GPIO Matrix*.

5.2.1.4 I2S Controller

ESP32-C3 includes a standard I2S interface. This interface can operate as a master or a slave in full-duplex mode or half-duplex mode, and can be configured for 8-bit, 16-bit, 24-bit, or 32-bit serial communication. BCK clock frequency, from 10 kHz up to 40 MHz, is supported.

The I2S interface connects to the GDMA controller. The interface supports TDM PCM, TDM MSB alignment, TDM standard, and PDM standard.

Pin Assignment

The pins for the I2S Controller can be chosen from any GPIOs via the GPIO Matrix.

For more information about the pin assignment, see [ESP32-C3 Series Datasheet](#) > Section *IO Pins* and [ESP32-C3 Technical Reference Manual](#) > Chapter *IO MUX and GPIO Matrix*.

5.2.1.5 USB Serial/JTAG Controller

ESP32-C3 integrates a USB Serial/JTAG controller. This controller has the following features:

- CDC-ACM virtual serial port and JTAG adapter functionality
- USB 2.0 full speed compliant, capable of up to 12 Mbit/s transfer speed (Note that this controller does not support the faster 480 Mbit/s high-speed transfer mode)
- programming in-package/off-package flash
- CPU debugging with compact JTAG instructions
- a full-speed USB PHY integrated in the chip

Pin Assignment

The pins for the USB Serial/JTAG Controller are multiplexed with GPIO18 ~ GPIO19.

For more information about the pin assignment, see [ESP32-C3 Series Datasheet](#) > Section *IO Pins* and [ESP32-C3 Technical Reference Manual](#) > Chapter *IO MUX and GPIO Matrix*.

5.2.1.6 Two-wire Automotive Interface

ESP32-C3 has a TWAI® controller with the following features:

- compatible with ISO 11898-1 protocol (CAN Specification 2.0)
- standard frame format (11-bit ID) and extended frame format (29-bit ID)
- bit rates from 1 Kbit/s to 1 Mbit/s
- multiple modes of operation: Normal, Listen Only, and Self-Test (no acknowledgment required)
- 64-byte receive FIFO
- acceptance filter (single and dual filter modes)
- error detection and handling: error counters, configurable error interrupt threshold, error code capture, arbitration lost capture

Pin Assignment

The pins for the Two-wire Automotive Interface can be chosen from any GPIOs via the GPIO Matrix.

For more information about the pin assignment, see [ESP32-C3 Series Datasheet](#) > Section *IO Pins* and [ESP32-C3 Technical Reference Manual](#) > Chapter *IO MUX and GPIO Matrix*.

5.2.1.7 LED PWM Controller

The LED PWM controller can generate independent digital waveform on six channels. The LED PWM controller:

- Can generate digital waveform with configurable periods and duty cycle. The resolution of duty cycle can be up to 14 bits.
- Has multiple clock sources, including APB clock and external main crystal clock.
- Can operate when the CPU is in Light-sleep mode.
- Supports gradual increase or decrease of duty cycle, which is useful for the LED RGB color-gradient generator.

Pin Assignment

The pins for the LED PWM Controller can be chosen from any GPIOs via the GPIO Matrix.

For more information about the pin assignment, see [ESP32-C3 Series Datasheet](#) > Section *IO Pins* and [ESP32-C3 Technical Reference Manual](#) > Chapter *IO MUX and GPIO Matrix*.

5.2.1.8 Remote Control Peripheral

The Remote Control Peripheral (RMT) supports two channels of infrared remote transmission and two channels of infrared remote reception. By controlling pulse waveform through software, it supports various infrared and other single wire protocols. All four channels share a 192 × 32-bit memory block to store transmit or receive waveform.

Pin Assignment

The pins for the Remote Control Peripheral can be chosen from any GPIOs via the GPIO Matrix.

For more information about the pin assignment, see [ESP32-C3 Series Datasheet](#) > Section *IO Pins* and [ESP32-C3 Technical Reference Manual](#) > Chapter *IO MUX and GPIO Matrix*.

5.2.2 Analog Signal Processing

This subsection describes components on the chip that sense and process real-world data.

5.2.2.1 SAR ADC

ESP32-C3 integrates two 12-bit SAR ADCs.

- ADC1 supports measurements on 5 channels, and is factory-calibrated.
- ADC2 supports measurements on 1 channel, and is not factory-calibrated.

Note:

ADC2 of some chip revisions is not operable. For details, please refer to [ESP32-C3 Series SoC Errata](#).

Pin Assignment

The pins for the SAR ADC are multiplexed with GPIO0 ~ GPIO5, JTAG interface, SPI2 interface, and pins for external crystal or oscillator.

For more information about the pin assignment, see [ESP32-C3 Series Datasheet](#) > Section *IO Pins* and [ESP32-C3 Technical Reference Manual](#) > Chapter *IO MUX and GPIO Matrix*.

5.2.2.2 Temperature Sensor

The temperature sensor generates a voltage that varies with temperature. The voltage is internally converted via an ADC into a digital value.

The temperature sensor has a range of $-40\text{ }^{\circ}\text{C}$ to $125\text{ }^{\circ}\text{C}$. It is designed primarily to sense the temperature changes inside the chip. The temperature value depends on factors like microcontroller clock frequency or I/O load. Generally, the chip's internal temperature is higher than the operating ambient temperature.

6 Electrical Characteristics

6.1 Absolute Maximum Ratings

Stresses above those listed in Table 9 *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under Table 10 *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

Table 9: Absolute Maximum Ratings

Symbol	Parameter	Min	Max	Unit
VDD33	Power supply voltage	-0.3	3.6	V
T _{STORE}	Storage temperature	-40	105	°C

6.2 Recommended Operating Conditions

Table 10: Recommended Operating Conditions

Symbol	Parameter	Min	Typ	Max	Unit
VDD33	Power supply voltage	3.0	3.3	3.6	V
I _{VDD}	Current delivered by external power supply	0.5	—	—	A
T _A	Operating ambient temperature	85 °C version 105 °C version	-40	— 85 105	°C

6.3 DC Characteristics (3.3 V, 25 °C)

Table 11: DC Characteristics (3.3 V, 25 °C)

Symbol	Parameter	Min	Typ	Max	Unit
C _{IN}	Pin capacitance	—	2	—	pF
V _{IH}	High-level input voltage	0.75 × VDD ¹	—	VDD ¹ + 0.3	V
V _{IL}	Low-level input voltage	-0.3	—	0.25 × VDD ¹	V
I _{IH}	High-level input current	—	—	50	nA
I _{IL}	Low-level input current	—	—	50	nA
V _{OH} ²	High-level output voltage	0.8 × VDD ¹	—	—	V
V _{OL} ²	Low-level output voltage	—	—	0.1 × VDD ¹	V
I _{OH}	High-level source current (VDD ¹ = 3.3 V, V _{OH} ≥ 2.64 V, PAD_DRIVER = 3)	—	40	—	mA
I _{OL}	Low-level sink current (VDD ¹ = 3.3 V, V _{OL} = 0.495 V, PAD_DRIVER = 3)	—	28	—	mA
R _{PU}	Pull-up resistor	—	45	—	kΩ
R _{PD}	Pull-down resistor	—	45	—	kΩ
V _{IH_nRST}	Chip reset release voltage	0.75 × VDD ¹	—	VDD ¹ + 0.3	V
V _{IL_nRST}	Chip reset voltage	-0.3	—	0.25 × VDD ¹	V

¹ VDD is the I/O voltage for pins of a particular power domain.

² V_{OH} and V_{OL} are measured using high-impedance load.

6.4 Current Consumption Characteristics

6.4.1 Current Consumption in Active Mode

The current consumption measurements are taken with a 3.3 V supply at 25 °C ambient temperature.

TX current consumption is rated at a 100% duty cycle.

RX current consumption is rated when the peripherals are disabled and the CPU idle.

Table 12: Current Consumption for Wi-Fi (2.4 GHz) in Active Mode

Work mode	Description		Peak (mA)
Active (RF working)	TX	802.11b, 1 Mbps, @20.5 dBm	350
		802.11g, 54 Mbps, @18 dBm	295
		802.11n, HT20, MCS7, @17.5 dBm	290
		802.11n, HT40, MCS7, @17 dBm	290
	RX	802.11b/g/n, HT20	82
		802.11n, HT40	84

Table 13: Current Consumption for Bluetooth LE in Active Mode

Work Mode	RF Condition	Description	Peak (mA)
Active (RF working)	TX	Bluetooth LE @ 20.0 dBm	340
		Bluetooth LE @ 9.0 dBm	190
		Bluetooth LE @ 0 dBm	170
		Bluetooth LE @ -15.0 dBm	100
	RX	Bluetooth LE	86

Note:

The content below is excerpted from *Section Power Consumption in Other Modes* in [ESP32-C3 Series Datasheet](#).

6.4.2 Current Consumption in Other Modes

Table 14: Current Consumption in Modem-sleep Mode

Mode	CPU Frequency (MHz)	Description	Typ	
			All Peripherals Clocks Disabled (mA)	All Peripherals Clocks Enabled (mA) ¹
Modem-sleep ^{2,3}	160	CPU is idle	16	21
		CPU is running	23	28
	80	CPU is idle	13	18
		CPU is running	17	22

¹ In practice, the current consumption might be different depending on which peripherals are enabled.

² In Modem-sleep mode, Wi-Fi is clock gated.

³ In Modem-sleep mode, the consumption might be higher when accessing flash. For a flash rated at 80 Mbit/s, in SPI 2-line mode the consumption is 10 mA.

Table 15: Current Consumption in Low-Power Modes

Mode	Description	Typ (μA)
Light-sleep	VDD_SPI and Wi-Fi are powered down, and all GPIOs are high-impedance	130
Deep-sleep	RTC timer + RTC memory	5
Power off	CHIP_EN is set to low level, the chip is powered off	1

7 RF Characteristics

This section contains tables with RF characteristics of the Espressif product.

The RF data is measured at the antenna port, where RF cable is connected, including the front-end loss. The external antennas used for the tests on the modules with external antenna connectors have an impedance of 50 Ω .

Devices should operate in the center frequency range allocated by regional regulatory authorities. The target center frequency range and the target transmit power are configurable by software. See [ESP RF Test Tool and Test Guide](#) for instructions.

Unless otherwise stated, the RF tests are conducted with a 3.3 V ($\pm 5\%$) supply at 25 °C ambient temperature.

7.1 Wi-Fi Radio

Table 16: Wi-Fi RF Characteristics

Name	Description
Center frequency range of operating channel	2412 ~ 2484 MHz
Wi-Fi wireless standard	IEEE 802.11b/g/n

7.1.1 Wi-Fi RF Transmitter (TX) Characteristics

Table 17: TX Power with Spectral Mask and EVM Meeting 802.11 Standards

Rate	Min (dBm)	Typ (dBm)	Max (dBm)
802.11b, 1 Mbps	—	20.5	—
802.11b, 11 Mbps	—	20.5	—
802.11g, 6 Mbps	—	20.0	—
802.11g, 54 Mbps	—	18.0	—
802.11n, HT20, MCS0	—	19.0	—
802.11n, HT20, MCS7	—	17.5	—
802.11n, HT40, MCS0	—	18.5	—
802.11n, HT40, MCS7	—	17.0	—

Table 18: TX EVM Test¹

Rate	Min (dB)	Typ (dB)	Limit (dB)
802.11b, 1 Mbps, @20.5 dBm	—	-24.5	-10
802.11b, 11 Mbps, @20.5 dBm	—	-25.0	-10
802.11g, 6 Mbps, @20 dBm	—	-23.0	-5
802.11g, 54 Mbps, @18 dBm	—	-28.0	-25

Cont'd on next page

Table 18 – cont'd from previous page

Rate	Min (dB)	Typ (dB)	Limit (dB)
802.11n, HT20, MCS0, @19 dBm	—	-23.5	-5
802.11n, HT20, MCS7, @17.5 dBm	—	-30.5	-27
802.11n, HT40, MCS0, @18.5 dBm	—	-26.5	-5
802.11n, HT40, MCS7, @17 dBm	—	-30.5	-27

¹ EVM is measured at the corresponding typical TX power provided in Table 17 *TX Power with Spectral Mask and EVM Meeting 802.11 Standards* above.

7.1.2 Wi-Fi RF Receiver (RX) Characteristics

For RX tests, the PER (packet error rate) limit is 8% for 802.11b, and 10% for 802.11g/n.

Table 19: RX Sensitivity

Rate	Min (dBm)	Typ (dBm)	Max (dBm)
802.11b, 1 Mbps	—	-98.0	—
802.11b, 2 Mbps	—	-96.0	—
802.11b, 5.5 Mbps	—	-93.0	—
802.11b, 11 Mbps	—	-88.6	—
802.11g, 6 Mbps	—	-92.8	—
802.11g, 9 Mbps	—	-91.8	—
802.11g, 12 Mbps	—	-90.8	—
802.11g, 18 Mbps	—	-88.4	—
802.11g, 24 Mbps	—	-85.4	—
802.11g, 36 Mbps	—	-82.0	—
802.11g, 48 Mbps	—	-77.8	—
802.11g, 54 Mbps	—	-76.2	—
802.11n, HT20, MCS0	—	-92.6	—
802.11n, HT20, MCS1	—	-90.6	—
802.11n, HT20, MCS2	—	-88.0	—
802.11n, HT20, MCS3	—	-84.8	—
802.11n, HT20, MCS4	—	-81.6	—
802.11n, HT20, MCS5	—	-77.4	—
802.11n, HT20, MCS6	—	-75.6	—
802.11n, HT20, MCS7	—	-74.4	—
802.11n, HT40, MCS0	—	-90.0	—
802.11n, HT40, MCS1	—	-87.6	—
802.11n, HT40, MCS2	—	-84.8	—
802.11n, HT40, MCS3	—	-81.8	—
802.11n, HT40, MCS4	—	-78.4	—
802.11n, HT40, MCS5	—	-74.2	—

Cont'd on next page

Table 19 – cont'd from previous page

Rate	Min (dBm)	Typ (dBm)	Max (dBm)
802.11n, HT40, MCS6	—	-72.6	—
802.11n, HT40, MCS7	—	-71.2	—

Table 20: Maximum RX Level

Rate	Min (dBm)	Typ (dBm)	Max (dBm)
802.11b, 1 Mbps	—	5	—
802.11b, 11 Mbps	—	5	—
802.11g, 6 Mbps	—	5	—
802.11g, 54 Mbps	—	0	—
802.11n, HT20, MCS0	—	5	—
802.11n, HT20, MCS7	—	0	—
802.11n, HT40, MCS0	—	5	—
802.11n, HT40, MCS7	—	0	—

Table 21: RX Adjacent Channel Rejection

Rate	Min (dB)	Typ (dB)	Max (dB)
802.11b, 1 Mbps	—	35	—
802.11b, 11 Mbps	—	35	—
802.11g, 6 Mbps	—	31	—
802.11g, 54 Mbps	—	14	—
802.11n, HT20, MCS0	—	31	—
802.11n, HT20, MCS7	—	13	—
802.11n, HT40, MCS0	—	19	—
802.11n, HT40, MCS7	—	8	—

7.2 Bluetooth 5 (LE) Radio

7.2.1 Bluetooth LE RF Transmitter (TX) Characteristics

Table 22: Bluetooth LE RF Characteristics

Name	Description
Center frequency range of operating channel	2402 ~ 2480 MHz
RF transmit power range	-24.0 ~ 20.0 dBm

Table 23: Bluetooth LE - Transmitter Characteristics - 1 Mbps

Parameter	Description	Min	Typ	Max	Unit
In-band emissions	$F = F_0 \pm 2 \text{ MHz}$	—	-37.62	—	dBm
	$F = F_0 \pm 3 \text{ MHz}$	—	-41.95	—	dBm
	$F = F_0 \pm > 3 \text{ MHz}$	—	-44.48	—	dBm
Modulation characteristics	$\Delta f_{1\text{avg}}$	—	245.00	—	kHz
	$\Delta f_{2\text{max}}$	—	208.00	—	kHz
	$\Delta f_{2\text{avg}}/\Delta f_{1\text{avg}}$	—	0.93	—	—
Carrier frequency offset	—	—	-9.00	—	kHz
Carrier frequency drift	$ f_0 - f_n _{n=2, 3, 4, \dots k}$	—	1.17	—	kHz
	$ f_1 - f_0 $	—	0.30	—	kHz
	$ f_n - f_{n-5} _{n=6, 7, 8, \dots k}$	—	4.90	—	kHz

Table 24: Bluetooth LE - Transmitter Characteristics - 2 Mbps

Parameter	Description	Min	Typ	Max	Unit
In-band emissions	$F = F_0 \pm 4 \text{ MHz}$	—	-43.55	—	dBm
	$F = F_0 \pm 5 \text{ MHz}$	—	-45.26	—	dBm
	$F = F_0 \pm > 5 \text{ MHz}$	—	-47.00	—	dBm
Modulation characteristics	$\Delta f_{1\text{avg}}$	—	497.00	—	kHz
	$\Delta f_{2\text{max}}$	—	398.00	—	kHz
	$\Delta f_{2\text{avg}}/\Delta f_{1\text{avg}}$	—	0.95	—	—
Carrier frequency offset	—	—	-9.00	—	kHz
Carrier frequency drift	$ f_0 - f_n _{n=2, 3, 4, \dots k}$	—	0.46	—	kHz
	$ f_1 - f_0 $	—	0.70	—	kHz
	$ f_n - f_{n-5} _{n=6, 7, 8, \dots k}$	—	6.80	—	kHz

Table 25: Bluetooth LE - Transmitter Characteristics - 125 Kbps

Parameter	Description	Min	Typ	Max	Unit
In-band emissions	$F = F_0 \pm 2 \text{ MHz}$	—	-37.90	—	dBm
	$F = F_0 \pm 3 \text{ MHz}$	—	-41.00	—	dBm
	$F = F_0 \pm > 3 \text{ MHz}$	—	-42.50	—	dBm
Modulation characteristics	$\Delta f_{1\text{avg}}$	—	252.00	—	kHz
	$\Delta f_{1\text{max}}$	—	200.00	—	kHz
Carrier frequency offset	—	—	-13.70	—	kHz
Carrier frequency drift	$ f_0 - f_n _{n=1, 2, 3, \dots k}$	—	1.52	—	kHz
	$ f_0 - f_3 $	—	0.65	—	kHz
	$ f_n - f_{n-3} _{n=7, 8, 9, \dots k}$	—	0.70	—	kHz

Table 26: Bluetooth LE - Transmitter Characteristics - 500 Kbps

Parameter	Description	Min	Typ	Max	Unit
In-band emissions	$F = F_0 \pm 2 \text{ MHz}$	—	-37.90	—	dBm
	$F = F_0 \pm 3 \text{ MHz}$	—	-41.30	—	dBm
	$F = F_0 \pm > 3 \text{ MHz}$	—	-42.80	—	dBm
Modulation characteristics	$\Delta f_{2\text{avg}}$	—	220.00	—	kHz
	$\Delta f_{2\text{max}}$	—	205.00	—	kHz
Carrier frequency offset	—	—	-11.90	—	kHz
Carrier frequency drift	$ f_0 - f_n _{n=1, 2, 3, \dots, k}$	—	1.37	—	kHz
	$ f_0 - f_3 $	—	1.09	—	kHz
	$ f_n - f_{n-3} _{n=7, 8, 9, \dots, k}$	—	0.51	—	kHz

7.2.2 Bluetooth LE RF Receiver (RX) Characteristics

Table 27: Bluetooth LE - Receiver Characteristics - 1 Mbps

Parameter	Description	Min	Typ	Max	Unit
Sensitivity @30.8% PER	—	—	-96	—	dBm
Maximum received signal @30.8% PER	—	—	10	—	dBm
Co-channel C/I	—	—	8	—	dB
Adjacent channel selectivity C/I	$F = F_0 + 1 \text{ MHz}$	—	-4	—	dB
	$F = F_0 - 1 \text{ MHz}$	—	-3	—	dB
	$F = F_0 + 2 \text{ MHz}$	—	-32	—	dB
	$F = F_0 - 2 \text{ MHz}$	—	-36	—	dB
	$F \geq F_0 + 3 \text{ MHz}^{(1)}$	—	—	—	dB
	$F \leq F_0 - 3 \text{ MHz}$	—	-39	—	dB
Image frequency	—	—	-29	—	dB
Adjacent channel to image frequency	$F = F_{\text{image}} + 1 \text{ MHz}$	—	-38	—	dB
	$F = F_{\text{image}} - 1 \text{ MHz}$	—	-34	—	dB
Out-of-band blocking performance	30 MHz ~ 2000 MHz	—	-9	—	dBm
	2003 MHz ~ 2399 MHz	—	-18	—	dBm
	2484 MHz ~ 2997 MHz	—	-16	—	dBm
	3000 MHz ~ 12.75 GHz	—	-6	—	dBm
Intermodulation	—	—	-44	—	dBm

¹ Refer to the value of Adjacent channel to image frequency when $F = F_{\text{image}} - 1 \text{ MHz}$.

Table 28: Bluetooth LE - Receiver Characteristics - 2 Mbps

Parameter	Description	Min	Typ	Max	Unit
Sensitivity @30.8% PER	—	—	-93	—	dBm
Maximum received signal @30.8% PER	—	—	0	—	dBm
Co-channel C/I	—	—	10	—	dB
Adjacent channel selectivity C/I	$F = F_0 + 2 \text{ MHz}$	—	-7	—	dB
	$F = F_0 - 2 \text{ MHz}$	—	-7	—	dB
	$F = F_0 + 4 \text{ MHz}^{(1)}$	—	—	—	dB
	$F = F_0 - 4 \text{ MHz}$	—	-34	—	dB
	$F \geq F_0 + 6 \text{ MHz}$	—	-39	—	dB
	$F \leq F_0 - 6 \text{ MHz}$	—	-39	—	dB
Image frequency	—	—	-27	—	dB
Adjacent channel to image frequency	$F = F_{image} + 2 \text{ MHz}$	—	-39	—	dB
	$F = F_{image} - 2 \text{ MHz}^{(2)}$	—	—	—	dB
Out-of-band blocking performance	30 MHz ~ 2000 MHz	—	-17	—	dBm
	2003 MHz ~ 2399 MHz	—	-19	—	dBm
	2484 MHz ~ 2997 MHz	—	-16	—	dBm
	3000 MHz ~ 12.75 GHz	—	-22	—	dBm
Intermodulation	—	—	-40	—	dBm

¹ Refer to the value of Image frequency.

² Refer to the value of Adjacent channel selectivity C/I when $F = F_0 + 2 \text{ MHz}$.

Table 29: Bluetooth LE - Receiver Characteristics - 125 Kbps

Parameter	Description	Min	Typ	Max	Unit
Sensitivity @30.8% PER	—	—	-104	—	dBm
Maximum received signal @30.8% PER	—	—	10	—	dBm
Co-channel C/I	—	—	2	—	dB
Adjacent channel selectivity C/I	$F = F_0 + 1 \text{ MHz}$	—	-6	—	dB
	$F = F_0 - 1 \text{ MHz}$	—	-5	—	dB
	$F = F_0 + 2 \text{ MHz}$	—	-40	—	dB
	$F = F_0 - 2 \text{ MHz}$	—	-42	—	dB
	$F \geq F_0 + 3 \text{ MHz}^{(1)}$	—	—	—	dB
	$F \leq F_0 - 3 \text{ MHz}$	—	-46	—	dB
Image frequency	—	—	-34	—	dB
Adjacent channel to image frequency	$F = F_{image} + 1 \text{ MHz}$	—	-44	—	dB
	$F = F_{image} - 1 \text{ MHz}$	—	-37	—	dB

¹ Refer to the value of Adjacent channel to image frequency when $F = F_{image} - 1 \text{ MHz}$.

Table 30: Bluetooth LE - Receiver Characteristics - 500 Kbps

Parameter	Description	Min	Typ	Max	Unit
Sensitivity @30.8% PER	—	—	-99	—	dBm

Cont'd on next page

Table 30 – cont'd from previous page

Parameter	Description	Min	Typ	Max	Unit
Maximum received signal @30.8% PER	—	—	10	—	dBm
Co-channel C/I	—	—	3	—	dB
Adjacent channel selectivity C/I	$F = F_0 + 1 \text{ MHz}$	—	-5	—	dB
	$F = F_0 - 1 \text{ MHz}$	—	-7	—	dB
	$F = F_0 + 2 \text{ MHz}$	—	-39	—	dB
	$F = F_0 - 2 \text{ MHz}$	—	-40	—	dB
	$F \geq F_0 + 3 \text{ MHz}^{(1)}$	—	—	—	dB
	$F \leq F_0 - 3 \text{ MHz}$	—	-40	—	dB
Image frequency	—	—	-34	—	dB
Adjacent channel to image frequency	$F = F_{image} + 1 \text{ MHz}$	—	-43	—	dB
	$F = F_{image} - 1 \text{ MHz}$	—	-38	—	dB

¹ Refer to the value of Adjacent channel to image frequency when $F = F_{image} - 1 \text{ MHz}$.

8 Module Schematics

This is the reference design of the module.

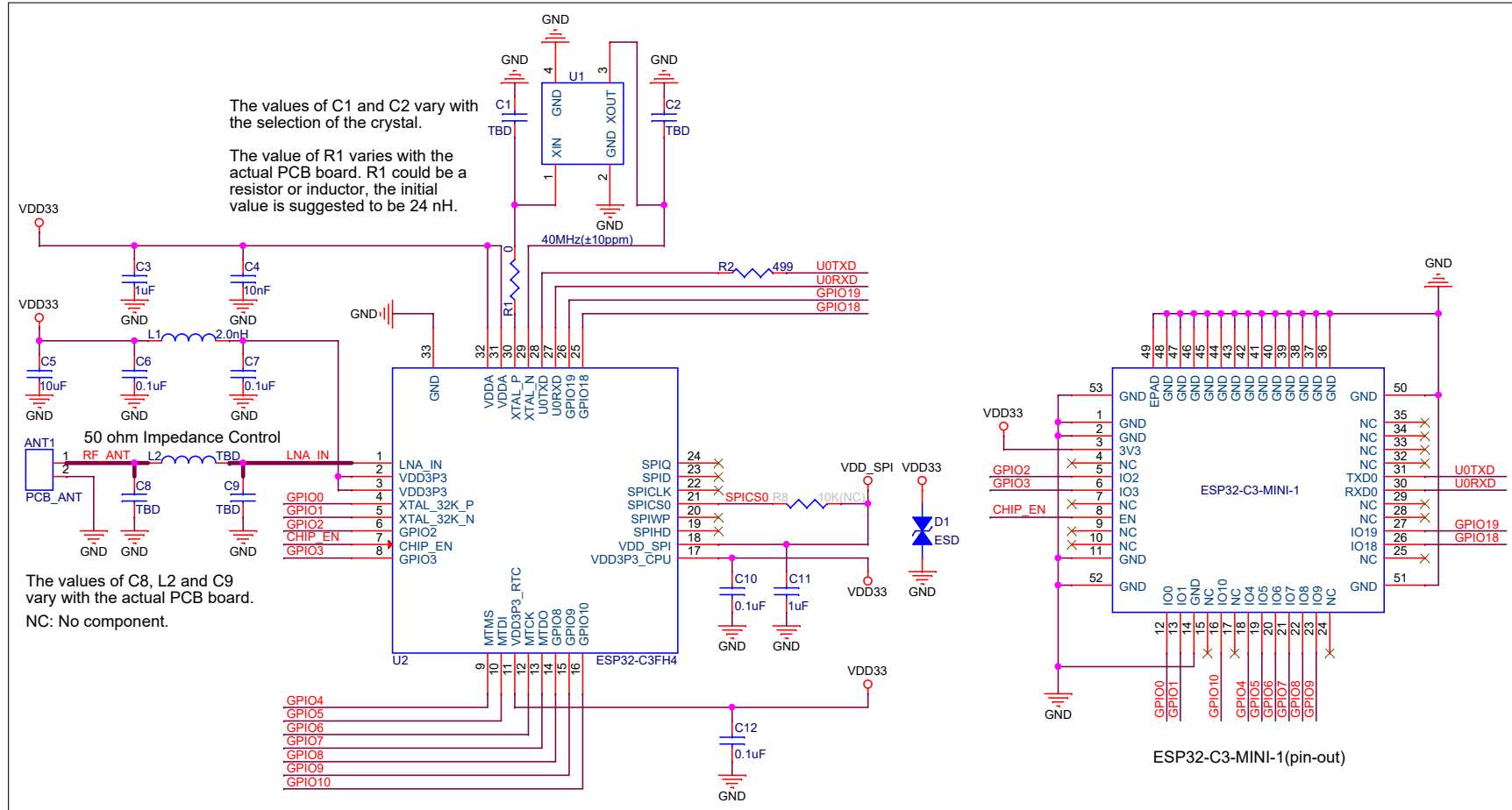


Figure 5: ESP32-C3-MINI-1 Schematics

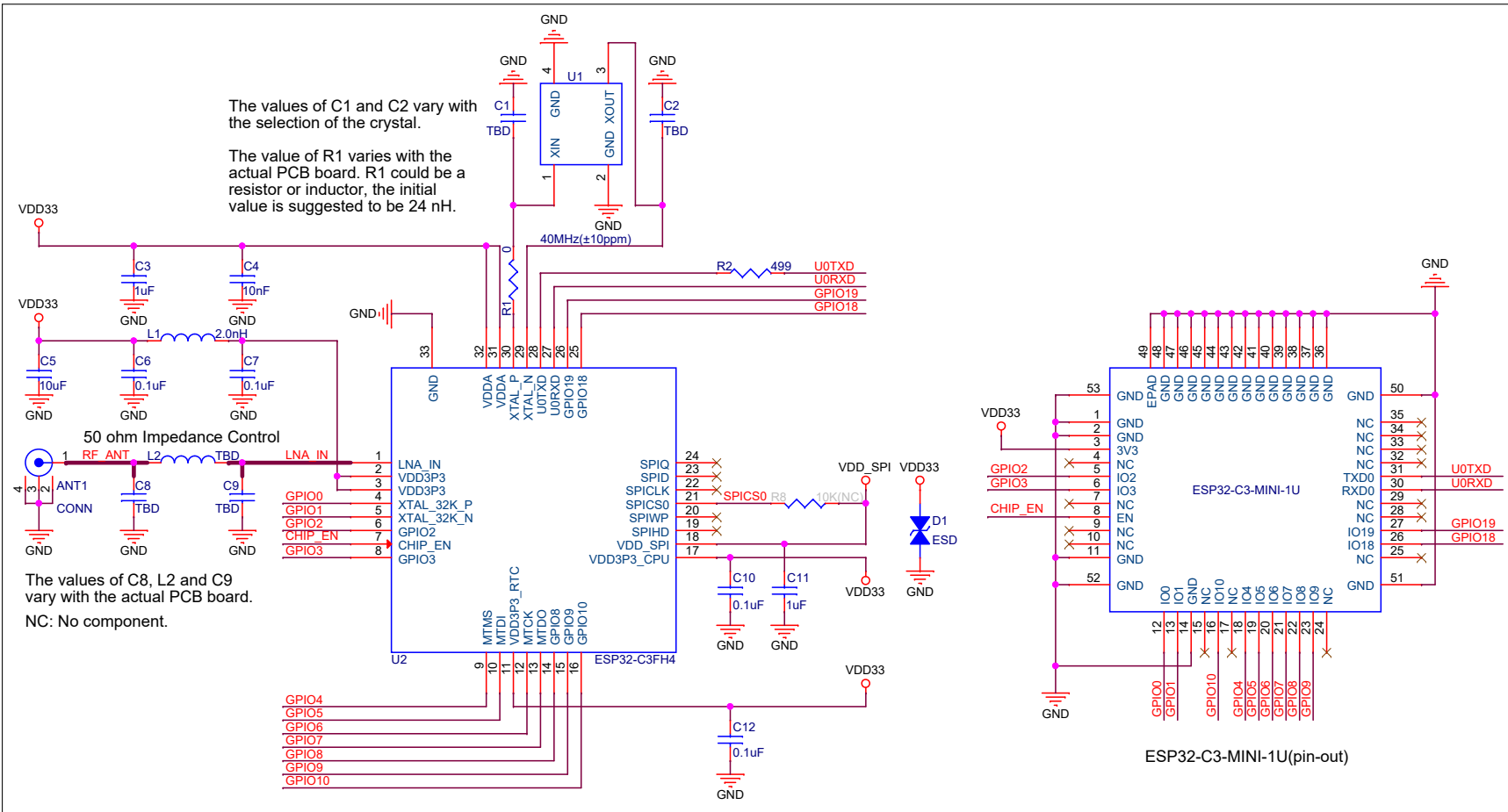


Figure 6: ESP32-C3-MINI-1U Schematics

10 Physical Dimensions

10.1 Module Dimensions

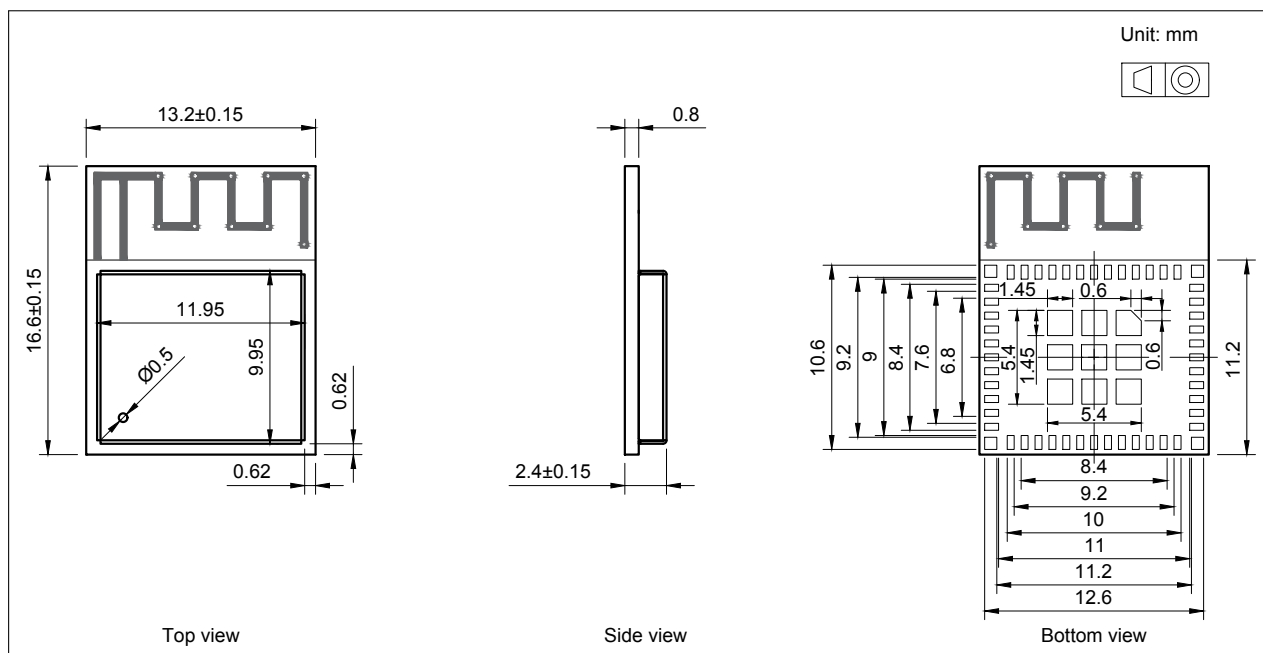


Figure 8: ESP32-C3-MINI-1 Physical Dimensions

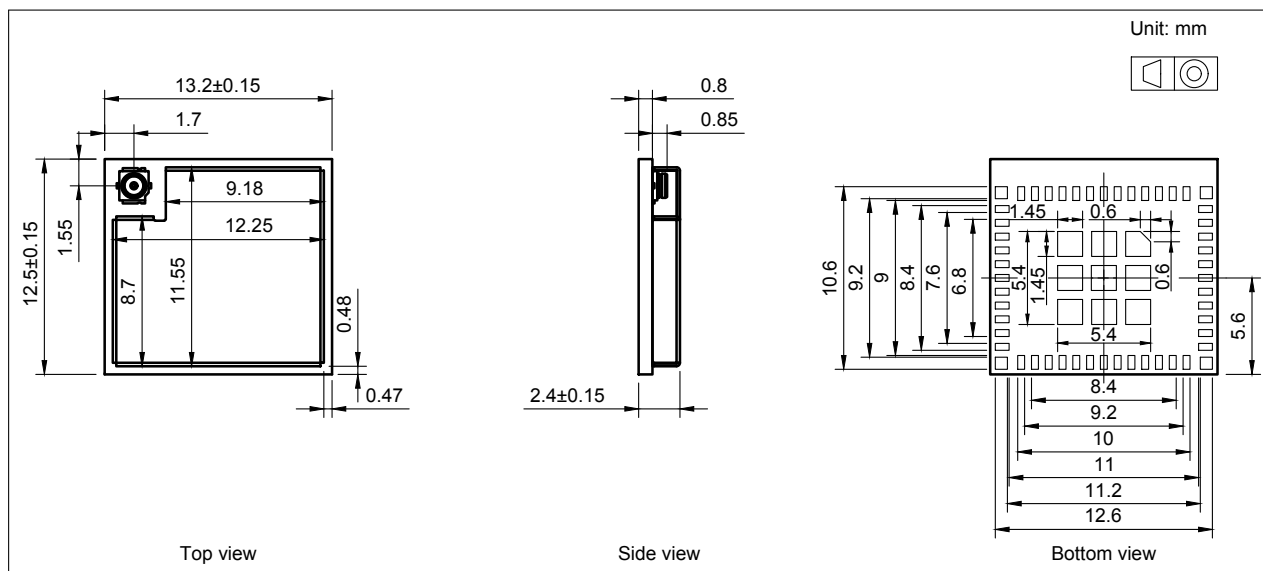


Figure 9: ESP32-C3-MINI-1U Physical Dimensions

Note:

For information about tape, reel, and product marking, please refer to [Espressif Module Packaging Information](#).

10.2 Dimensions of External Antenna Connector

ESP32-C3-MINI-1U uses the third generation external antenna connector as shown in Figure 10 *Dimensions of External Antenna Connector*. This connector is compatible with the following connectors:

- W.FL Series connector from Hirose
- MHF III connector from I-PEX
- AMMC connector from Amphenol

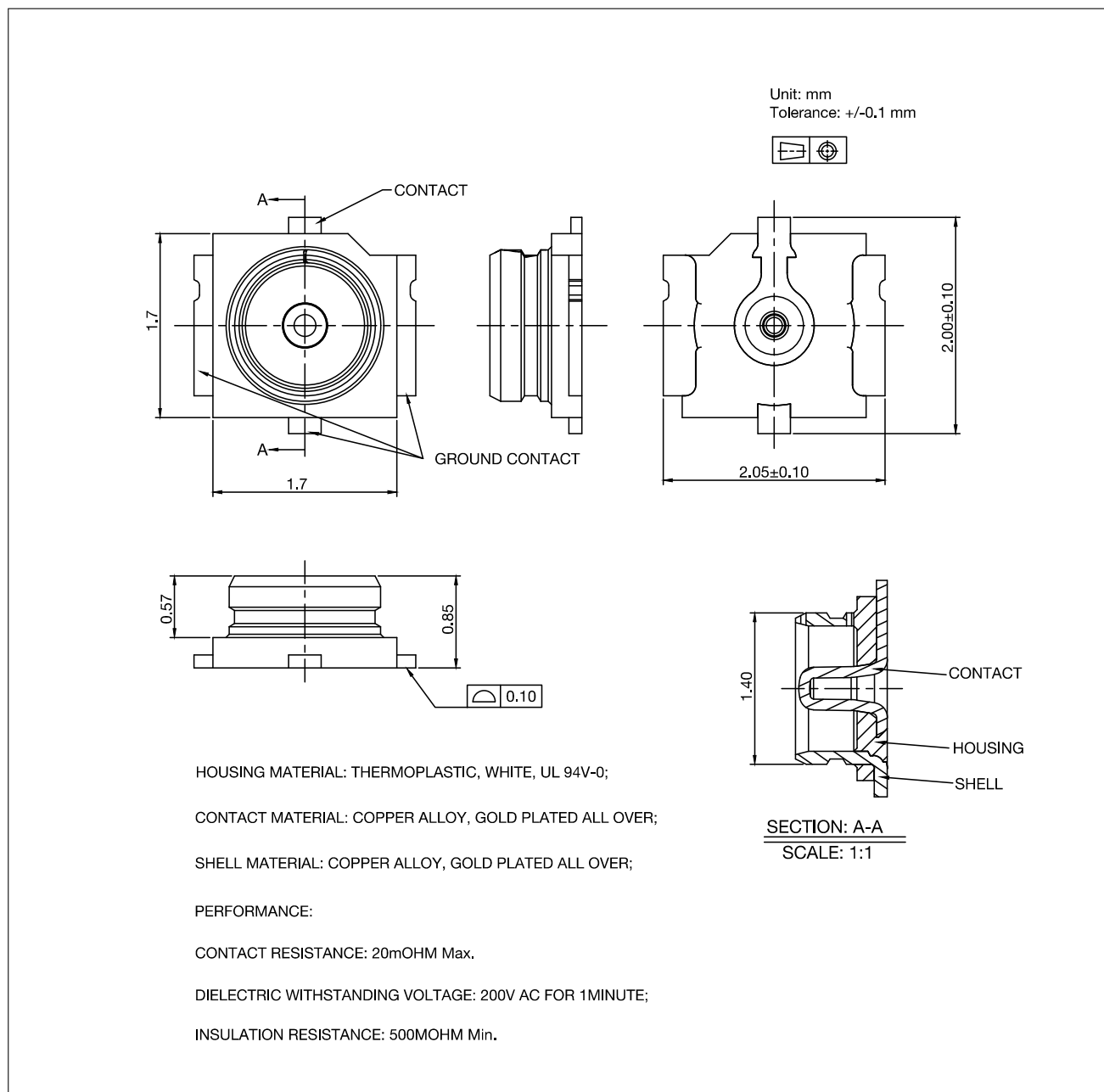


Figure 10: Dimensions of External Antenna Connector

fig:10.2-ant-connector

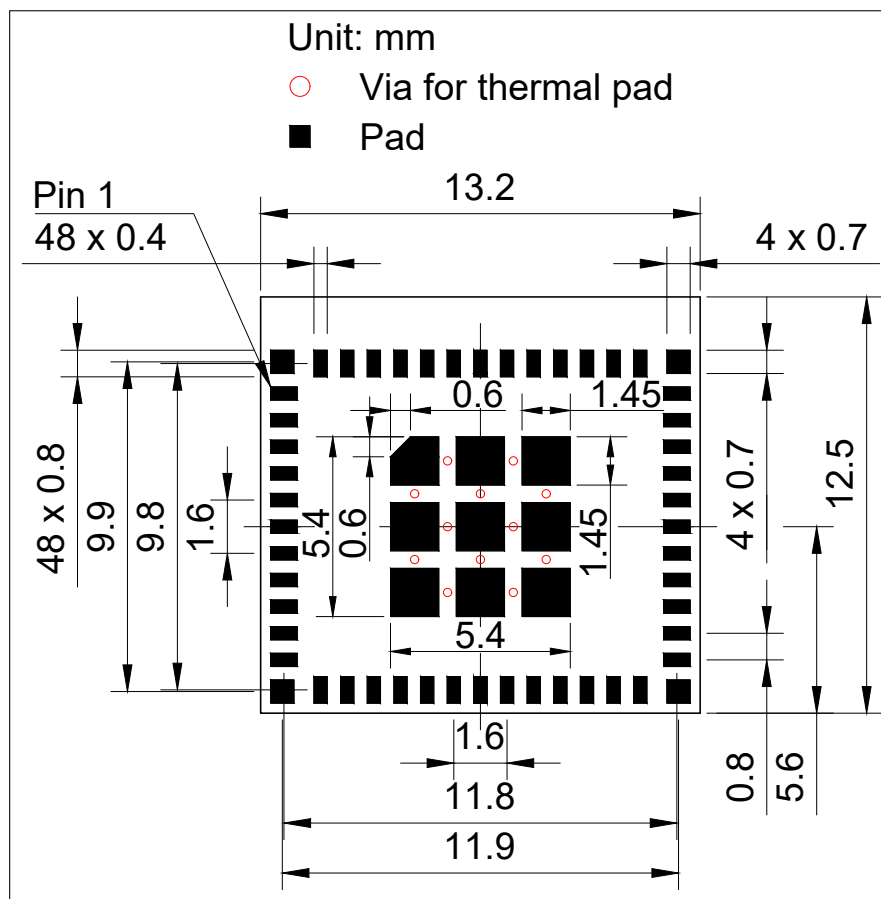


Figure 12: ESP32-C3-MINI-1U Recommended PCB Land Pattern

11.2 Module Placement for PCB Design

If module-on-board design is adopted, attention should be paid while positioning the module on the base board. The interference of the base board on the module's antenna performance should be minimized.

For details about module placement for PCB design, please refer to [ESP32-C3 Hardware Design Guidelines](#) > Section *Positioning a Module on a Base Board*.

12 Product Handling

12.1 Storage Conditions

The products sealed in moisture barrier bags (MBB) should be stored in a non-condensing atmospheric environment of $< 40\text{ }^{\circ}\text{C}$ and 90%RH. The module is rated at the moisture sensitivity level (MSL) of 3.

After unpacking, the module must be soldered within 168 hours with the factory conditions $25\pm 5\text{ }^{\circ}\text{C}$ and 60%RH. If the above conditions are not met, the module needs to be baked.

12.2 Electrostatic Discharge (ESD)

- Human body model (HBM): $\pm 2000\text{ V}$
- Charged-device model (CDM): $\pm 500\text{ V}$

12.3 Reflow Profile

Solder the module in a single reflow.

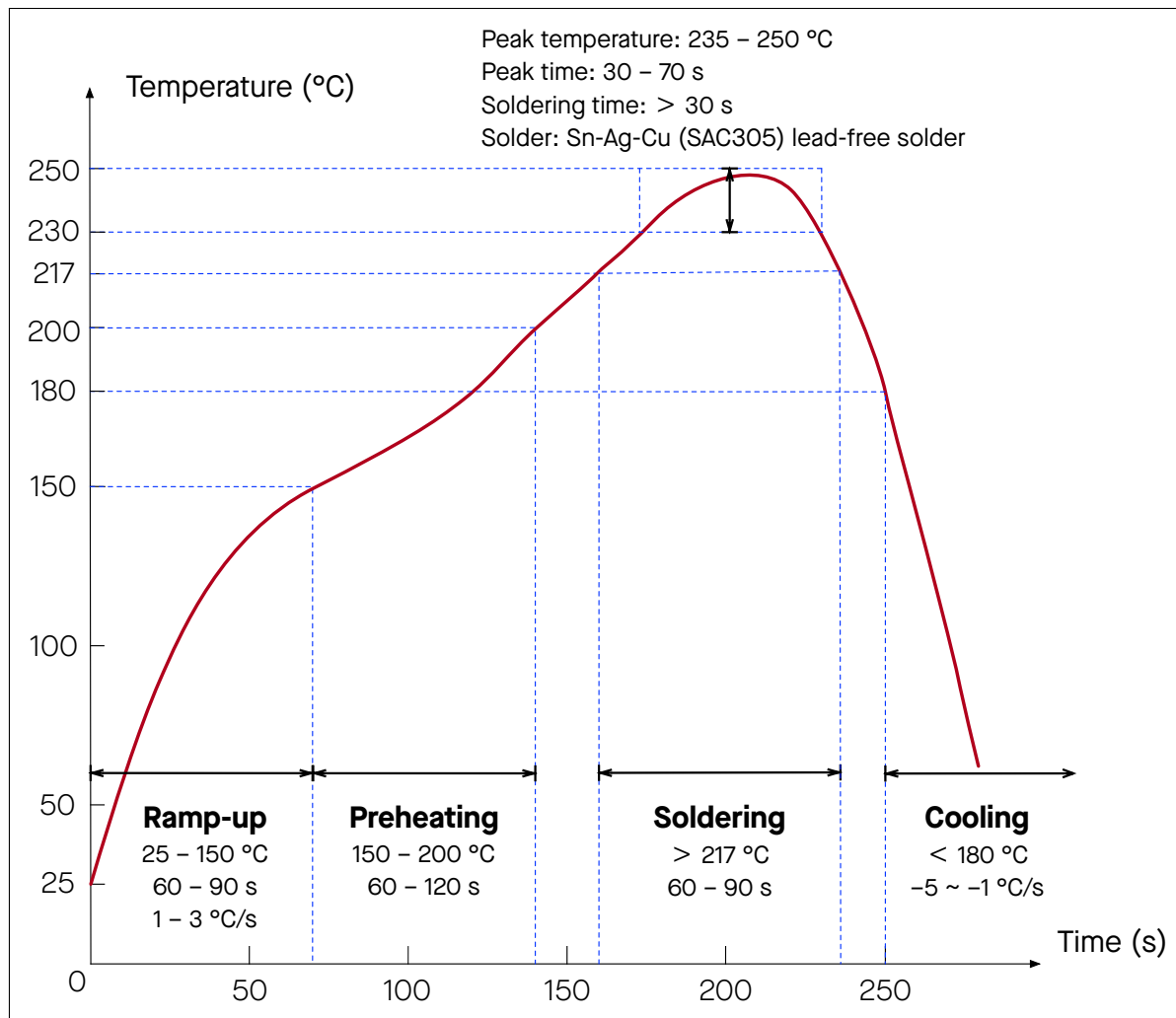


Figure 13: Reflow Profile

12.4 Ultrasonic Vibration

Avoid exposing Espressif modules to vibration from ultrasonic equipment, such as ultrasonic welders or ultrasonic cleaners. This vibration may induce resonance in the in-module crystal and lead to its malfunction or even failure. As a consequence, **the module may stop working or its performance may deteriorate.**

Related Documentation and Resources

Related Documentation

- [ESP32-C3 Series Datasheet](#) – Specifications of the ESP32-C3 hardware.
- [ESP32-C3 Technical Reference Manual](#) – Detailed information on how to use the ESP32-C3 memory and peripherals.
- [ESP32-C3 Hardware Design Guidelines](#) – Guidelines on how to integrate the ESP32-C3 into your hardware product.
- [ESP32-C3 Series SoC Errata](#) – Descriptions of known errors in ESP32-C3 series of SoCs.
- *Certificates*
<https://espressif.com/en/support/documents/certificates>
- *ESP32-C3 Product/Process Change Notifications (PCN)*
<https://espressif.com/en/support/documents/pcns?keys=ESP32-C3>
- *ESP32-C3 Advisories* – Information on security, bugs, compatibility, component reliability.
<https://espressif.com/en/support/documents/advisories?keys=ESP32-C3>
- *Documentation Updates and Update Notification Subscription*
<https://espressif.com/en/support/download/documents>

Developer Zone

- [ESP-IDF Programming Guide for ESP32-C3](#) – Extensive documentation for the ESP-IDF development framework.
- *ESP-IDF* and other development frameworks on GitHub.
<https://github.com/espressif>
- *ESP32 BBS Forum* – Engineer-to-Engineer (E2E) Community for Espressif products where you can post questions, share knowledge, explore ideas, and help solve problems with fellow engineers.
<https://esp32.com/>
- *The ESP Journal* – Best Practices, Articles, and Notes from Espressif folks.
<https://blog.espressif.com/>
- See the tabs *SDKs and Demos, Apps, Tools, AT Firmware*.
<https://espressif.com/en/support/download/sdks-demos>

Products

- *ESP32-C3 Series SoCs* – Browse through all ESP32-C3 SoCs.
<https://espressif.com/en/products/socs?id=ESP32-C3>
- *ESP32-C3 Series Modules* – Browse through all ESP32-C3-based modules.
<https://espressif.com/en/products/modules?id=ESP32-C3>
- *ESP32-C3 Series DevKits* – Browse through all ESP32-C3-based devkits.
<https://espressif.com/en/products/devkits?id=ESP32-C3>
- *ESP Product Selector* – Find an Espressif hardware product suitable for your needs by comparing or applying filters.
<https://products.espressif.com/#/product-selector?language=en>

Contact Us

- See the tabs *Sales Questions, Technical Enquiries, Circuit Schematic & PCB Design Review, Get Samples* (Online stores), *Become Our Supplier, Comments & Suggestions*.
<https://espressif.com/en/contact-us/sales-questions>

Revision History

Date	Version	Release notes
2025-04-14	v2.0	According to updates in Compatibility Advisory for ESP32-C3 Chip Revision v1.1 , updated SRAM space in note 6 for Table ESP32-C3-MINI-1U (CONN) Series Comparison
2025-01-24	v1.9	Updated chip in ESP32-C3-MINI-1-N4 and ESP32-C3-MINI-1U-N4 from ESP32-C3FN4 to ESP32-C3FH4
2024-11-20	v1.8	<ul style="list-style-type: none"> Table 1 ESP32-C3-MINI-1 (ANT) Series Comparison¹ and 2 ESP32-C3-MINI-1U (CONN) Series Comparison: <ul style="list-style-type: none"> Added the ESP32-C3-MINI-1-N4X, ESP32-C3-MINI-1U-N4X, and ESP32-C3-MINI-1U-H4X variants Marked the ESP32-C3-MINI-1U-N4 and ESP32-C3-MINI-1U-H4 variants as Not Recommended for New Designs (NRND) Added Table 13 Current Consumption for Bluetooth LE in Active Mode
2024-09-19	v1.7	<ul style="list-style-type: none"> Table 2 ESP32-C3-MINI-1U (CONN) Series Comparison: Updated flash program/erase cycles, data retention time (note 4) and maximum clock frequency (note 7) Improved the wording and structure of following sections: <ul style="list-style-type: none"> Updated Section "Strapping Pins" and renamed to 4 Boot Configurations Added Chapter 5 Peripherals Updated Table "Wi-Fi RF Standards" and renamed to "Wi-Fi RF Characteristics" Added Section 11.2 Module Placement for PCB Design Optimized Figure 13 Reflow Profile
2024-07-29	v1.6	Added Compatibility Advisory for ESP32-C3 Chip Revision v1.1 to the notes of Table ESP32-C3-MINI-1U (CONN) Series Comparison
2024-06-05	v1.5	<ul style="list-style-type: none"> Added new variant ESP32-C3-MINI-1-H4X Marked the ESP32-C3-MINI-1-N4, ESP32-C3-MINI-1-H4, and ESP32-C3-MINI-1-H4-AZ variants as Not Recommended for New Designs (NRND)

Cont'd on next page

Cont'd from previous page

Date	Version	Release notes
2024-05-15	v1.4	<ul style="list-style-type: none"> Updated note 5 of Table ESP32-C3-MINI-1 (ANT) Series Comparison¹ and Table ESP32-C3-MINI-1U (CONN) Series Comparison Updated the formatting of Section 4 Boot Configurations Updated the maximum value of "RF power control range" to 20 dBm in Table Bluetooth LE RF Characteristics Updated the note about solder paste in Section 9 Peripheral Schematics Updated the markings of dimensions and thermal pad vias in Section 11.1 PCB Land Pattern
2022-11-08	v1.3	<ul style="list-style-type: none"> Added a new variant ESP32-C3-MINI-1-H4-AZ Changed Table Ordering Information to Table ESP32-C3-MINI-1 (ANT) Series Comparison¹ and Table ESP32-C3-MINI-1U (CONN) Series Comparison Updated test condition descriptions and data in Section 6.4 Current Consumption Characteristics Updated "RF power control range" in Table Bluetooth LE RF Characteristics Added descriptions in Section 11.1 PCB Land Pattern
2022-06-30	v1.2	Added Section 12.4 Ultrasonic Vibration
2022-05-16	v1.1	<ul style="list-style-type: none"> Added a note under Table Ordering Information Updated Chapter 8 Module Schematics
2021-06-21	v1.0	<ul style="list-style-type: none"> Updated module description on the title page Deleted Section "About This Document" Restructured Section 1.1 Features Added ordering code in Table Ordering Information Added descriptions in Section 10.2 Dimensions of External Antenna Connector Updated Section "Learning Resources" and renamed to Related Documentation and Resources Replaced "chip family" with "chip series" following Espressif's taxonomy
2021-04-16	v0.7	Added information about ESP32-C3-MINI-1U module
2021-02-22	v0.6	Updated the value of C7 to 0.1 μ F in Chapter 8 Module Schematics
2021-02-05	v0.5	Preliminary release



Disclaimer and Copyright Notice

Information in this document, including URL references, is subject to change without notice.

ALL THIRD PARTY'S INFORMATION IN THIS DOCUMENT IS PROVIDED AS IS WITH NO WARRANTIES TO ITS AUTHENTICITY AND ACCURACY.

NO WARRANTY IS PROVIDED TO THIS DOCUMENT FOR ITS MERCHANTABILITY, NON-INFRINGEMENT, FITNESS FOR ANY PARTICULAR PURPOSE, NOR DOES ANY WARRANTY OTHERWISE ARISING OUT OF ANY PROPOSAL, SPECIFICATION OR SAMPLE.

All liability, including liability for infringement of any proprietary rights, relating to use of information in this document is disclaimed. No licenses express or implied, by estoppel or otherwise, to any intellectual property rights are granted herein.

The Wi-Fi Alliance Member logo is a trademark of the Wi-Fi Alliance. The Bluetooth logo is a registered trademark of Bluetooth SIG.

All trade names, trademarks and registered trademarks mentioned in this document are property of their respective owners, and are hereby acknowledged.

Copyright © 2025 Espressif Systems (Shanghai) Co., Ltd. All rights reserved.

www.espressif.com