ESP32-C3-MINI-1
ESP32-C3-MINI-1U

Datasheet Version 2.2

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
Up to 8 MB flash in chip package
15 GPIOs
On-board PCB antenna or external antenna connector

ESP32-C3-MINI-1

ESP32-C3-MINI-1U

ESPRESSIF

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, ESP32-C3FH4X, ESP32-C3FH8X, or ESP32-C3FH4AZ 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
- Up to 8 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 1-1 and 1-2.

The series comparison for the two modules is as follows:

Table 1-1. ESP32-C3-MINI-1 (ANT) Series Comparison[1]

Part Number[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-H8X	8 MB (Quad SPI)	–40 ~ 105	v1.1	
ESP32-C3-MINI-1-N4 (NRND)	4 MB (Quad SPI)	–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 1-2 below.

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

Part Number[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. For specifications, refer to Section 6.5 *Memory Specifications*.

[5] All modules can be pre-programmed with AWS IoT ExpressLink firmware. Modules with such firmware have suffix "-A" in their part numbers, 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. These modules can be embedded with the following chips:

- ESP32-C3FH4: chip revision v0.4, 4 MB flash
- ESP32-C3FH4X: chip revision v1.1, 4 MB flash
- ESP32-C3FH8X: chip reivision v1.1, 8 MB

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

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2 Block Diagram

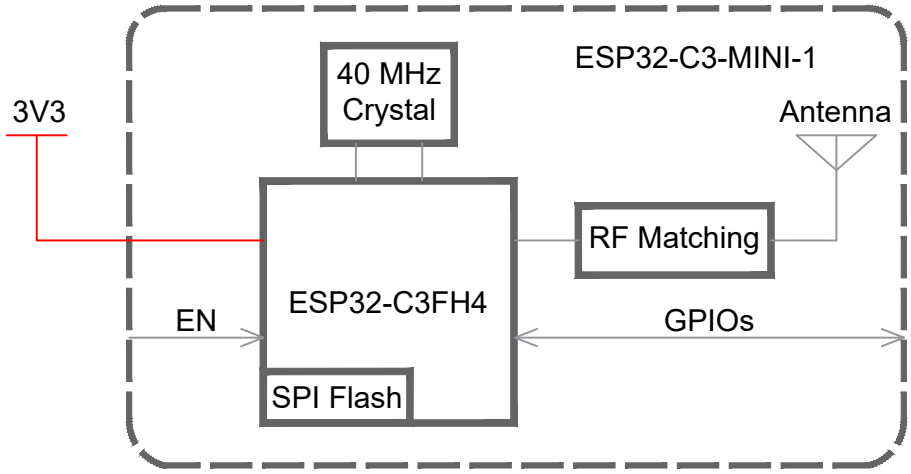

Figure 2-1. ESP32-C3-MINI-1 Block Diagram

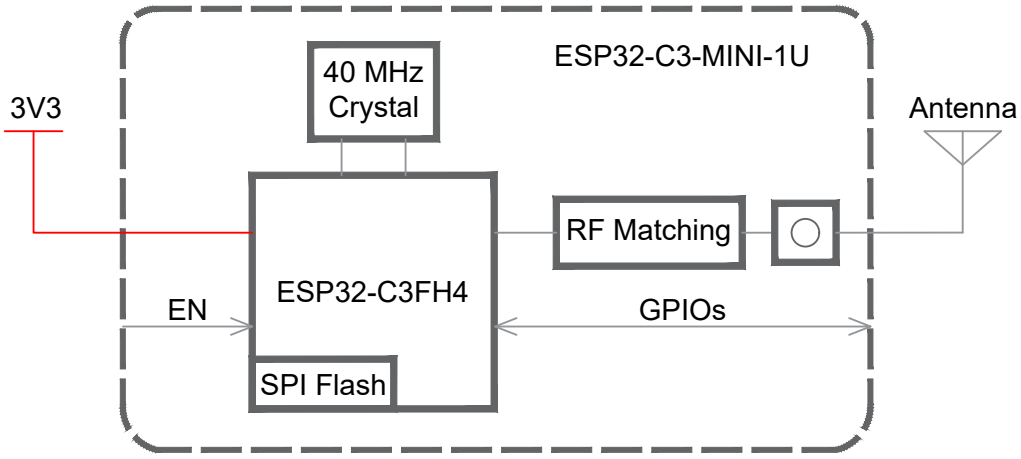

Figure 2-2. ESP32-C3-MINI-1U Block Diagram

Note:

For the pin mapping between the chip and the in-package flash, please refer to *ESP32-C3 Series Datasheet* > Table *Pin Mapping Between Chip and In-package Flash*.

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*.

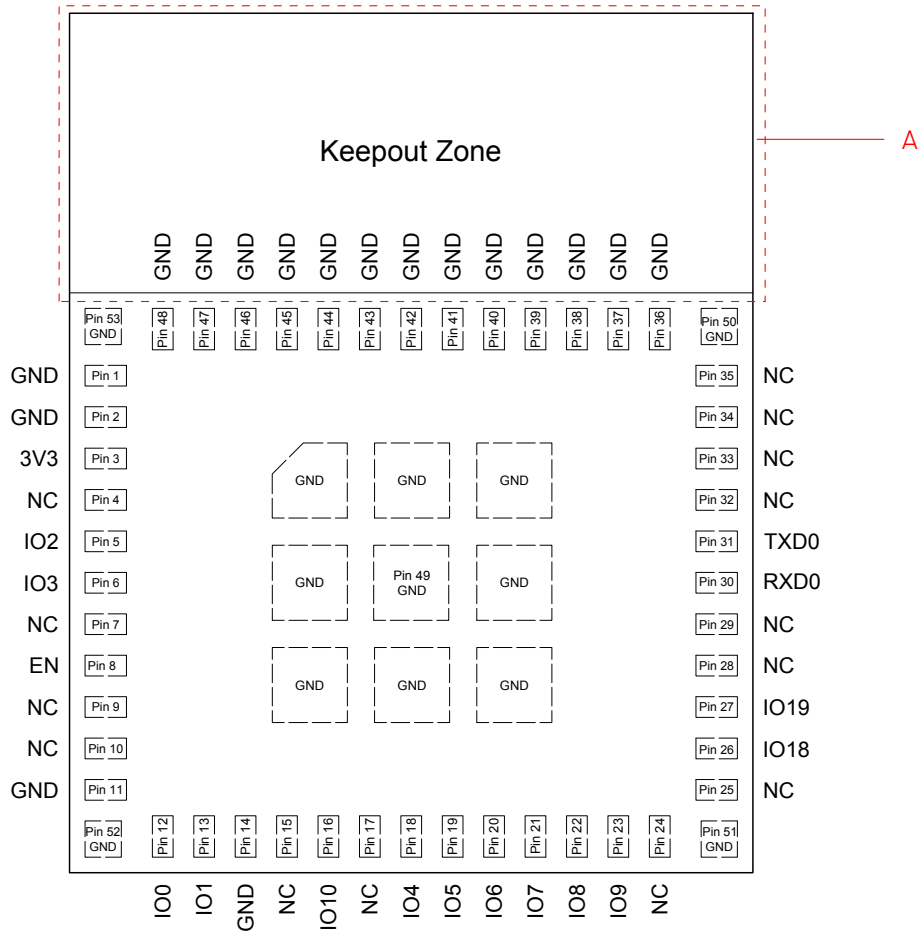

Figure 3-1. Pin Layout (Top View)

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 *General Principles of PCB Layout for Modules*.

3.2 Pin Description

The module has 53 pins. See pin definitions in Table 3-1 *Pin Definitions*.

For peripheral pin configurations, please refer to Section 5.2 *Peripheral Description*.

Table 3-1. 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, FSPICS0
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* > Chapter *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 parameters 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 parameters are 0, which means that they are not burnt. Given that eFuse is one-time programmable, once programmed to 1, it can never be reverted to 0. For how to program eFuse parameters, 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 4-1. 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 Chip 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. For details on Chip Reset, see *ESP32-C3 Technical Reference Manual* > Chapter *Reset and Clock*.

The timing of signals connected to the strapping pins should adhere to the *setup time* and *hold time* specifications in Table 4-2 and Figure 4-1.

Table 4-2. 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

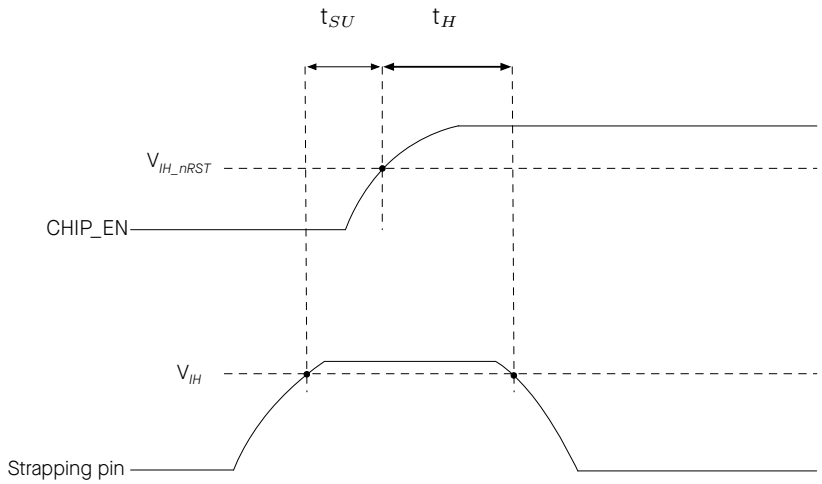

Figure 4-1. Visualization of Timing Parameters for the Strapping Pins

4.1 Chip Boot Mode Control

GPIO2, GPIO8, and GPIO9 control the boot mode after the reset is released. See Table 4-3 *Chip Boot Mode Control*.

Table 4-3. Chip Boot Mode Control

Boot Mode	GPIO2 [2]	GPIO8	GPIO9
SPI boot mode	1	Any value	**1**
Joint download boot mode [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 4-4 *UART0 ROM Message Printing Control*.

Table 4-4. 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 4-5 *USB Serial/JTAG ROM Message Printing Control*.

Table 4-5. 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.

4.3 Chip Power-up and Reset

Once the power is supplied to the chip, its power rails need a short time to stabilize. After that, CHIP_EN – the pin used for power-up and reset – is pulled high to activate the chip. For information on CHIP_EN as well as power-up and reset timing, see Figure 4-2 and Table 4-6.

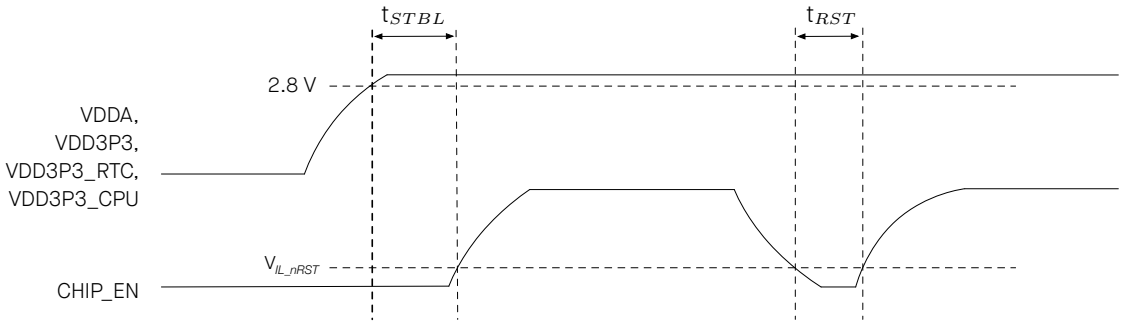

Figure 4-2. Visualization of Timing Parameters for Power-up and Reset

Table 4-6. Description of Timing Parameters for Power-up and Reset

Parameter	Description	Min (μs)
t_{STBL}	Time reserved for the power rails of VDDA, VDD3P3, VDD3P3_RTC, and VDD3P3_CPU to stabilize before the CHIP_EN pin is pulled high to activate the chip	50
t_{RST}	Time reserved for CHIP_EN to stay below V_{IL_nRST} to reset the chip (see Table 6-3)	50

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 UHCI0, and can be accessed by the GDMA controller or directly by the CPU.

For details, see *ESP32-C3 Technical Reference Manual* > Chapter *UART Controller (UART, LP_UART)*.

Pin Assignment

For details, see *ESP32-C3 Series Datasheet* > Section *Peripheral Pin Assignment*.

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

For details, see *ESP32-C3 Technical Reference Manual* > Chapter *SPI Controller (SPI)*.

Pin Assignment

For details, see *ESP32-C3 Series Datasheet* > Section *Peripheral Pin Assignment*.

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

For details, see *ESP32-C3 Technical Reference Manual* > Chapter *I2C Controller (I2C)*.

Pin Assignment

For details, see *ESP32-C3 Series Datasheet* > Section *Peripheral Pin Assignment*.

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.

For details, see *ESP32-C3 Technical Reference Manual* > Chapter *I2S Controller (I2S)*.

Pin Assignment

For details, see *ESP32-C3 Series Datasheet* > Section *Peripheral Pin Assignment*.

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

For details, see *ESP32-C3 Technical Reference Manual* > Chapter *USB Serial/JTAG Controller (USB_SERIAL_JTAG)*.

Pin Assignment

For details, see *ESP32-C3 Series Datasheet* > Section *Peripheral Pin Assignment*.

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

For details, see *ESP32-C3 Technical Reference Manual* > Chapter *Two-wire Automotive Interface*.

Pin Assignment

For details, see *ESP32-C3 Series Datasheet* > Section *Peripheral Pin Assignment*.

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.

For details, see *ESP32-C3 Technical Reference Manual* > Chapter *LED PWM Controller*.

Pin Assignment

For details, see *ESP32-C3 Series Datasheet* > Section *Peripheral Pin Assignment*.

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.

For more details, see *ESP32-C3 Technical Reference Manual* > Chapter *Remote Control Peripheral (RMT)*.

Pin Assignment

For details, see *ESP32-C3 Series Datasheet* > Section *Peripheral Pin Assignment*.

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.

For more details, see *ESP32-C3 Technical Reference Manual* > Chapter *On-Chip Sensors and Analog Signal Processing*.

Pin Assignment

For details, see *ESP32-C3 Series Datasheet* > Section *Peripheral Pin Assignment*.

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 °C to 125 °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.

For more details, see *ESP32-C3 Technical Reference Manual* > Chapter *On-Chip Sensors and Analog Signal Processing*.

6 Electrical Characteristics

6.1 Absolute Maximum Ratings

Stresses above those listed in Table 6-1 *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 6-2 *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

Table 6-1. Absolute Maximum Ratings

Symbol	Parameter	Min	Max	Unit
VDD33	Power supply voltage	−0.3	3.6	V

6.2 Recommended Operating Conditions

Table 6-2. 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	−40	—	85	°C
		105 °C version			105	

6.3 DC Characteristics (3.3 V, 25 °C)

Table 6-3. DC Characteristics (3.3 V, 25 °C)

Parameter	Description	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}	Internal weak pull-up resistor	—	45	—	kΩ
R_{PD}	Internal weak pull-down resistor	—	45	—	kΩ
V_{IH_nRST}	Chip reset release voltage (CHIP_EN voltage is within the specified range)	0.75 × VDD [1]	—	VDD [1] + 0.3	V

Cont'd on next page

Table 6-3 – cont'd from previous page

Parameter	Description	Min	Typ	Max	Unit
V_{IL_nRST}	Chip reset voltage (CHIP_EN voltage is within the specified range)	−0.3	—	0.25 × VDD [1]	V

[1] VDD – voltage from a power pin of a respective 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 6-4. 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 6-5. 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 6-6. 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 running	23	28
		CPU is idle	16	21
	80	CPU is running	17	22
		CPU is idle	13	18

[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 6-7. 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

6.5 Memory Specifications

The data below is sourced from the memory vendor datasheet. These values are guaranteed through design and/or characterization but are not fully tested in production. Devices are shipped with the memory erased.

Table 6-8. Flash Specifications

Parameter	Description	Min	Typ	Max	Unit
VCC	Power supply voltage (1.8 V)	1.65	1.80	2.00	V
	Power supply voltage (3.3 V)	2.7	3.3	3.6	V
F_C	Maximum clock frequency	80	—	—	MHz
—	Program/erase cycles	100,000	—	—	cycles
T_{RET}	Data retention time	20	—	—	years
T_{PP}	Page program time	—	0.8	5	ms
T_{SE}	Sector erase time (4 KB)	—	70	500	ms
T_{BE1}	Block erase time (32 KB)	—	0.2	2	s
T_{BE2}	Block erase time (64 KB)	—	0.3	3	s

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Table 6-8 – cont'd from previous page

Parameter	Description	Min	Typ	Max	Unit
T_{CE}	Chip erase time (16 Mb)	—	7	20	s
	Chip erase time (32 Mb)	—	20	60	s
	Chip erase time (64 Mb)	—	25	100	s
	Chip erase time (128 Mb)	—	60	200	s
	Chip erase time (256 Mb)	—	70	300	s

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 (±5%) supply at 25 °C ambient temperature.

7.1 Wi-Fi Radio

Table 7-1. 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 7-2. 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 7-3. TX EVM Test[1]

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 7-3 – 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 7-2 *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 7-4. 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	—

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Table 7-4 – 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 7-5. 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 7-6. 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 7-7. 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 7-8. Bluetooth LE - Transmitter Characteristics - 1 Mbps

Parameter	Description	Min	Typ	Max	Unit
In-band emissions	F = F0 ± 2 MHz	—	–37.62	—	dBm
	F = F0 ± 3 MHz	—	–41.95	—	dBm
	F = F0 ± > 3 MHz	—	–44.48	—	dBm
Modulation characteristics	$\Delta\ f1_{avg}$	—	245.00	—	kHz
	$\Delta\ f2_{max}$	—	208.00	—	kHz
	$\Delta\ f2_{avg}/\Delta\ f1_{avg}$	—	0.93	—	—
Carrier frequency offset	—	—	–9.00	—	kHz
Carrier frequency drift	$\lvert f_0 - f_n \rvert_{n=2,\ 3,\ 4,\ ..k}$	—	1.17	—	kHz
	$\lvert f_1 - f_0 \rvert$	—	0.30	—	kHz
	$\lvert f_n - f_{n-5} \rvert_{n=6,\ 7,\ 8,\ ..k}$	—	4.90	—	kHz

Table 7-9. Bluetooth LE - Transmitter Characteristics - 2 Mbps

Parameter	Description	Min	Typ	Max	Unit
In-band emissions	F = F0 ± 4 MHz	—	–43.55	—	dBm
	F = F0 ± 5 MHz	—	–45.26	—	dBm
	F = F0 ± > 5 MHz	—	–47.00	—	dBm
Modulation characteristics	$\Delta\ f1_{avg}$	—	497.00	—	kHz
	$\Delta\ f2_{max}$	—	398.00	—	kHz
	$\Delta\ f2_{avg}/\Delta\ f1_{avg}$	—	0.95	—	—
Carrier frequency offset	—	—	–9.00	—	kHz
Carrier frequency drift	$\lvert f_0 - f_n \rvert_{n=2,\ 3,\ 4,\ ..k}$	—	0.46	—	kHz
	$\lvert f_1 - f_0 \rvert$	—	0.70	—	kHz
	$\lvert f_n - f_{n-5} \rvert_{n=6,\ 7,\ 8,\ ..k}$	—	6.80	—	kHz

Table 7-10. Bluetooth LE - Transmitter Characteristics - 125 Kbps

Parameter	Description	Min	Typ	Max	Unit
In-band emissions	F = F0 ± 2 MHz	—	–37.90	—	dBm
	F = F0 ± 3 MHz	—	–41.00	—	dBm
	F = F0 ± > 3 MHz	—	–42.50	—	dBm
Modulation characteristics	$\Delta\ f1_{avg}$	—	252.00	—	kHz
	$\Delta\ f1_{max}$	—	200.00	—	kHz
Carrier frequency offset	—	—	–13.70	—	kHz
Carrier frequency drift	$\lvert f_0 - f_n \rvert_{n=1,\ 2,\ 3,\ ..k}$	—	1.52	—	kHz
	$\lvert f_0 - f_3 \rvert$	—	0.65	—	kHz
	$\lvert f_n - f_{n-3} \rvert_{n=7,\ 8,\ 9,\ ..k}$	—	0.70	—	kHz

Table 7-11. Bluetooth LE - Transmitter Characteristics - 500 Kbps

Parameter	Description	Min	Typ	Max	Unit
In-band emissions	F = F0 ± 2 MHz	—	-37.90	—	dBm
	F = F0 ± 3 MHz	—	-41.30	—	dBm
	F = F0 ± > 3 MHz	—	-42.80	—	dBm
Modulation characteristics	$\Delta f2_{avg}$	—	220.00	—	kHz
	$\Delta f2_{max}$	—	205.00	—	kHz
Carrier frequency offset	—	—	-11.90	—	kHz
Carrier frequency drift	$\lvert f_0 - f_n \rvert_{n=1,\,2,\,3,\,..k}$	—	1.37	—	kHz
	$\lvert f_0 - f_3 \rvert$	—	1.09	—	kHz
	$\lvert f_n - f_{n-3} \rvert_{n=7,\,8,\,9,\,..k}$	—	0.51	—	kHz

7.2.2 Bluetooth LE RF Receiver (RX) Characteristics

Table 7-12. 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 = F0 + 1 MHz	—	-4	—	dB
	F = F0 – 1 MHz	—	-3	—	dB
	F = F0 + 2 MHz	—	-32	—	dB
	F = F0 – 2 MHz	—	-36	—	dB
	F ≥ F0 + 3 MHz(1)	—	—	—	dB
	F ≤ F0 – 3 MHz	—	-39	—	dB
Image frequency	—	—	-29	—	dB
Adjacent channel to image frequency	F = F_{image} + 1 MHz	—	-38	—	dB
	F = F_{image} – 1 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_{image} – 1 MHz.

Table 7-13. 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 = F0 + 2 MHz	—	–7	—	dB
	F = F0 – 2 MHz	—	–7	—	dB
	F = F0 + 4 MHz(1)	—	—	—	dB
	F = F0 – 4 MHz	—	–34	—	dB
	F ≥ F0 + 6 MHz	—	–39	—	dB
	F ≤ F0 – 6 MHz	—	–39	—	dB
Image frequency	—	—	–27	—	dB
Adjacent channel to image frequency	F = F_{image} + 2 MHz	—	–39	—	dB
	F = F_{image} – 2 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 = F0 + 2 MHz.

Table 7-14. 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 = F0 + 1 MHz	—	–6	—	dB
	F = F0 – 1 MHz	—	–5	—	dB
	F = F0 + 2 MHz	—	–40	—	dB
	F = F0 – 2 MHz	—	–42	—	dB
	F ≥ F0 + 3 MHz(1)	—	—	—	dB
	F ≤ F0 – 3 MHz	—	–46	—	dB
Image frequency	—	—	–34	—	dB
Adjacent channel to image frequency	F = F_{image} + 1 MHz	—	–44	—	dB
	F = F_{image} – 1 MHz	—	–37	—	dB

[1] Refer to the value of Adjacent channel to image frequency when F = F_{image} – 1 MHz.

Table 7-15. Bluetooth LE - Receiver Characteristics - 500 Kbps

Parameter	Description	Min	Typ	Max	Unit
Sensitivity @30.8% PER	—	—	–99	—	dBm
Maximum received signal @30.8% PER	—	—	10	—	dBm
Co-channel C/I	—	—	3	—	dB
Adjacent channel selectivity C/I	F = F0 + 1 MHz	—	–5	—	dB
	F = F0 – 1 MHz	—	–7	—	dB
	F = F0 + 2 MHz	—	–39	—	dB
	F = F0 – 2 MHz	—	–40	—	dB
	F $\geq$ F0 + 3 MHz(1)	—	—	—	dB
	F $\leq$ F0 – 3 MHz	—	–40	—	dB
Image frequency	—	—	–34	—	dB
Adjacent channel to image frequency	F = F_{image} + 1 MHz	—	–43	—	dB
	F = F_{image} – 1 MHz	—	–38	—	dB

[1] Refer to the value of Adjacent channel to image frequency when F = F_{image} – 1 MHz.

8 Module Schematics

This is the reference design of the module.

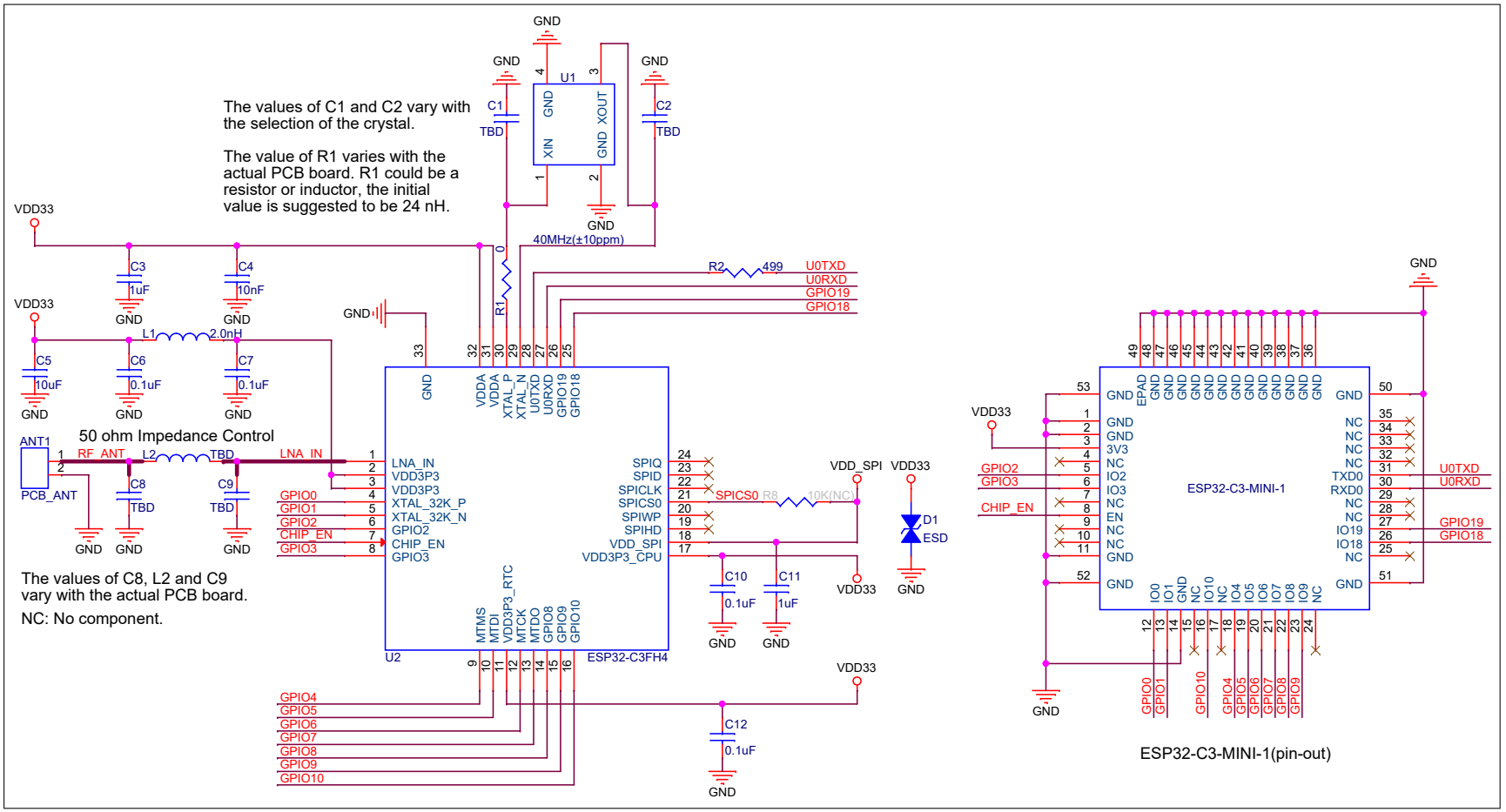

Figure 8-1. ESP32-C3-MINI-1 Schematics

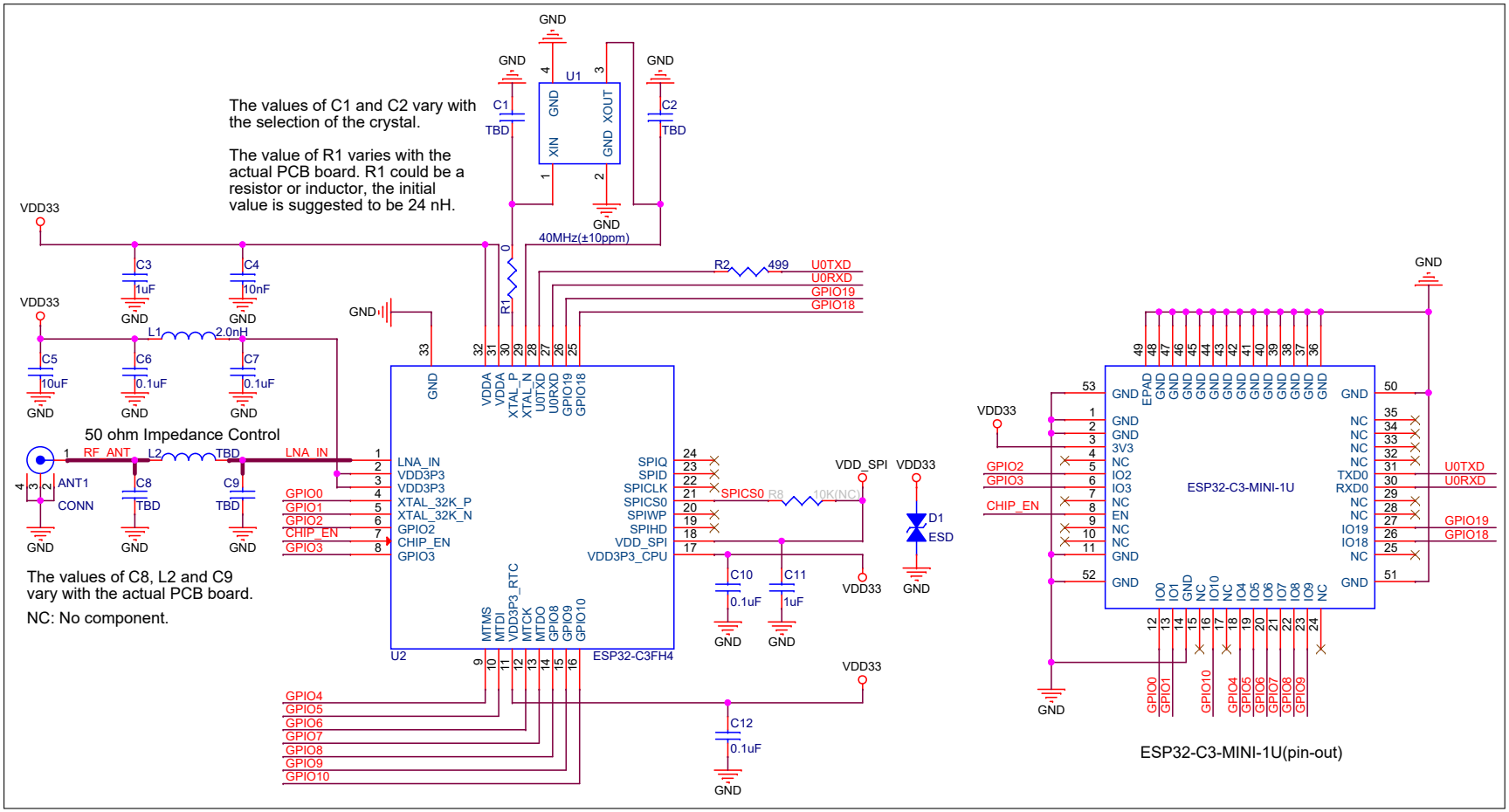

Figure 8-2. ESP32-C3-MINI-1U Schematics

9 Peripheral Schematics

This is the typical application circuit of the module connected with peripheral components (for example, power supply, antenna, reset button, JTAG interface, and UART interface).

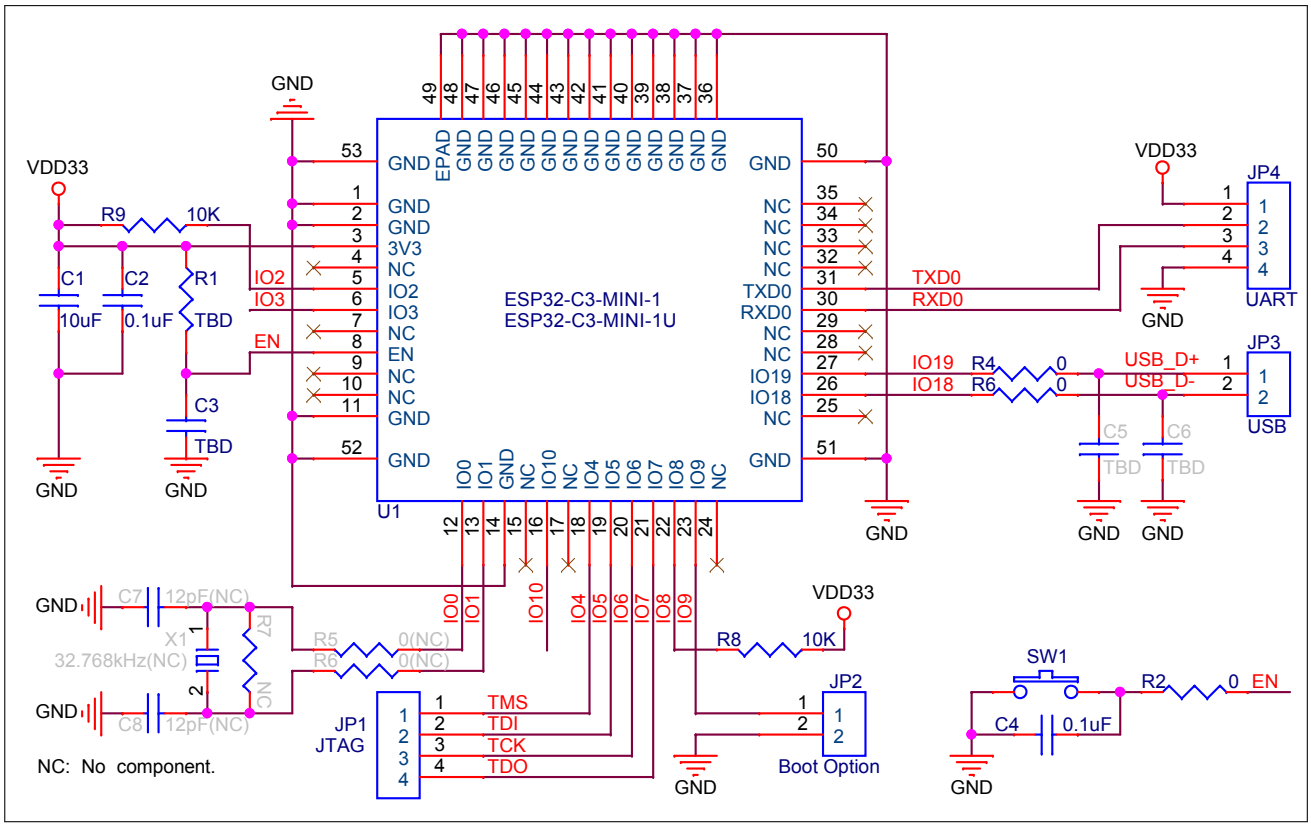

Figure 9-1. Peripheral Schematics

- Soldering the EPAD to the ground of the base board is not a must, however, it can optimize thermal performance. If you choose to solder it, please apply the correct amount of soldering paste. Too much soldering paste may increase the gap between the module and the baseboard. As a result, the adhesion between other pins and the baseboard may be poor.
- To ensure that the power supply to the ESP32-C3 chip is stable during power-up, it is advised to add an RC delay circuit at the EN pin. The recommended setting for the RC delay circuit is usually R = 10 kΩ and C = 1 μF. However, specific parameters should be adjusted based on the power-up timing of the module and the power-up and reset sequence timing of the chip. For ESP32-C3's power-up and reset sequence timing diagram, please refer Section 4.3 *Chip Power-up and Reset*.
- UART0 is used to download firmware and log output. When using the AT firmware, note that the UART GPIO is already configured. It is recommended to use the default configuration. Please refer to *ESP-AT User Guide for ESP32-C3* > Section *Hardware Connection*.

10 Physical Dimensions

10.1 Module Dimensions

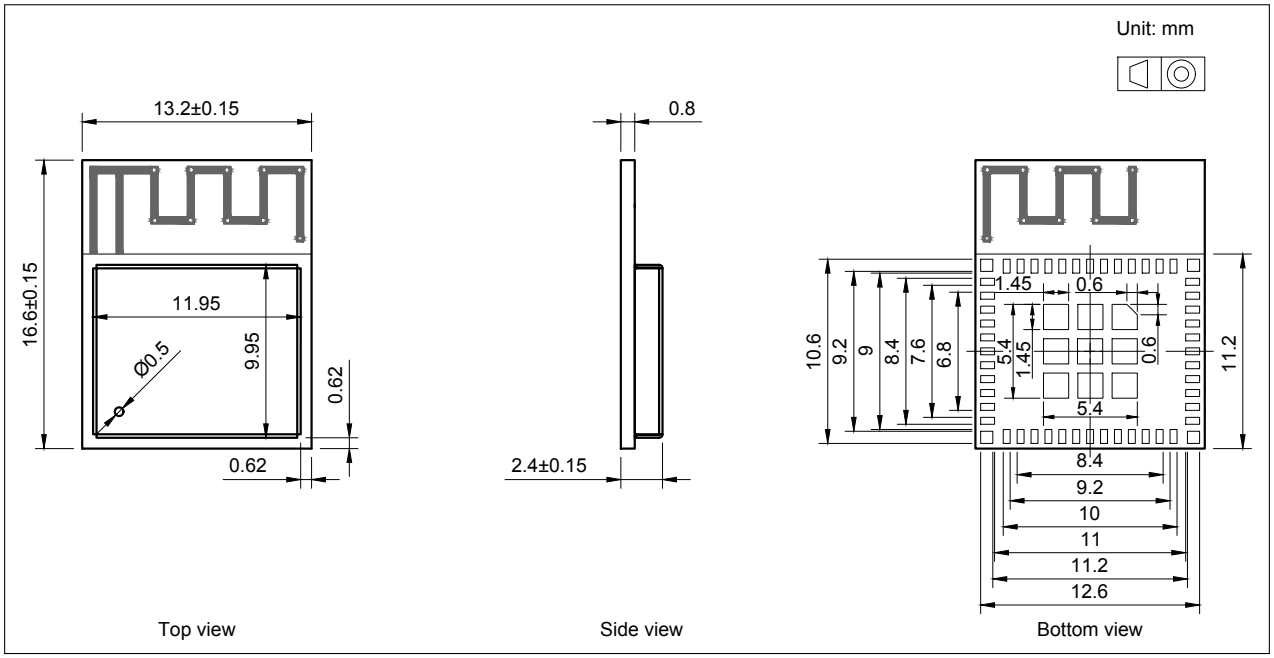

Figure 10-1. ESP32-C3-MINI-1 Physical Dimensions

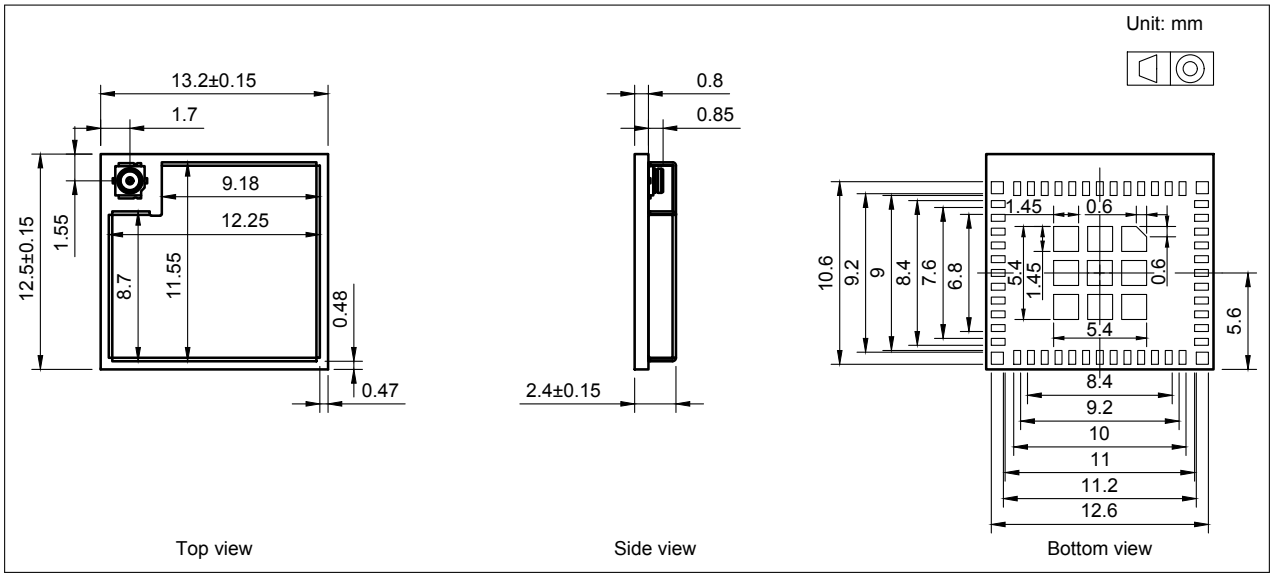

Figure 10-2. ESP32-C3-MINI-1U Physical Dimensions

Note:
For information about tape, reel, and product marking, please refer to *ESP32-C3 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 10-3 *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
- AMC connector from Amphenol

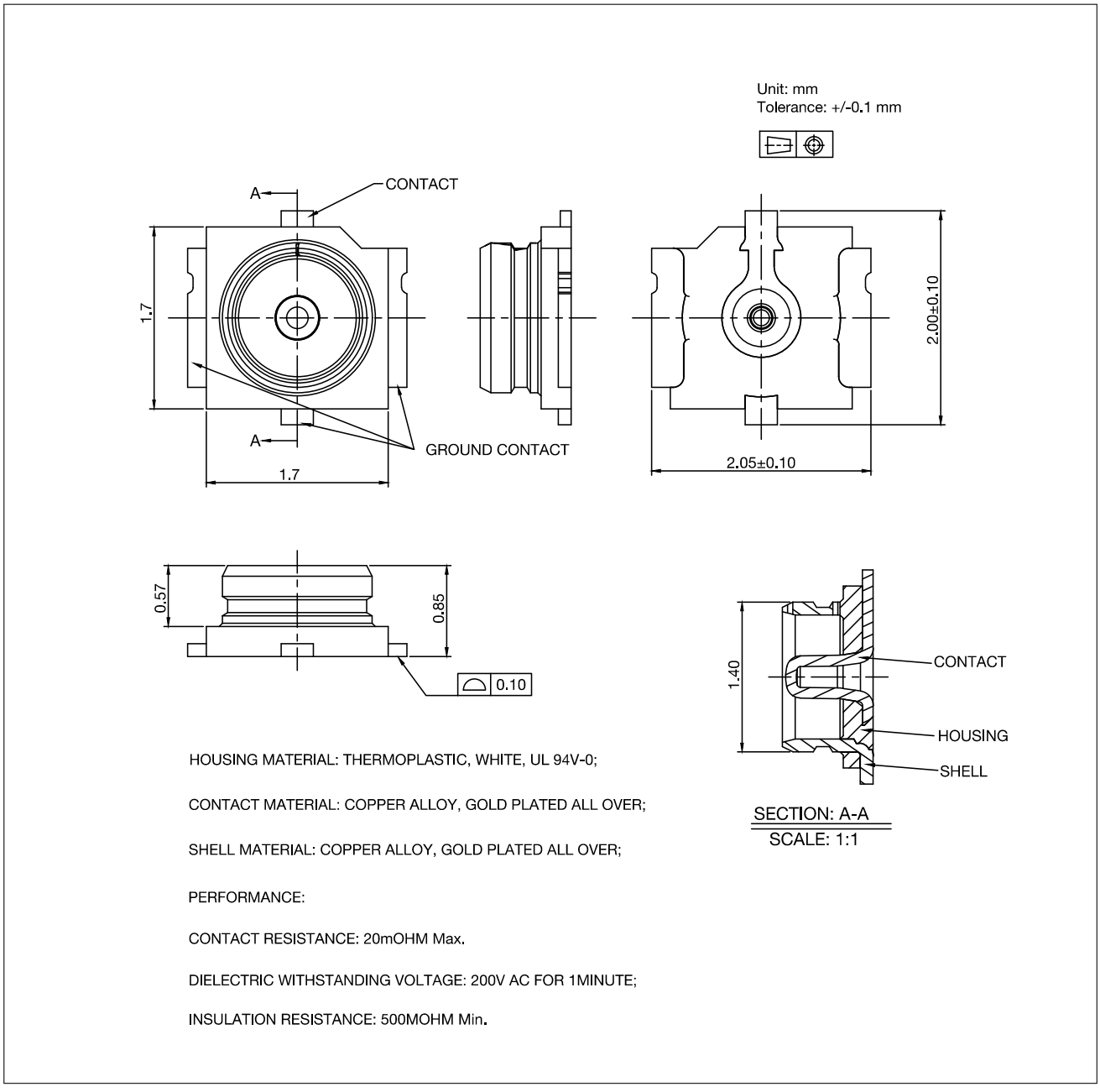

Figure 10-3. Dimensions of External Antenna Connector

The external antenna used for ESP32-C3-MINI-1U during certification testing is the third generation monopole antenna, with material code TFPD08H10060011.

The module does not include an external antenna upon shipment. If needed, select a suitable external

antenna based on the product's usage environment and performance requirements.

It is recommended to select an antenna that meets the following requirements:

- 2.4 GHz band
- 50 Ω impedance
- The maximum gain does not exceed 2.33 dBi, the gain of the antenna used for certification
- The connector matches the specifications shown in Figure 10-3 *Dimensions of External Antenna Connector*

Note:
If you use an external antenna of a different type or gain, additional testing, such as EMC, may be required beyond the existing antenna test reports for Espressif modules. Specific requirements depend on the certification type.

11 PCB Layout Recommendations

11.1 PCB Land Pattern

This section provides the following resources for your reference:

- Figures for recommended PCB land patterns with all the dimensions needed for PCB design. See Figure 11-1 *ESP32-C3-MINI-1 Recommended PCB Land Pattern* and Figure 11-2 *ESP32-C3-MINI-1U Recommended PCB Land Pattern*.
- Source files of recommended PCB land patterns to measure dimensions not covered in Figure 11-1 and Figure 11-2. You can view the source files for ESP32-C3-MINI-1 and ESP32-C3-MINI-1U with Autodesk Viewer.
- 3D models of ESP32-C3-MINI-1 and ESP32-C3-MINI-1U. Please make sure that you download the 3D model file in .STEP format. Beware that some browsers might add .txt.

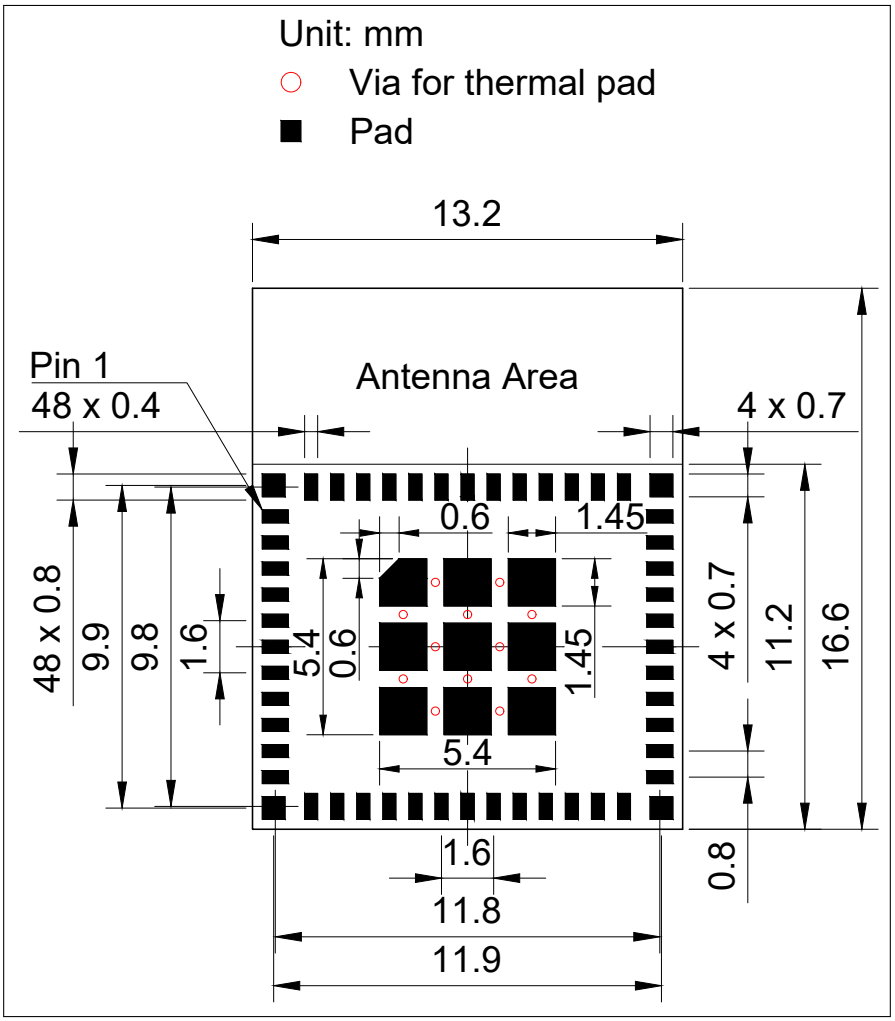

Figure 11-1. ESP32-C3-MINI-1 Recommended PCB Land Pattern

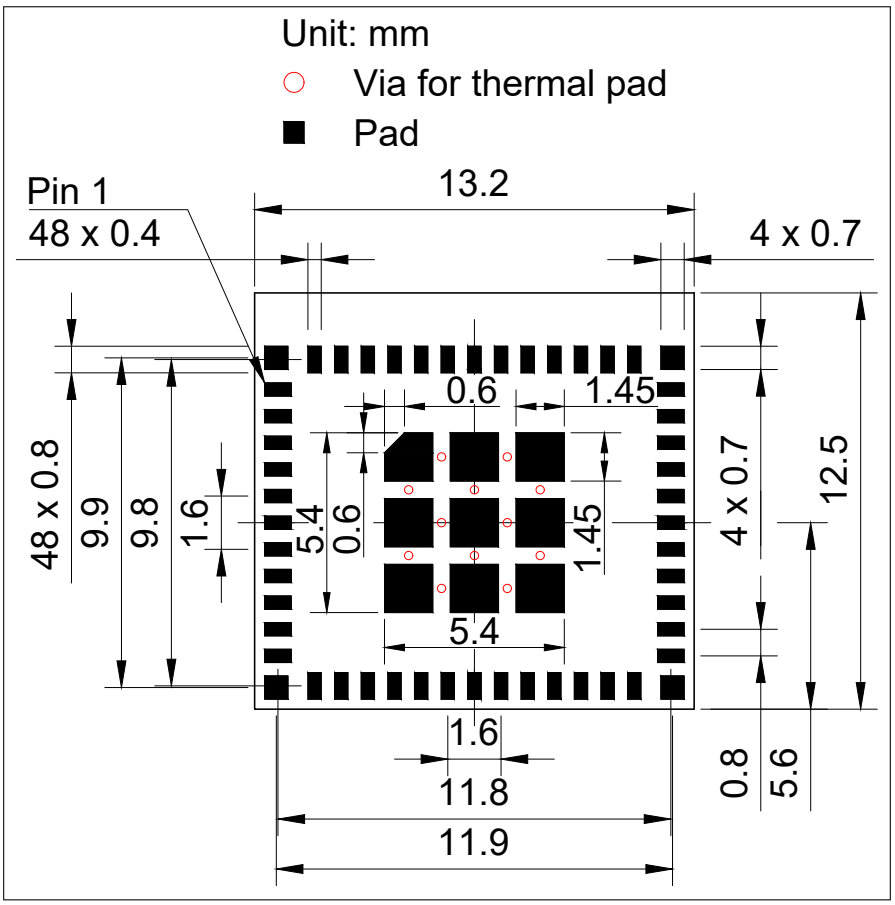

Figure 11-2. ESP32-C3-MINI-1U Recommended PCB Land Pattern

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 *General Principles of PCB Layout for Modules*.

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 °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±5 °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): ±2000 V
- Charged-device model (CDM): ±500 V

12.3 Reflow Profile

Solder the module in a single reflow.

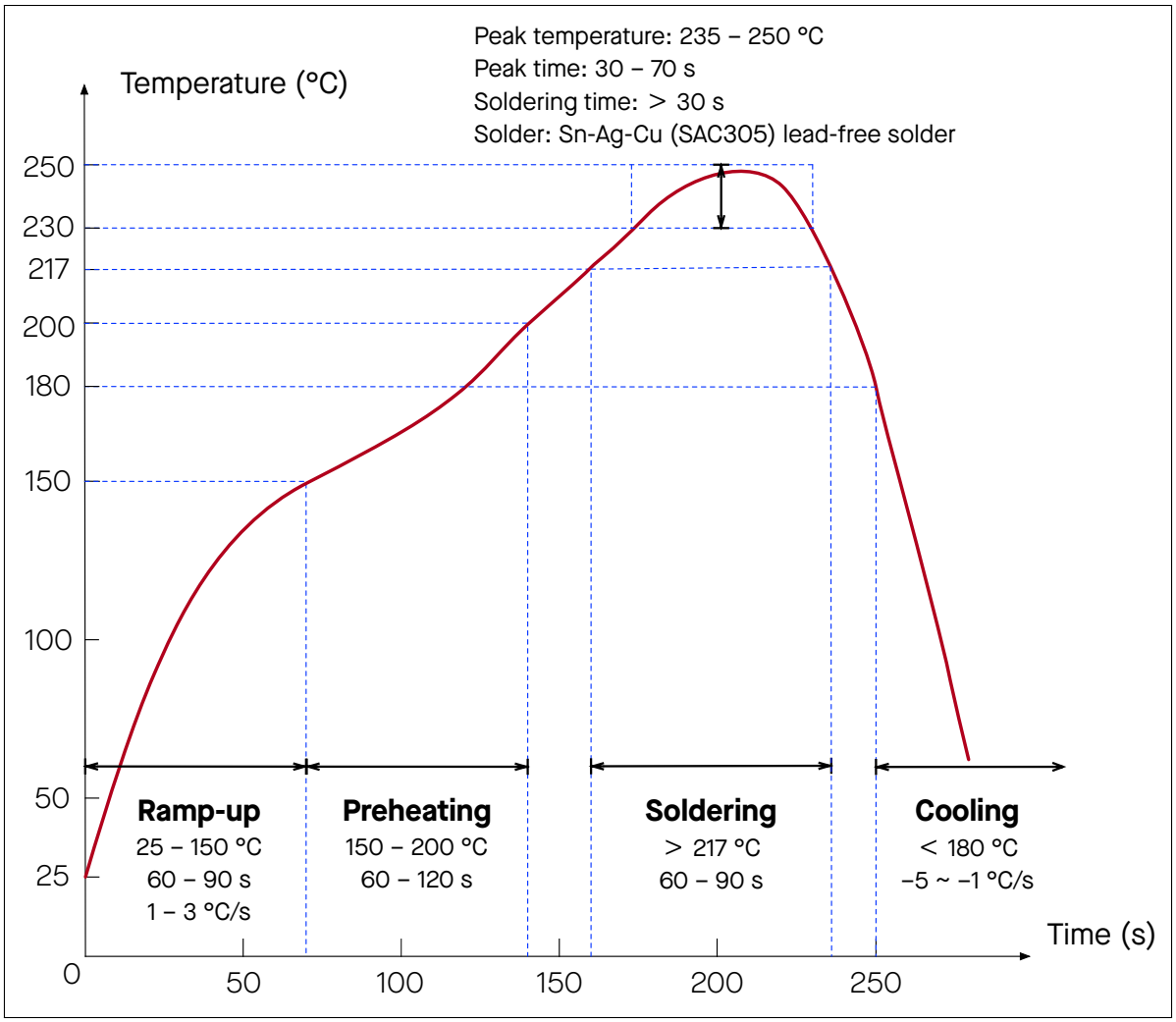

Figure 12-1. Reflow Profile

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**.

Datasheet Versioning

Datasheet Version	Status	Watermark	Definition
v0.1 ~ v0.5 (excluding v0.5)	Draft	Confidential	This datasheet is under development for products in the design stage. Specifications may change without prior notice.
v0.5 ~ v1.0 (excluding v1.0)	Preliminary release	Preliminary	This datasheet is actively updated for products in the verification stage. Specifications may change before mass production, and the changes will be documentation in the datasheet's Revision History.
v1.0 and higher	Official release	—	This datasheet is publicly released for products in mass production. Specifications are finalized, and major changes will be communicated via Product Change Notifications (PCN).
Any version	—	Not Recommended for New Design (NRND)[1]	This datasheet is updated less frequently for products not recommended for new designs.
Any version	—	End of Life (EOL)[2]	This datasheet is no longer mtained for products that have reached end of life.

[1] Watermark will be added to the datasheet title page only when all the product variants covered by this datasheet are not recommended for new designs.

[2] Watermark will be added to the datasheet title page only when all the product variants covered by this datasheet have reached end of life.

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/
- *ESP-FAQ* – A summary document of frequently asked questions released by Espressif.
  https://espressif.com/projects/esp-faq/en/latest/index.html
- *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

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  https://espressif.com/en/contact-us/sales-questions

Revision History

Date	Version	Release notes
2026-05-06	v2.2	• Added ESP32-C3-MINI-1-H8X • Table 1-1 *ESP32-C3-MINI-1 (ANT) Series Comparison*[1] and Table 1-2 *ESP32-C3-MINI-1U (CONN) Series Comparison*: Updated "Ordering Code" to "Part Number"
2025-07-14	v2.1	• Added Section 4.3 *Chip Power-up and Reset* • Added Section 6.5 *Memory Specifications* • Section 9 *Peripheral Schematics*: Added a note about AT communication using UART0 • Section 10.2 *Dimensions of External Antenna Connector*: Added the external antenna information for certification • Added Datasheet Versioning
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	• Table 1-1 *ESP32-C3-MINI-1 (ANT) Series Comparison*[1] and 1-2 *ESP32-C3-MINI-1U (CONN) Series Comparison*: – 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 6-5 *Current Consumption for Bluetooth LE in Active Mode*
2024-09-19	v1.7	• Table 1-2 *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: – 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 12-1 *Reflow Profile*

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Date	Version	Release notes
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	• 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)
2024-05-15	v1.4	• Updated note 5 of Table *ESP32-C3-MINI-1 (ANT) Series Comparison*[1] 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	• Added a new variant ESP32-C3-MINI-1-H4-AZ • Changed Table *Ordering Information* to Table *ESP32-C3-MINI-1 (ANT) Series Comparison*[1] 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	• Added a note under Table *Ordering Information* • Updated Chapter 8 *Module Schematics*
2021-06-21	v1.0	• 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

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Date	Version	Release notes
2021-02-22	v0.6	Updated the value of C7 to 0.1 μF in Chapter 8 *Module Schematics*
2021-02-05	v0.5	Preliminary release

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