ESP32-S2-MINI-1 & ESP32-S2-MINI-1U

Datasheet

2.4 GHz Wi-Fi (802.11 b/g/n) module
Built around ESP32-S2 series of SoC, Xtensa® single-core 32-bit LX7 microprocessor
4 MB flash and optional 2 MB PSRAM in chip package
37 GPIOs, rich set of peripherals
On-board PCB antenna or external antenna connector

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About This Document

This document provides the specifications for ESP32-S2-MINI-1 and ESP32-S2-MINI-1U modules.

Document Updates

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1 Module Overview

1.1 Features

CPU and On-Chip Memory

- ESP32-S2FH4 or ESP32-S2FN4R2 chip embedded, Xtensa® single-core 32-bit LX7 microprocessor, up to 240 MHz
- 128 KB ROM
- 320 KB SRAM
- 16 KB SRAM in RTC
- 4 MB embedded flash
- 2 MB embedded PSRAM (ESP32-S2FN4R2 only)

Wi-Fi

- 802.11 b/g/n
- Bit rate: 802.11n up to 150 Mbps
- A-MPDU and A-MSDU aggregation
- 0.4 μs guard interval support
- Center frequency range of operating channel: 2412 ~ 2484 MHz

Peripherals

- GPIO, SPI, LCD, UART, I2C, I2S, Camera interface, IR, pulse counter, LED PWM, TWAI® (compatible with ISO 11898-1), USB OTG 1.1, ADC, DAC, touch sensor, temperature sensor

Integrated Components on Module

- 40 MHz crystal oscillator

Antenna Options

- On-board PCB antenna (ESP32-S2-MINI-1)
- External antenna via a connector (ESP32-S2-MINI-1U)

Operating Conditions

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

Certification

- Green certification: RoHS/REACH
- RF certification: FCC/CE-RED/SRRC/IC

Test

- HTOL/HTSL/uHAST/TCT/ESD

1.2 Description

ESP32-S2-MINI-1 and ESP32-S2-MINI-1U are two powerful, generic Wi-Fi MCU modules that have a rich set of peripherals. They are an ideal choice for a wide variety of application scenarios relating to Internet of Things (IoT), wearable electronics and smart home.

The ordering information of the two modules is listed as follows:

Table 1: Ordering Information

Module	Ordering code	Chip embedded	Module dimensions (mm)
ESP32-S2-MINI-1 (ANT)	ESP32-S2-MINI-1-N4	ESP32-S2FH4	15.4 × 20.0 × 2.4
	ESP32-S2-MINI-1-N4R2	ESP32-S2FN4R2	
ESP32-S2-MINI-1U (CONN)	ESP32-S2-MINI-1U-N4	ESP32-S2FH4	15.4 × 15.4 × 2.4
	ESP32-S2-MINI-1U-N4R2	ESP32-S2FN4R2	
Notes: For dimensions of the external antenna connector, please see Section 7.3.			

ESP32-S2-MINI-1 comes with a on-board PCB antenna, and ESP32-S2-MINI-1U with an U.FL connector for external antenna. Both ESP32-S2-MINI-1 and ESP32-S2-MINI-1U have two variants:

- integrating the ESP32-S2FH4 chip (which is embedded with a 4 MB high-temperature flash), or
- integrating the ESP32-S2FN4R2 chip (which is embedded with a 4 MB flash and 2 MB PSRAM)

The two variants only differ in the chip integrated. In this datasheet unless otherwise stated, ESP32-S2-MINI-1 refers to both ESP32-S2-MINI-1-N4 and ESP32-S2-MINI-1-N4R2, whereas ESP32-S2-MINI-1U refers to both ESP32-S2-MINI-1U-N4 and ESP32-S2-MINI-1U-N4R2.

The ESP32-S2FH4 chip and the ESP32-S2FN4R2 chip falls into the same category, namely ESP32-S2 chip series. ESP32-S2 series of chips has an Xtensa® 32-bit LX7 CPU that operates at up to 240 MHz. It has a low-power co-processor that can be used instead of the CPU to save power while performing tasks that do not require much computing power, such as monitoring of peripherals.

ESP32-S2 series integrates a rich set of peripherals, ranging from SPI, I2S, UART, I2C, LED PWM, TWAI®, LCD, Camera interface, ADC, DAC, touch sensor, temperature sensor, as well as up to 43 GPIOs. It also includes a full-speed USB On-The-Go (OTG) interface to enable USB communication.

The ESP32-S2FH4 chip and the ESP32-S2FN4R2 chip vary in:

- temperature of embedded flash
- whether a PSRAM is embedded

For details, please refer to Section *Family Member Comparison* in *ESP32-S2 Series Datasheet*.

1.3 Applications

- Generic Low-power IoT Sensor Hub
- Generic Low-power IoT Data Loggers
- Cameras for Video Streaming
- Over-the-top (OTT) Devices
- USB Devices
- Speech Recognition
- Image Recognition
- Mesh Network
- Home Automation
- Smart Home Control Panel
- Smart Building
- Industrial Automation
- Smart Agriculture
- Audio Applications
- Health Care Applications
- Wi-Fi-enabled Toys
- Wearable Electronics
- Retail & Catering Applications
- Smart POS Machines

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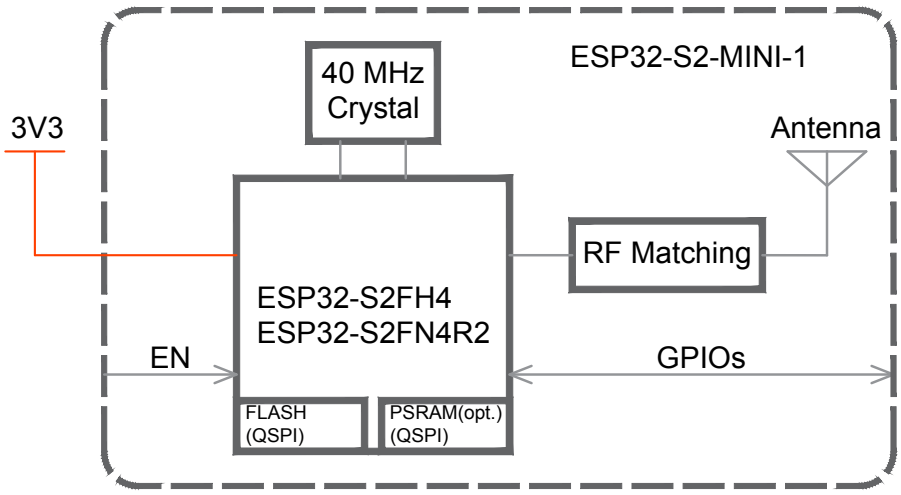

Figure 1: ESP32-S2-MINI-1 Block Diagram

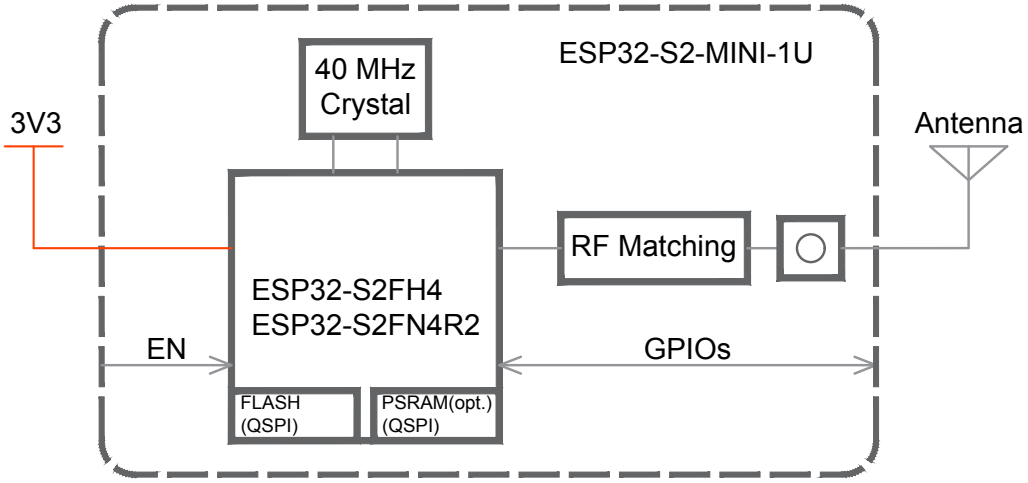

Figure 2: ESP32-S2-MINI-1U Block Diagram

3 Pin Definitions

3.1 Pin Layout

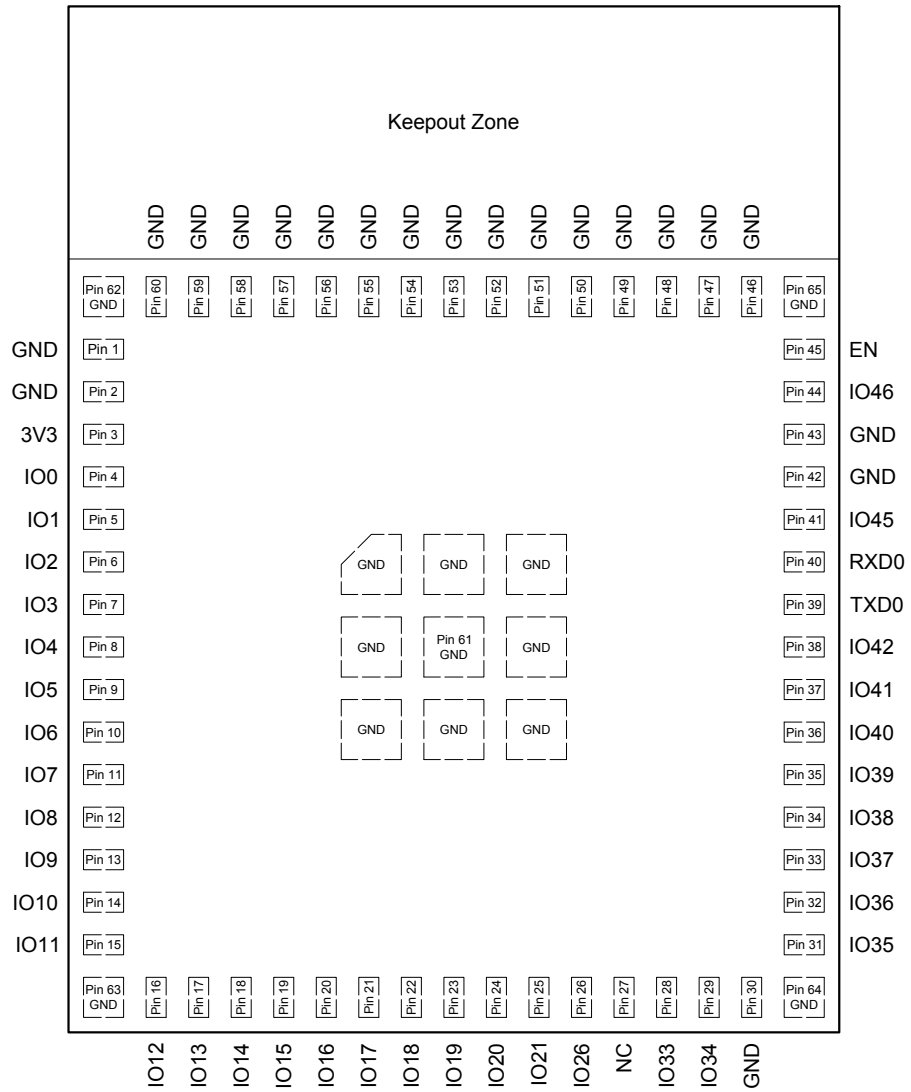

Figure 3: ESP32-S2-MINI-1 Pin Layout (Top View)

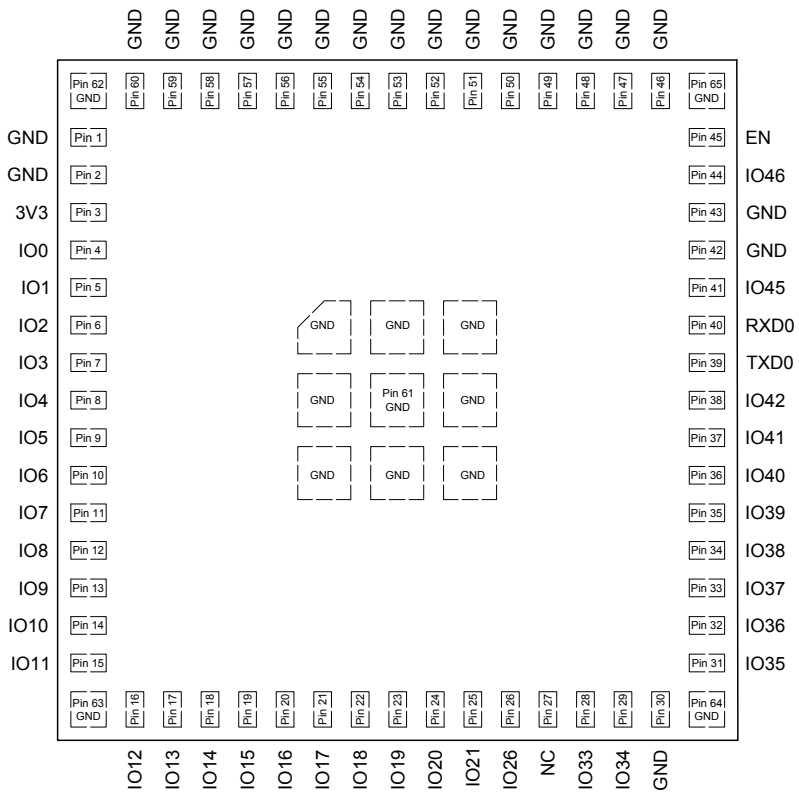

Figure 4: ESP32-S2-MINI-1U Pin Layout (Top View)

Note:
The pin diagram shows the approximate location of pins on the module. For the actual mechanical diagram, please refer to Figure 7.1 *Physical Dimensions*.

3.2 Pin Description

The module has 65 pins. See pin definitions in Table 2.

Table 2: Pin Definitions

Name	No.	Type	Function
GND	1, 2, 30, 42, 43, 46-65	P	Ground
3V3	3	P	Power supply
IO0	4	I/O/T	RTC_GPIO0, GPIO0
IO1	5	I/O/T	RTC_GPIO1, GPIO1, TOUCH1, ADC1_CH0
IO2	6	I/O/T	RTC_GPIO2, GPIO2, TOUCH2, ADC1_CH1
IO3	7	I/O/T	RTC_GPIO3, GPIO3, TOUCH3, ADC1_CH2
IO4	8	I/O/T	RTC_GPIO4, GPIO4, TOUCH4, ADC1_CH3
IO5	9	I/O/T	RTC_GPIO5, GPIO5, TOUCH5, ADC1_CH4
IO6	10	I/O/T	RTC_GPIO6, GPIO6, TOUCH6, ADC1_CH5
IO7	11	I/O/T	RTC_GPIO7, GPIO7, TOUCH7, ADC1_CH6
IO8	12	I/O/T	RTC_GPIO8, GPIO8, TOUCH8, ADC1_CH7

Name	No.	Type	Function
IO9	13	I/O/T	RTC_GPIO9, GPIO9, TOUCH9, ADC1_CH8, FSPIHD
IO10	14	I/O/T	RTC_GPIO10, GPIO10, TOUCH10, ADC1_CH9, FSPICS0, FSPIIO4
IO11	15	I/O/T	RTC_GPIO11, GPIO11, TOUCH11, ADC2_CH0, FSPID, FSPIIO5
IO12	16	I/O/T	RTC_GPIO12, GPIO12, TOUCH12, ADC2_CH1, FSPICLK, FSPIIO6
IO13	17	I/O/T	RTC_GPIO13, GPIO13, TOUCH13, ADC2_CH2, FSPIQ, FSPIIO7
IO14	18	I/O/T	RTC_GPIO14, GPIO14, TOUCH14, ADC2_CH3, FSPIWP, FSPIDQS
IO15	19	I/O/T	RTC_GPIO15, GPIO15, U0RTS, ADC2_CH4, XTAL_32K_P
IO16	20	I/O/T	RTC_GPIO16, GPIO16, U0CTS, ADC2_CH5, XTAL_32K_N
IO17	21	I/O/T	RTC_GPIO17, GPIO17, U1TXD, ADC2_CH6, DAC_1
IO18	22	I/O/T	RTC_GPIO18, GPIO18, U1RXD, ADC2_CH7, DAC_2, CLK_OUT3
IO19	23	I/O/T	RTC_GPIO19, GPIO19, U1RTS, ADC2_CH8, CLK_OUT2, USB_D-
IO20	24	I/O/T	RTC_GPIO20, GPIO20, U1CTS, ADC2_CH9, CLK_OUT1, USB_D+
IO21	25	I/O/T	RTC_GPIO21, GPIO21
IO26	26	I/O/T	SPICS1, GPIO26
NC	27	—	NC
IO33	28	I/O/T	SPIIO4, GPIO33, FSPIHD
IO34	29	I/O/T	SPIIO5, GPIO34, FSPICS0
IO35	31	I/O/T	SPIIO6, GPIO35, FSPID
IO36	32	I/O/T	SPIIO7, GPIO36, FSPICLK
IO37	33	I/O/T	SPIDQS, GPIO37, FSPIQ
IO38	34	I/O/T	GPIO38, FSPIWP
IO39	35	I/O/T	MTCK, GPIO39, CLK_OUT3
IO40	36	I/O/T	MTDO, GPIO40, CLK_OUT2
IO41	37	I/O/T	MTDI, GPIO41, CLK_OUT1
IO42	38	I/O/T	MTMS, GPIO42
TXD0	39	I/O/T	U0TXD, GPIO43, CLK_OUT1
RXD0	40	I/O/T	U0RXD, GPIO44, CLK_OUT2
IO45	41	I/O/T	GPIO45
IO46	44	I	GPIO46
EN	45	I	High: on, enables the chip. Low: off, the chip powers off. Note: Do not leave the EN pin floating.

Notice:

1. IO18 on the module is pulled up to VDD33 through a 10 kΩ resistor. For details, please refer to Figure 5 and Figure 6.
2. IO26 is used by the embedded PSRAM on the ESP32-S2-MINI-1-N4R2 and ESP32-S2-MINI-1U-N4R2 modules, and cannot be used for other purposes.
3. For peripheral pin configurations, please refer to *ESP32-S2 Series Datasheet*.

3.3 Strapping Pins

ESP32-S2 series of chips has three strapping pins: GPIO0, GPIO45, GPIO46. The pin-pin mapping between ESP32-S2 series of chips and the module is as follows, which can be seen in Chapter 5 *Schematics*:

- GPIO0 = IO0
- GPIO45 = IO45
- GPIO46 = IO46

Software can read the values of corresponding bits from register "GPIO_STRAPPING".

During the chip's system reset (power-on-reset, RTC watchdog reset, brownout reset, analog super watchdog reset, and crystal clock glitch detection reset), the latches of the strapping pins sample the voltage level as strapping bits of "0" or "1", and hold these bits until the chip is powered down or shut down.

IO0, IO45 and IO46 are connected to the internal pull-up/pull-down. If they are unconnected or the connected external circuit is high-impedance, the internal weak pull-up/pull-down will determine the default input level of these strapping pins.

To change the strapping bit values, users can apply the external pull-down/pull-up resistances, or use the host MCU's GPIOs to control the voltage level of these pins when powering on ESP32-S2 series of chips.

After reset, the strapping pins work as normal-function pins.

Refer to Table 3 for a detailed boot-mode configuration of the strapping pins.

Table 3: Strapping Pins

VDD_SPI Voltage [1]			
Pin	Default	3.3 V	1.8 V
IO45 [3]	Pull-down	0	1
Booting Mode[2]			
Pin	Default	SPI Boot	Download Boot
IO0	Pull-up	1	0
IO46	Pull-down	Don't-care	0
Enabling/Disabling ROM Code Print During Booting [4] [5]			
Pin	Default	Enabled	Disabled
IO46	Pull-down	See the fifth note	See the fifth note

Note:

1. Firmware can configure register bits to change the settings of "VDD_SPI Voltage".
2. The strapping combination of GPIO46 = 1 and GPIO0 = 0 is invalid and will trigger unexpected behavior.
3. Internal pull-up resistor (R1) for IO45 is not populated in the module, as the flash in the module works at 3.3 V by default (output by VDD_SPI). Please make sure IO45 will not be pulled high when the module is powered up by external circuit.
4. ROM code can be printed over TXD0 (by default) or DAC_1 (IO17), depending on the eFuse bit.
5. When eFuse UART_PRINT_CONTROL value is:
   0, print is normal during boot and not controlled by IO46.
   1 and IO46 is 0, print is normal during boot; but if IO46 is 1, print is disabled.

2 and IO46 is 0, print is disabled; but if IO46 is 1, print is normal.

3, print is disabled and not controlled by IO46.

4 Electrical Characteristics

4.1 Absolute Maximum Ratings

Table 4: Absolute Maximum Ratings

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

4.2 Recommended Operating Conditions

Table 5: 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	–40	—	85	°C
Humidity	Humidity condition	—	—	85	%RH

4.3 DC Characteristics (3.3 V, 25 °C)

Table 6: 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	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

Note:

1. VDD is the I/O voltage for a particular power domain of pins.
2. V_{OH} and V_{OL} are measured using high-impedance load.

4.4 Current Consumption Characteristics

With the use of advanced power-management technologies, the module can switch between different power modes. For details on different power modes, please refer to Section *RTC and Low-Power Management* in *ESP32-S2 Series Datasheet*.

Table 7: Current Consumption Depending on RF Modes

Work mode	Description		Peak (mA)
Active (RF working)	TX	802.11b, 20 MHz, 1 Mbps, @19.5 dBm	310
		802.11g, 20 MHz, 54 Mbps, @15 dBm	220
		802.11n, 20 MHz, MCS7, @13 dBm	200
		802.11n, 40 MHz, MCS7, @13 dBm	160
	RX	802.11b/g/n, 20 MHz	63
		802.11n, 40 MHz	68

Note:

- The current consumption measurements are taken with a 3.3 V supply at 25 °C of ambient temperature at the RF port. All transmitters' measurements are based on a 100% duty cycle.
- The current consumption figures for in RX mode are for cases when the peripherals are disabled and the CPU idle.

Table 8: Current Consumption Depending on Work Modes

Work mode	Description		Current consumption (Typ)
Modem-sleep	The CPU is powered on	240 MHz	22 mA
		160 MHz	17 mA
		Normal speed: 80 MHz	14 mA
Light-sleep	—		550 μA
Deep-sleep	The ULP co-processor is powered on.		235 μA
	ULP sensor-monitored pattern		22 μA @1% duty
	RTC timer + RTC memory		25 μA
	RTC timer only		20 μA
Power off	CHIP_PU is set to low level, the chip is powered off.		1 μA

Note:

- The current consumption figures in Modem-sleep mode are for cases where the CPU is powered on and the cache idle.
- When Wi-Fi is enabled, the chip switches between Active and Modem-sleep modes. Therefore, current consumption changes accordingly.

- In Modem-sleep mode, the CPU frequency changes automatically. The frequency depends on the CPU load and the peripherals used.
- During Deep-sleep, when the ULP co-processor is powered on, peripherals such as GPIO and I2C are able to operate.
- The "ULP sensor-monitored pattern" refers to the mode where the ULP coprocessor or the sensor works periodically. When touch sensors work with a duty cycle of 1%, the typical current consumption is 22 μA.

4.5 Wi-Fi RF Characteristics

4.5.1 Wi-Fi RF Standards

Table 9: Wi-Fi RF Standards

Name		Description
Center frequency range of operating channel ^{note1}		2412 ~ 2484 MHz
Wi-Fi wireless standard		IEEE 802.11b/g/n
Data rate	20 MHz	11b: 1, 2, 5.5 and 11 Mbps 11g: 6, 9, 12, 18, 24, 36, 48, 54 Mbps 11n: MCS0-7, 72.2 Mbps (Max)
	40 MHz	11n: MCS0-7, 150 Mbps (Max)
Antenna type		PCB antenna, IPEX antenna

1. Device should operate in the center frequency range allocated by regional regulatory authorities. Target center frequency range is configurable by software.
2. For the modules that use IPEX antennas, the output impedance is 50 Ω. For other modules without IPEX antennas, users do not need to concern about the output impedance.

4.5.2 Transmitter Characteristics

Table 10: Transmitter Characteristics

Parameter	Rate	Typ	Unit
TX Power ^{note1}	11b, 1 Mbps	19.5	dBm
	11b, 11 Mbps	19.5	
	11g, 6 Mbps	18	
	11g, 54 Mbps	15	
	11n, HT20, MCS0	18	
	11n, HT20, MCS7	13.5	
	11n, HT40, MCS0	18	
	11n, HT40, MCS7	13.5	

1. Target TX power is configurable based on device or certification requirements.

4.5.3 Receiver Characteristics

Table 11: Receiver Characteristics

Parameter	Rate	Typ	Unit
RX Sensitivity	1 Mbps	–97	dBm
	2 Mbps	–95	
	5.5 Mbps	–93	
	11 Mbps	–88	
	6 Mbps	–92	
	9 Mbps	–91	
	12 Mbps	–89	
	18 Mbps	–86	
	24 Mbps	–83	
	36 Mbps	–80	
	48 Mbps	–76	
	54 Mbps	–74	
	11n, HT20, MCS0	–92	
	11n, HT20, MCS1	–88	
	11n, HT20, MCS2	–85	
	11n, HT20, MCS3	–82	
	11n, HT20, MCS4	–79	
	11n, HT20, MCS5	–75	
	11n, HT20, MCS6	–73	
	11n, HT20, MCS7	–72	
	11n, HT40, MCS0	–89	
	11n, HT40, MCS1	–85	
	11n, HT40, MCS2	–83	
	11n, HT40, MCS3	–79	
	11n, HT40, MCS4	–76	
	11n, HT40, MCS5	–72	
	11n, HT40, MCS6	–70	
	11n, HT40, MCS7	–68	
RX Maximum Input Level	11b, 1 Mbps	5	dBm
	11b, 11 Mbps	5	
	11g, 6 Mbps	5	
	11g, 54 Mbps	0	
	11n, HT20, MCS0	5	
	11n, HT20, MCS7	0	
	11n, HT40, MCS0	5	
	11n, HT40, MCS7	0	
Adjacent Channel Rejection	11b, 11 Mbps	35	dB
	11g, 6 Mbps	31	
	11g, 54 Mbps	14	
	11n, HT20, MCS0	31	
	11n, HT20, MCS7	13	
	11n, HT40, MCS0	19	
	11n, HT40, MCS7	8	

5 Schematics

This is the reference design of the module.

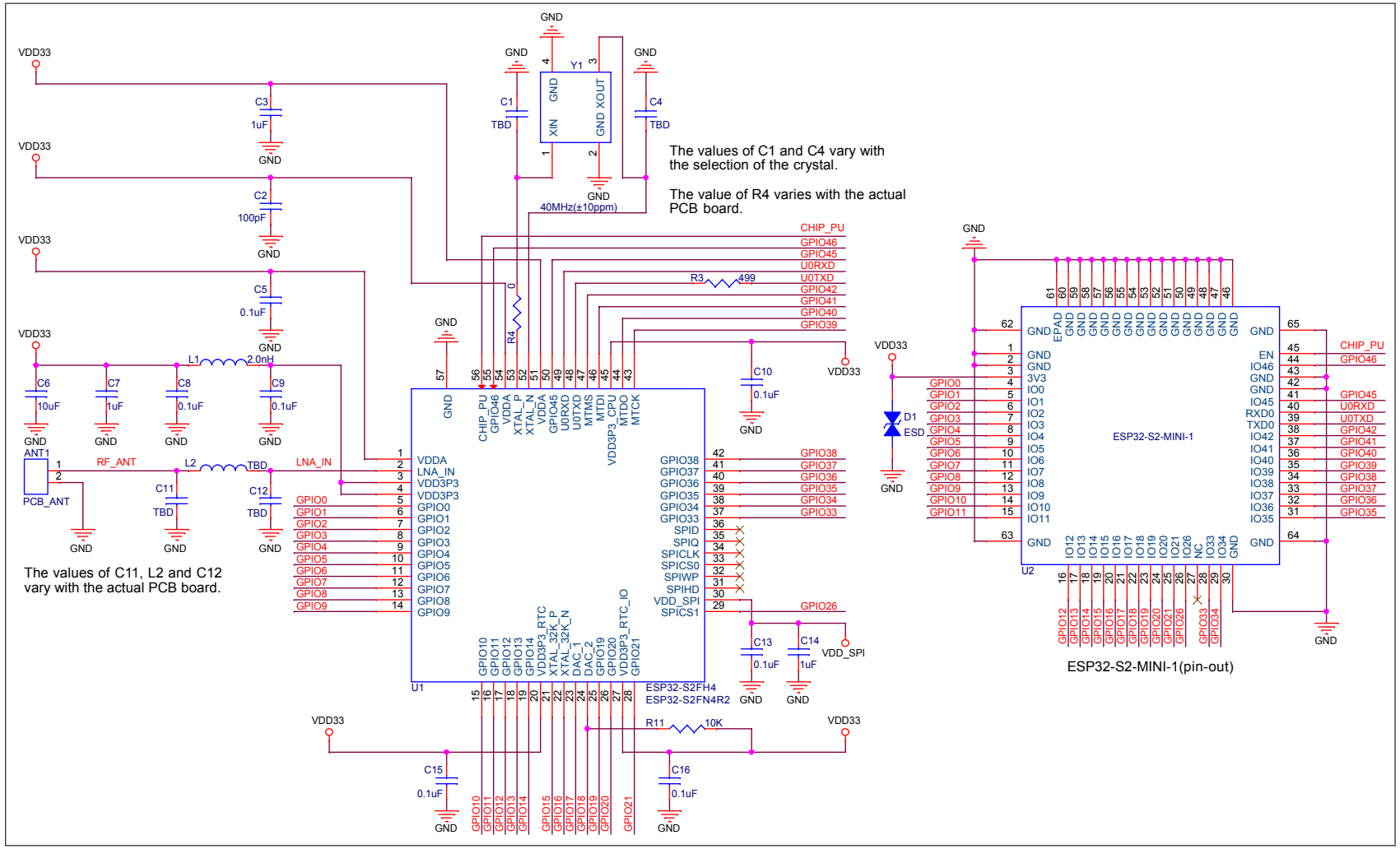

Figure 5: ESP32-S2-MINI-1 Schematics

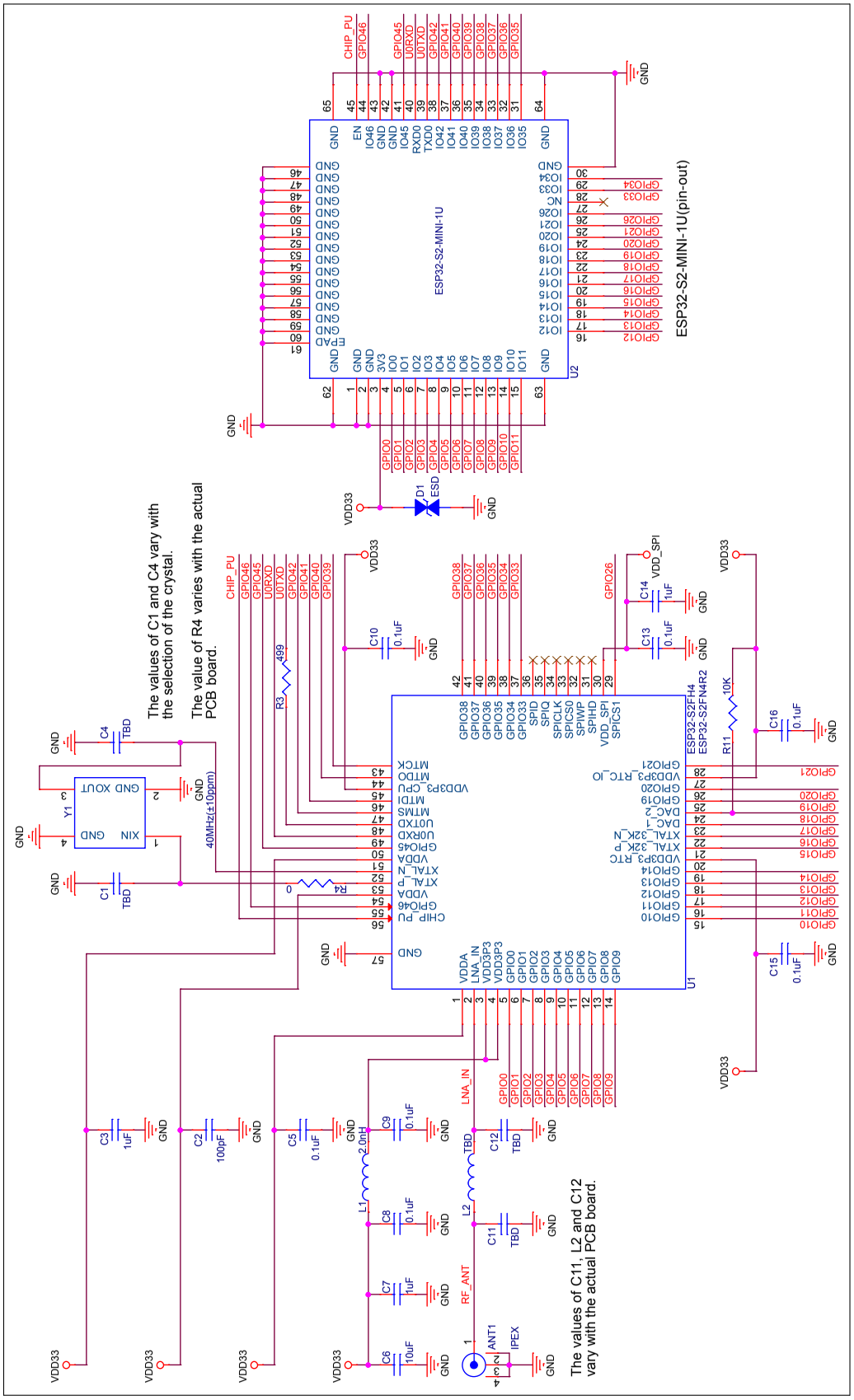

Figure 6: ESP32-S2-MINI-1U Schematics

6 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).

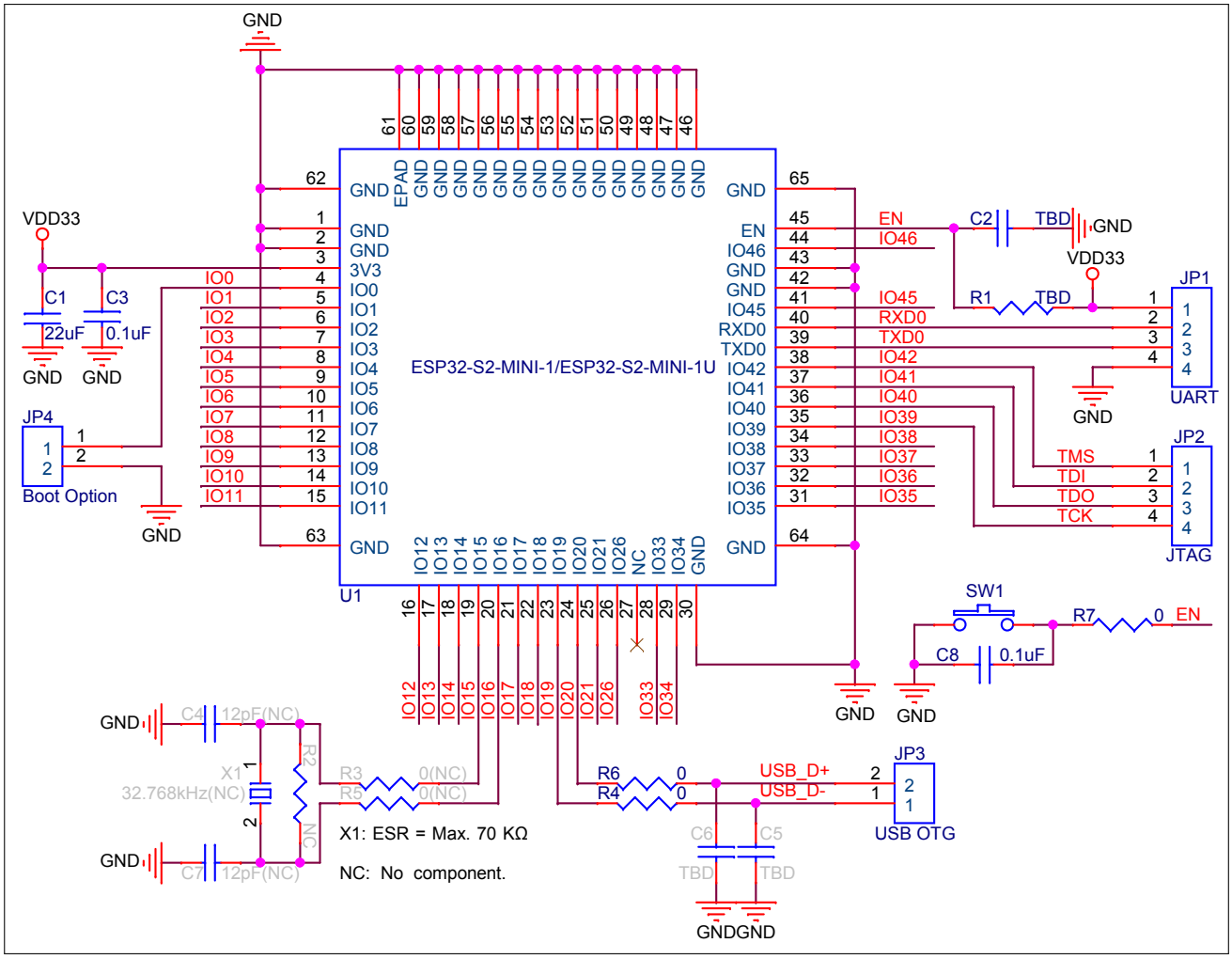

Figure 7: Peripheral Schematics

Note:

- Soldering the EPAD to the ground of the base board is not a must, though doing so can get optimized thermal performance. If users do want to solder it, they need to ensure that the correct quantity of soldering paste is applied.
- To ensure the power supply to the ESP32-S2 series of chips 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-S2's power-up and reset sequence timing diagram, please refer to Section *Power Scheme* in *ESP32-S2 Series Datasheet*.

7 Physical Dimensions and PCB Land Pattern

7.1 Physical Dimensions

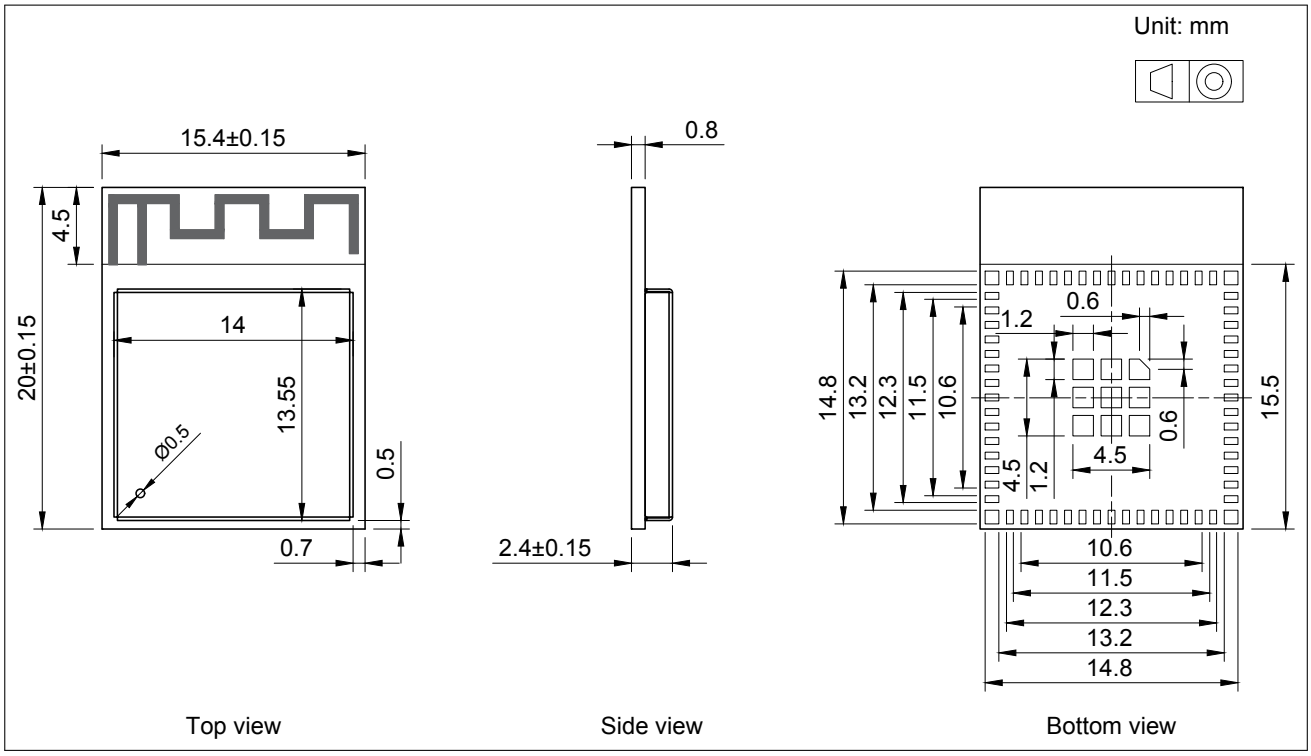

Figure 8: ESP32-S2-MINI-1 Physical Dimensions

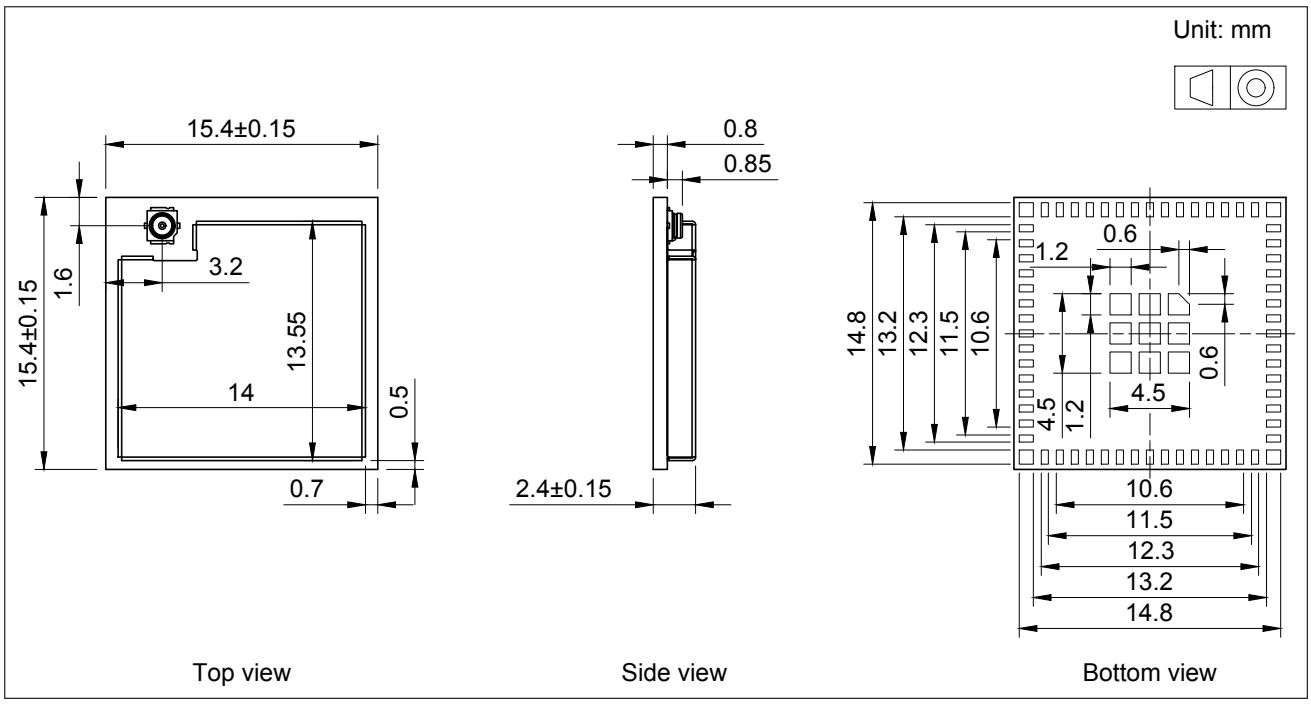

Figure 9: ESP32-S2-MINI-1U Physical Dimensions

Note:

For information about tape, reel, and product marking, please refer to *Espressif Module Package Information*.

7.2 Recommended PCB Land Pattern

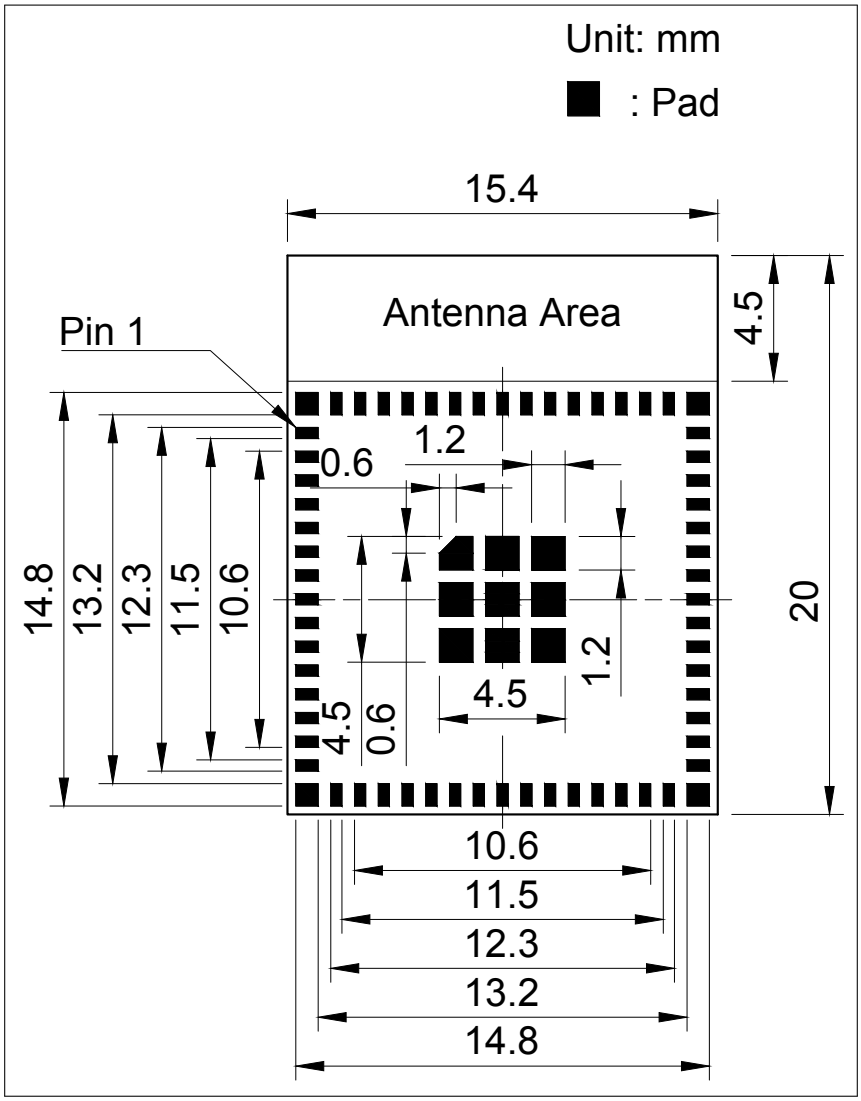

Figure 10: ESP32-S2-MINI-1 Recommended PCB Land Pattern

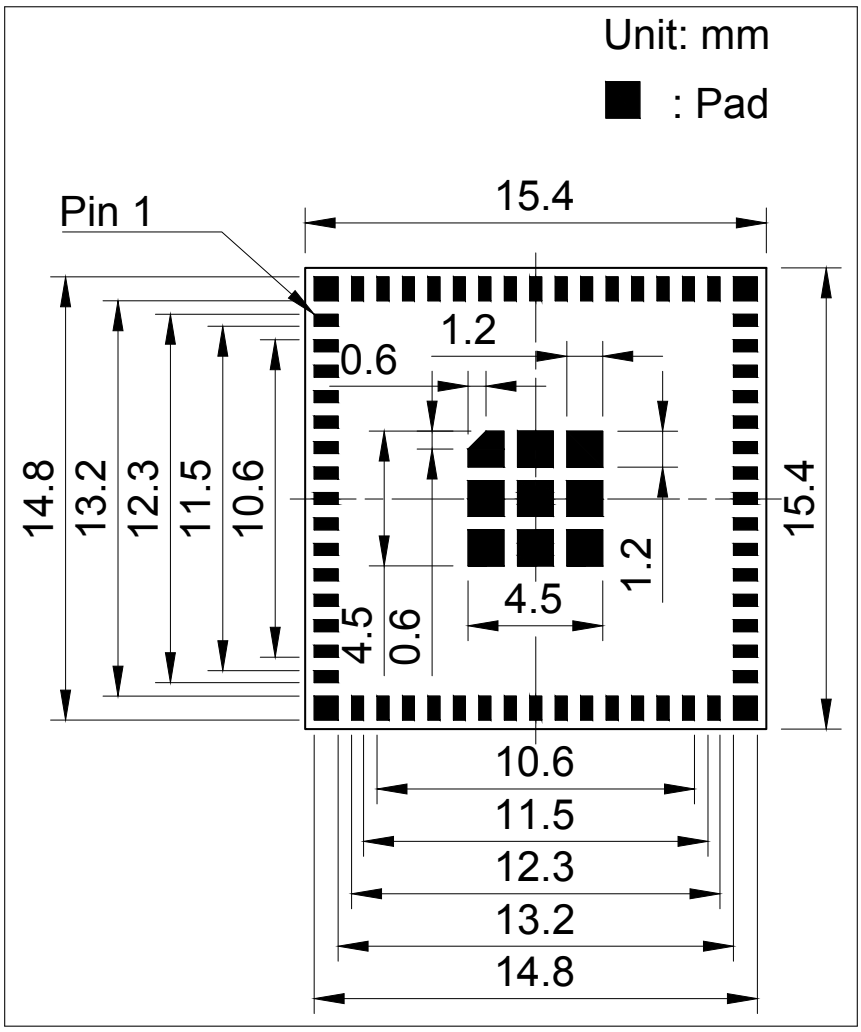

Figure 11: ESP32-S2-MINI-1U Recommended PCB Land Pattern

7.3 Dimensions of External Antenna Connector

ESP32-S2-MINI-1U uses the third generation external antenna connector as shown in Figure 12. This connector is compatible with the following connectors:

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

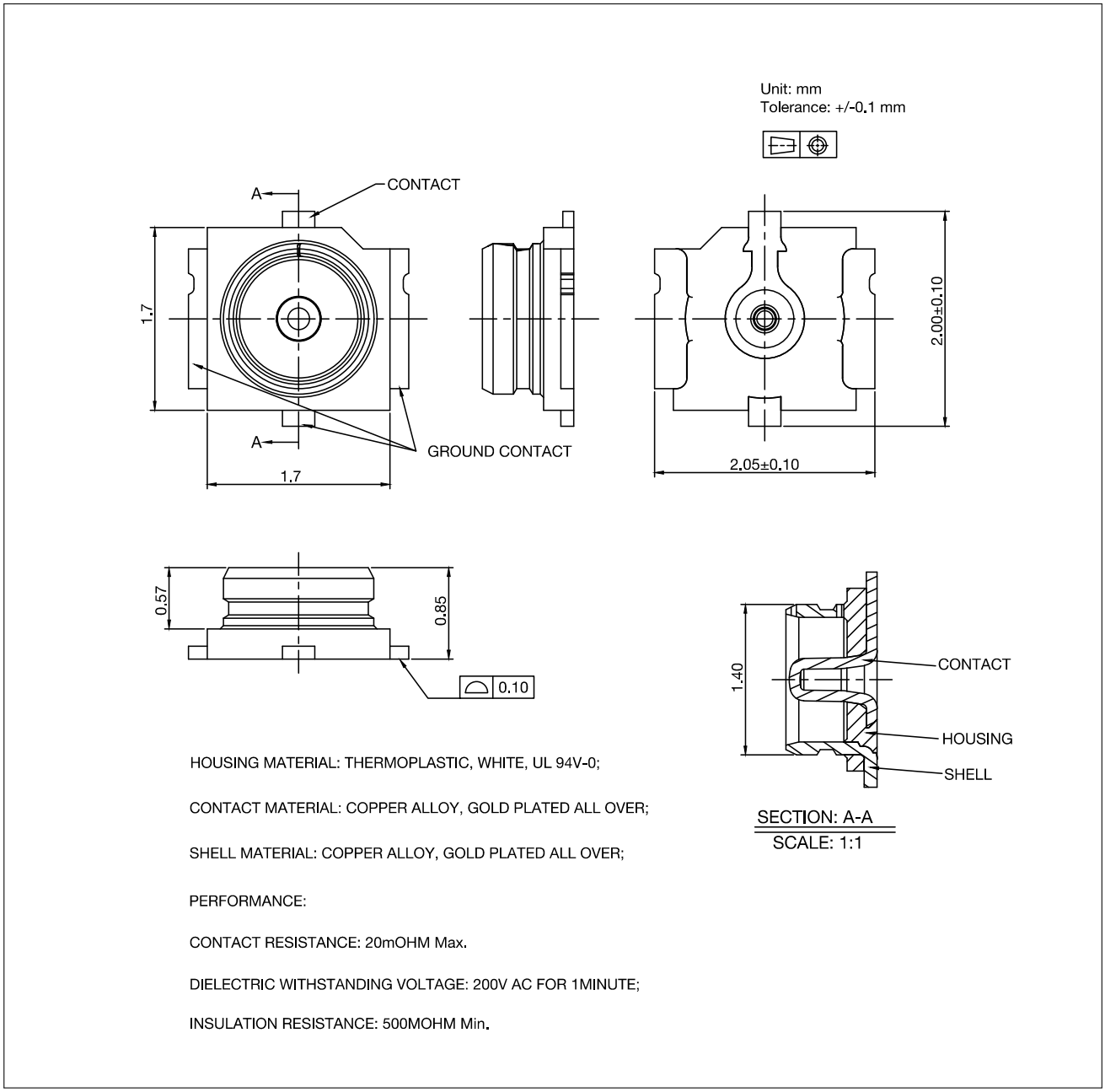

Figure 12: Dimensions of External Antenna Connector

8 Product Handling

8.1 Storage Condition

The products sealed in Moisture Barrier Bag (MBB) should be stored in a noncondensing atmospheric environment of < 40 °C/90%RH.

The module is rated at moisture sensitivity level (MSL) 3.

After unpacking, the module must be soldered within 168 hours with factory conditions 25±5 °C and /60%RH. The module needs to be baked if the above conditions are not met.

8.2 ESD

- Human body model (HBM): 2000 V
- Charged-device model (CDM): 500 V
- Air discharge: 6000 V
- Contact discharge: 4000 V

8.3 Reflow Profile

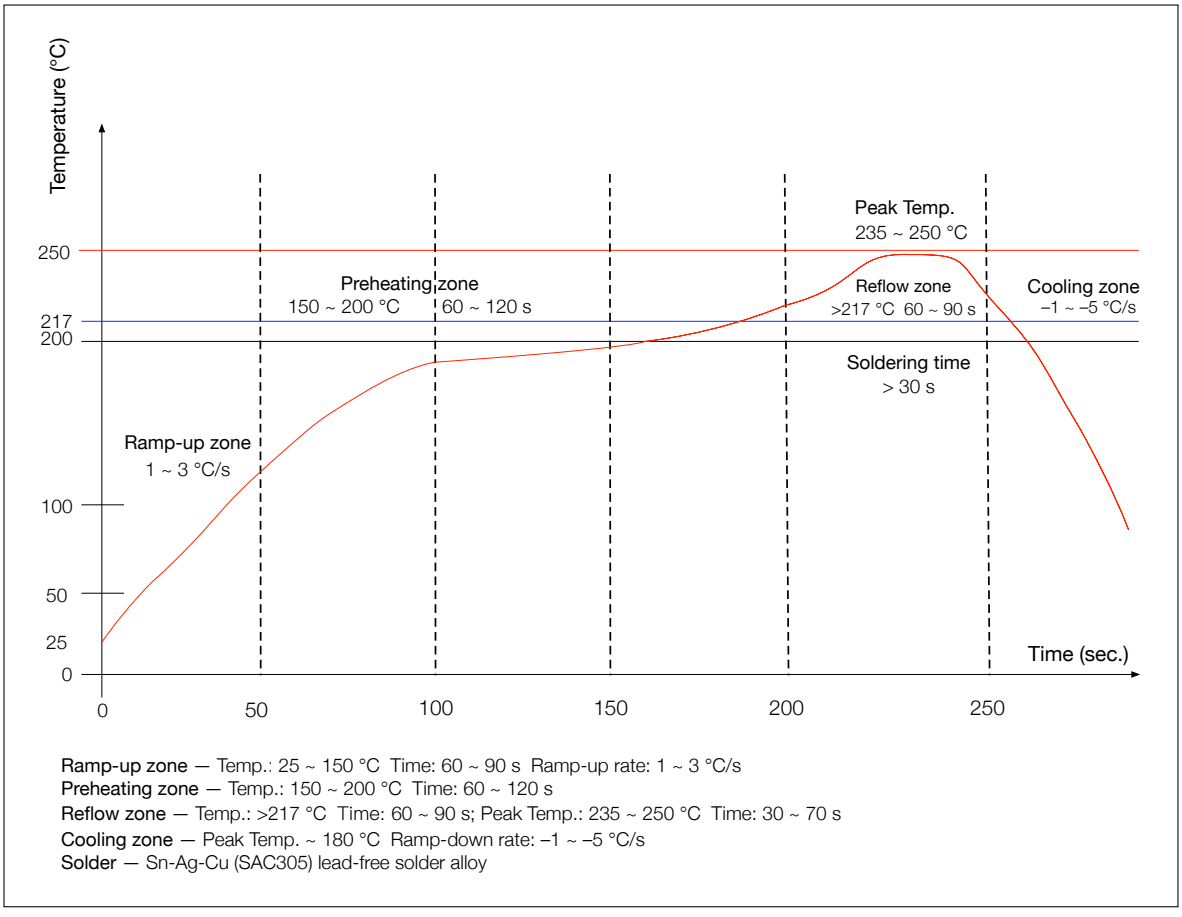

Figure 13: Reflow Profile

Note:
Solder the module in a single reflow.

9 MAC Addresses and eFuse

The eFuse in ESP32-S2 family of chips has been burnt into 48-bit mac_address. The actual addresses the chip uses in station or AP modes correspond to mac_address in the following way:

- Station mode: mac_address
- AP mode: mac_address + 1

There are seven blocks in eFuse for users to use. Each block is 256 bits in size and has independent write/read disable controller. Six of them can be used to store encrypted key or user data, and the remaining one is only used to store user data.

10 Learning Resources

10.1 Must-Read Documents

The following link provides documents related to ESP32-S2.

- *ESP32-S2 Datasheet*
  This document provides an introduction to the specifications of the ESP32-S2 hardware, including overview, pin definitions, functional description, peripheral interface, electrical characteristics, etc.
- *ESP-IDF Programming Guide*
  It hosts extensive documentation for ESP-IDF ranging from hardware guides to API reference.
- *ESP32-S2 Technical Reference Manual*
  The manual provides detailed information on how to use the ESP32-S2 memory and peripherals.
- *Espressif Products Ordering Information*

10.2 Must-Have Resources

Here are the ESP32-S2-related must-have resources.

- ESP32-S2 BBS
  This is an Engineer-to-Engineer (E2E) Community for ESP32-S2 where you can post questions, share knowledge, explore ideas, and help solve problems with fellow engineers.

Revision History

Date	Version	Release notes
2021-06-25	V1.0	• Added module variants embedded with the ESP32-S2FN4R2 chip • Added module description to the title page • Updated Chapter 1 *Module Overview* • Added description in Section 7.3 *Dimensions of External Antenna Connector* • Replaced ”chip family” with ”chip series” following Espressif’s taxonomy
2020-12-17	V0.6	• Added TWAI to Chapter 1 *Module Overview* • Updated Table 7 *Current Consumption Characteristics* • Updated the capacitance value of RC delay circuit to 1 μF in Chapter 6 *Peripheral Schematics* • Updated note in Section 8.3 *Reflow Profile*
2020-09-23	V0.5	Preliminary release.

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