

ESP8684-MINI-1

ESP8684-MINI-1U

Datasheet

Small-sized 2.4 GHz Wi-Fi (802.11 b/g/n) and Bluetooth® 5 module
Built around ESP8684 series of SoCs, RISC-V single-core microprocessor
14 GPIOs
On-board PCB antenna or external antenna connector



ESP8684-MINI-1



ESP8684-MINI-1U



Version0.1
Espressif Systems
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1 Module Overview

1.1 Features

CPU and On-Chip Memory

- ESP8684H1, ESP8684H2 or ESP8684H4 embedded, 32-bit RISC-V single-core processor, up to 120 MHz
- 576 KB ROM
- 272 KB SRAM (16 KB for cache)
- SiP flash (see details in Table 1 [Ordering Information](#))
- Access to flash accelerated by cache
- Supports flash in-Circuit Programming (ICP)

Wi-Fi

- IEEE 802.11 b/g/n-compliant
- Supports 20 MHz bandwidth in 2.4 GHz band
- 1T1R mode with data rate up to 72.2 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)
- 3 × virtual Wi-Fi interfaces
- Simultaneous support for Infrastructure BSS in Station mode, SoftAP mode, Station + SoftAP mode, and promiscuous mode

Note that when ESP8684 series scans in Station mode, the SoftAP channel will change along with the Station channel

- Antenna diversity
- Supports external power amplifier

Bluetooth®

- Bluetooth LE: Bluetooth 5
- High power mode 20 dBm
- 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

- GPIO, SPI, UART, I2C, LED PWM controller, general DMA controller, temperature sensor, SAR ADC

Integrated Components on Module

- 40 MHz crystal oscillator

Antenna Options

- On-board PCB antenna (ESP8684-MINI-1)
- External antenna via a connector (ESP8684-MINI-1U)

Operating Conditions

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

1.2 Description

ESP8684-MINI-1 and ESP8684-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.

The ordering information for the two modules is as follows:

Table 1: Ordering Information

Module	Ordering code	Chip embedded	SiP Flash	Ambient operating temperature (°C)	Module dimensions (mm)
ESP8684-MINI-1 (ANT)	ESP8684-MINI-1-H1	ESP8684H1	1 MB	-40 ~ 105	13.2 × 16.6 × 2.4
	ESP8684-MINI-1-H2	ESP8684H2	2 MB		
	ESP8684-MINI-1-H4	ESP8684H4	4 MB		
ESP8684-MINI-1U (CONN)	ESP8684-MINI-1U-H1	ESP8684H1	1 MB	-40 ~ 105	13.2 × 12.5 × 2.4
	ESP8684-MINI-1U-H2	ESP8684H2	2 MB		
	ESP8684-MINI-1U-H4	ESP8684H4	4 MB		

ESP8684-MINI-1 comes with a PCB antenna. ESP8684-MINI-1U comes with a connector for an external antenna. Both ESP8684-MINI-1 and ESP8684-MINI-1U are available in three variants that integrate the ESP8684H1, ESP8684H2 and ESP8684H4 chip respectively.

The ESP8684H1, ESP8684H2 and the ESP8684H4 chip fall into the same category, namely ESP8684 chip series. ESP8684 series of chips have a 32-bit RISC-V single-core processor. They integrate a rich set of peripherals, ranging from UART, I2C, LED PWM controller, general DMA controller, temperature sensor, and SAR ADC. It also includes SPI, Dual SPI and Quad SPI interfaces.

1.3 Applications

- [Smart Home](#)
 - Light control
 - Smart button
 - Smart plug
 - Indoor positioning
- [Industrial Automation](#)
 - Industrial robot
 - Industrial field bus
- [Consumer Electronics](#)
 - Smart watch and bracelet
 - Over-the-top (OTT) devices
 - Logger toys and proximity sensing toys
- [Health Care](#)
 - Health monitor
 - Baby monitor
- Smart Agriculture
 - Smart greenhouse
 - Smart irrigation
 - Agriculture robot
- Retail and Catering
 - POS machines
 - Service robot
- Generic Low-power IoT Sensor Hubs
- Generic Low-power IoT Data Loggers

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2 Block Diagram

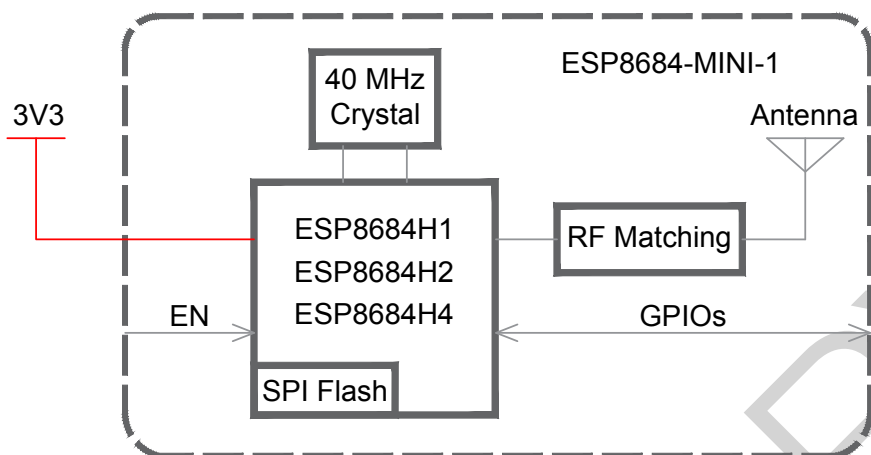


Figure 1: ESP8684-MINI-1 Block Diagram

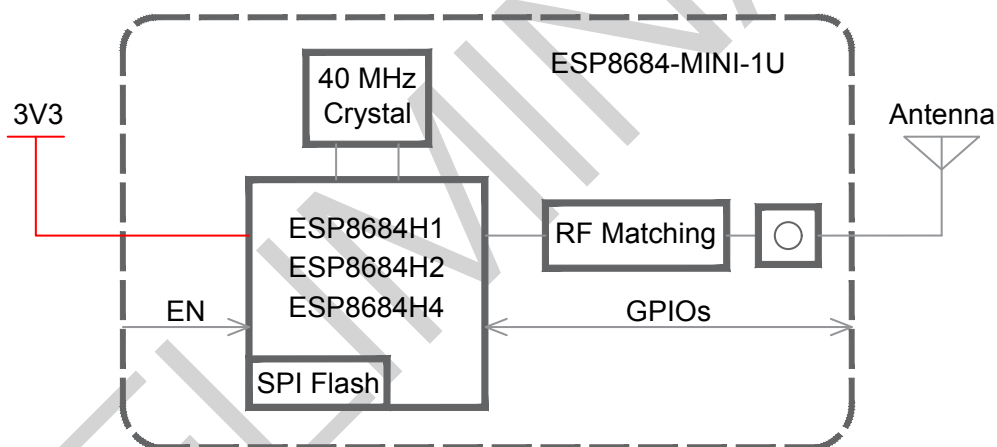


Figure 2: ESP8684-MINI-1U Block Diagram

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 7.1 *Physical Dimensions*.

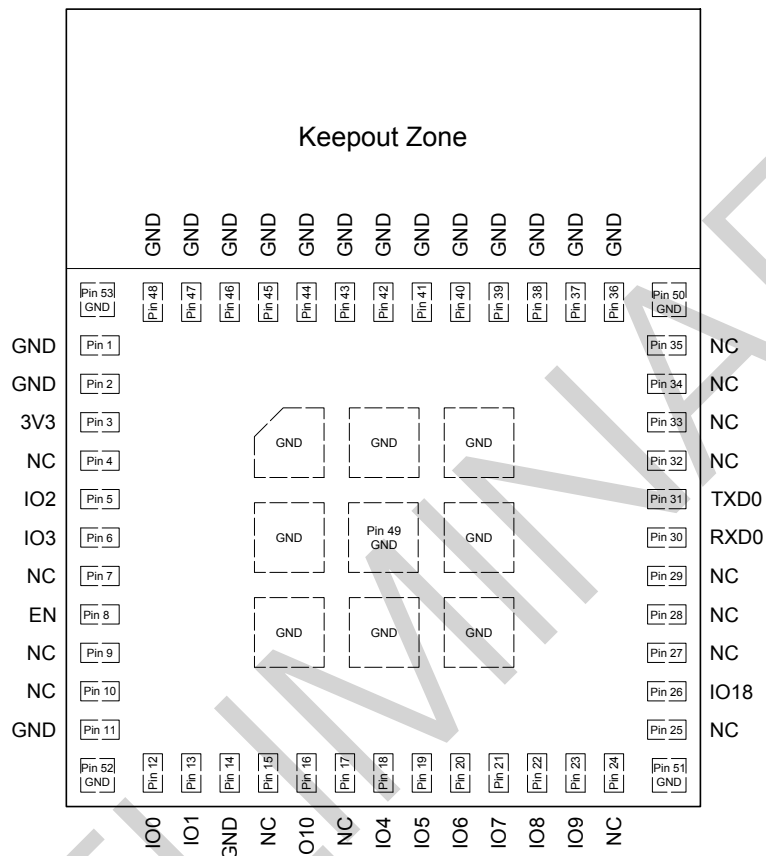


Figure 3: Pin Layout (Top View)

3.2 Pin Description

The module has 53 pins. See pin definitions in Table 2.

Table 2: 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	—	Not connected

Cont'd on next page

Table 2 – cont'd from previous page

Name	No.	Type ¹	Function
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-
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.

3.3 Strapping Pins

Note:

For the strapping pin mapping between the chip and modules, please refer to Chapter 5 *Module Schematics*.

ESP8684 series has two strapping pins:

- GPIO8
- GPIO9

Software can read the values of GPIO8 and GPIO9 from GPIO_STRAPPING field in GPIO_STRAP_REG register.

During the chip's power-on reset, RTC watchdog reset, and brownout 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.

By default, GPIO9 is connected to the internal weak pull-up resistor. If GPIO9 is not connected or connected to an external high-impedance circuit, the latched bit value will be "1"

To change the strapping bit values, you 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 ESP8684.

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

Table 3 lists detailed booting configurations of the strapping pins.

Table 3: Strapping Pins

Bootling Mode ¹			
Pin	Default	SPI Boot	Download Boot
GPIO8	N/A	Don't care	1
GPIO9	Internal weak pull-up	1	0
Enabling/Disabling ROM Messages Print During Bootling			
Pin	Default	Functionality	
GPIO8	N/A	When the value of eFuse field EFUSE_UART_PRINT_CONTROL is 0 (default), print is enabled and not controlled by GPIO8. 1, if GPIO8 is 0, print is enabled; if GPIO8 is 1, it is disabled. 2, if GPIO8 is 0, print is disabled; if GPIO8 is 1, it is enabled. 3, print is disabled and not controlled by GPIO8.	

¹ The strapping combination of GPIO8 = 0 and GPIO9 = 0 is invalid and will trigger unexpected behavior.

Figure 4 shows the setup and hold times for the strapping pins before and after the CHIP_EN signal goes high. Details about the parameters are listed in Table 4.

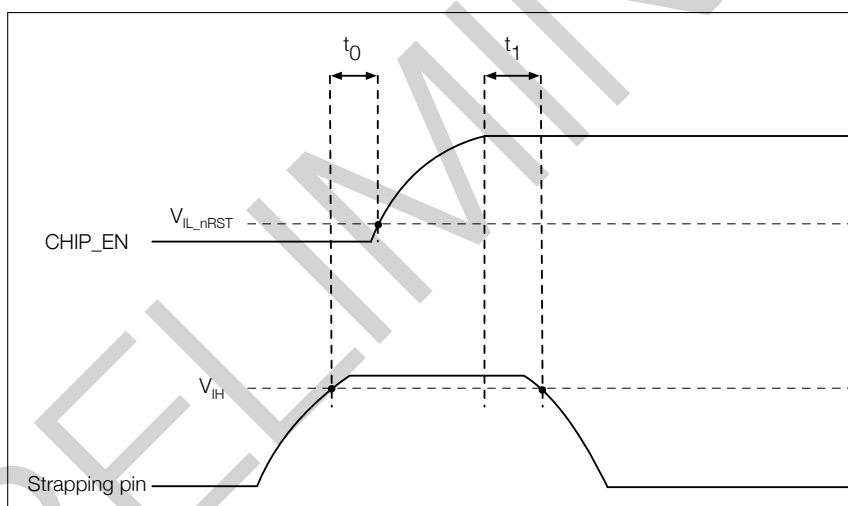


Figure 4: Setup and Hold Times for the Strapping Pins

Table 4: Parameter Descriptions of Setup and Hold Times for the Strapping Pins

Parameter	Description	Min (ms)
t_0	Setup time before CHIP_EN goes from low to high	0
t_1	Hold time after CHIP_EN goes high	3

4 Electrical Characteristics

The values presented in this section are preliminary and may change with the final release of this datasheet.

4.1 Absolute Maximum Ratings

Stresses beyond the absolute maximum ratings listed in the table below may cause permanent damage to the device. These are stress ratings only, and do not refer to the functional operation of the device. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

Table 5: Absolute Maximum Ratings

Symbol	Parameter	Min	Max	Unit
VDDA3P3, VDDA, VDD3P3_RTC, VDD3P3_CPU	Voltage applied to power supply pins per power domain	-0.3	3.6	V
I_{output}^1	Cumulative IO output current	—	730	mA
T_{STORE}	Storage temperature	-40	125	°C

¹ The chip worked properly after a 24-hour test in ambient temperature at 25 °C, and the IOs in two domains (VDD3P3_RTC, VDD3P3_CPU) output high logic level to ground.

4.2 Recommended Operating Conditions

Table 6: Recommended Operating Conditions

Symbol	Parameter	Min	Typ	Max	Unit
VDDA3P3, VDDA, VDD3P3_RTC, VDD3P3_CPU ¹	Voltage applied to power supply pin	3.0	3.3	3.6	V
I_{VDD}^2	Current delivered by external power supply	0.5	—	—	A
T_A	Operating ambient temperature	-40	—	105	°C

¹ To write eFuse, VDD3P3_CPU should not be higher than 3.3 V.

² If you use a single power supply, the recommended output current is 500 mA or more.

4.3 DC Characteristics (3.3 V, 25 °C)

Table 7: 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	$0.75 \times VDD^1$	—	$VDD^1 + 0.3$	V
V_{IL}	Low-level input voltage	-0.3	—	$0.25 \times VDD^1$	V
I_{IH}	High-level input current	—	—	50	nA
I_{IL}	Low-level input current	—	—	50	nA

V_{OH}^2	High-level output voltage	$0.8 \times VDD^1$	—	—	V
V_{OL}^2	Low-level output voltage	—	—	$0.1 \times VDD^1$	V
I_{OH}	High-level source current ($VDD^1 = 3.3$ V, $V_{OH} \geq 2.64$ 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	—	k Ω
R_{PD}	Pull-down resistor	—	45	—	k Ω
V_{IH_nRST}	Chip reset release voltage	$0.75 \times VDD^1$	—	$VDD^1 + 0.3$	V
V_{IL_nRST}	Chip reset voltage	-0.3	—	$0.25 \times VDD^1$	V

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.

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Figure 5: ESP8684-MINI-1 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).

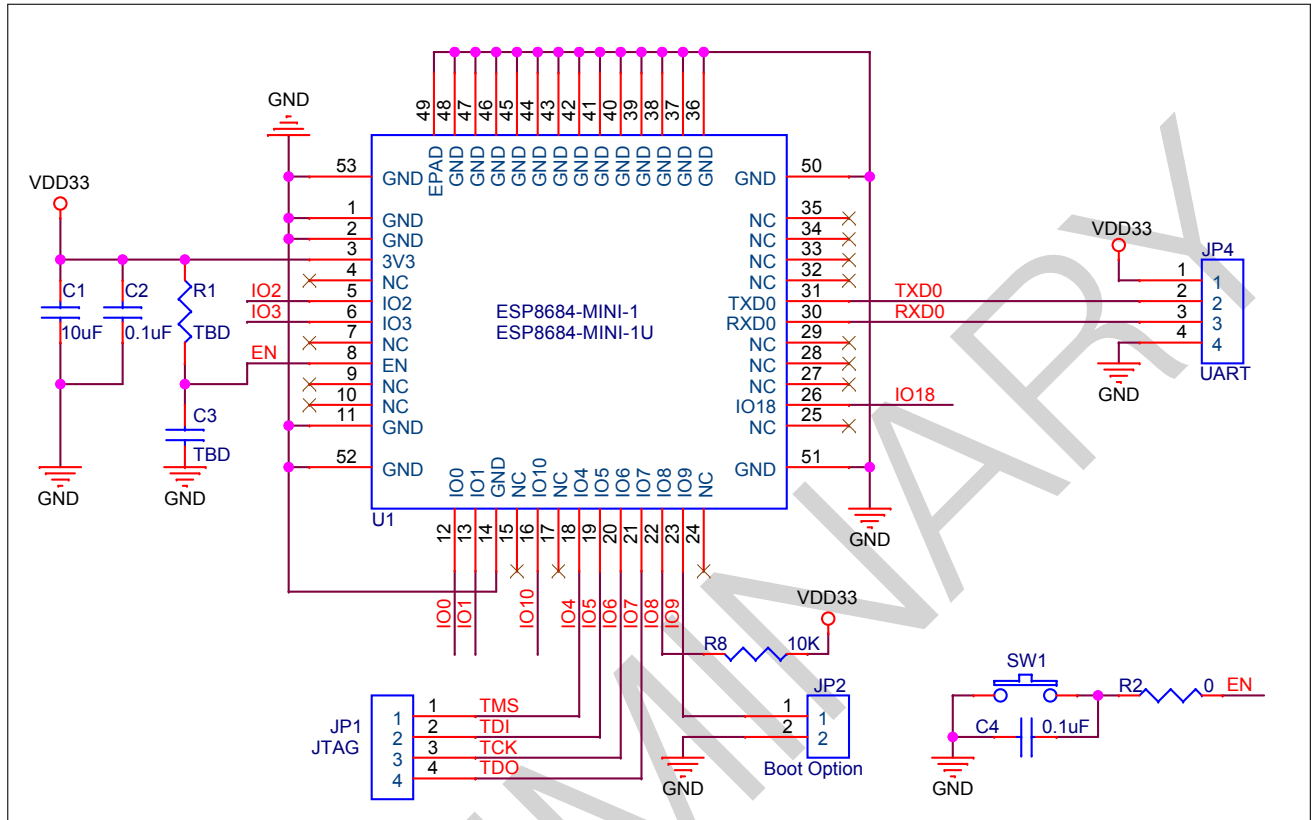


Figure 7: Peripheral Schematics

- 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.
- To ensure that the power supply to the ESP8684 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 $R = 10\text{ k}\Omega$ and $C = 1\text{ }\mu\text{F}$. 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.

7 Physical Dimensions and PCB Land Pattern

7.1 Physical Dimensions

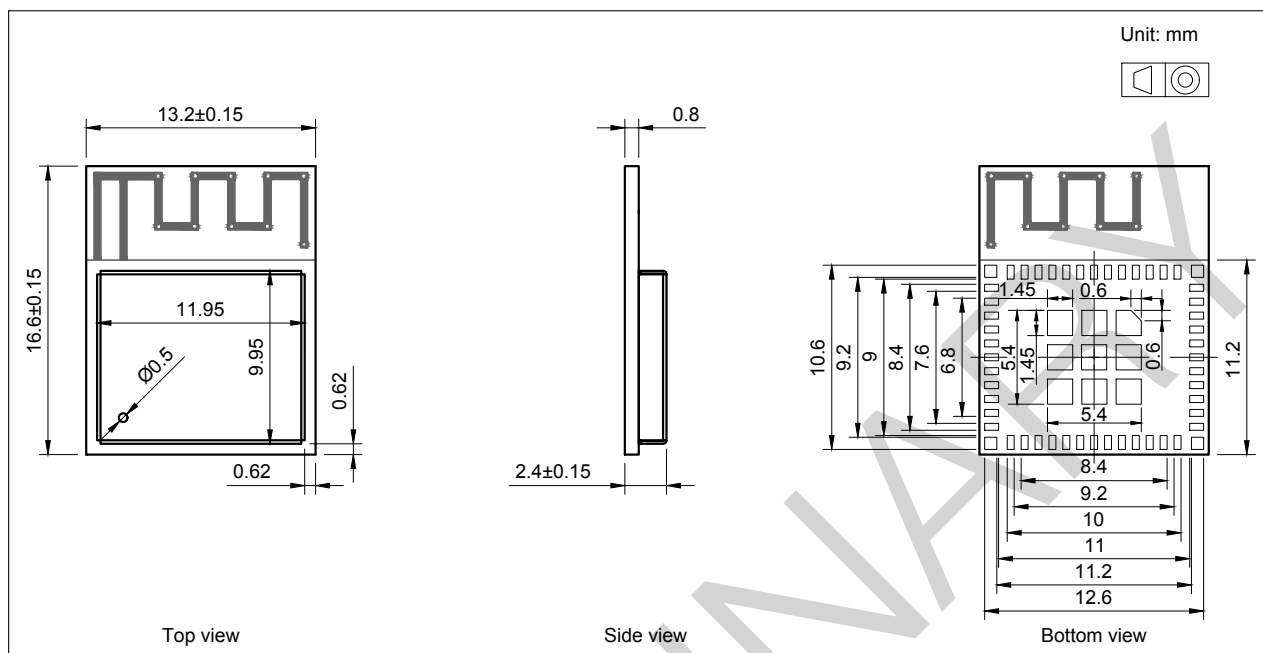


Figure 8: ESP8684-MINI-1 Physical Dimensions

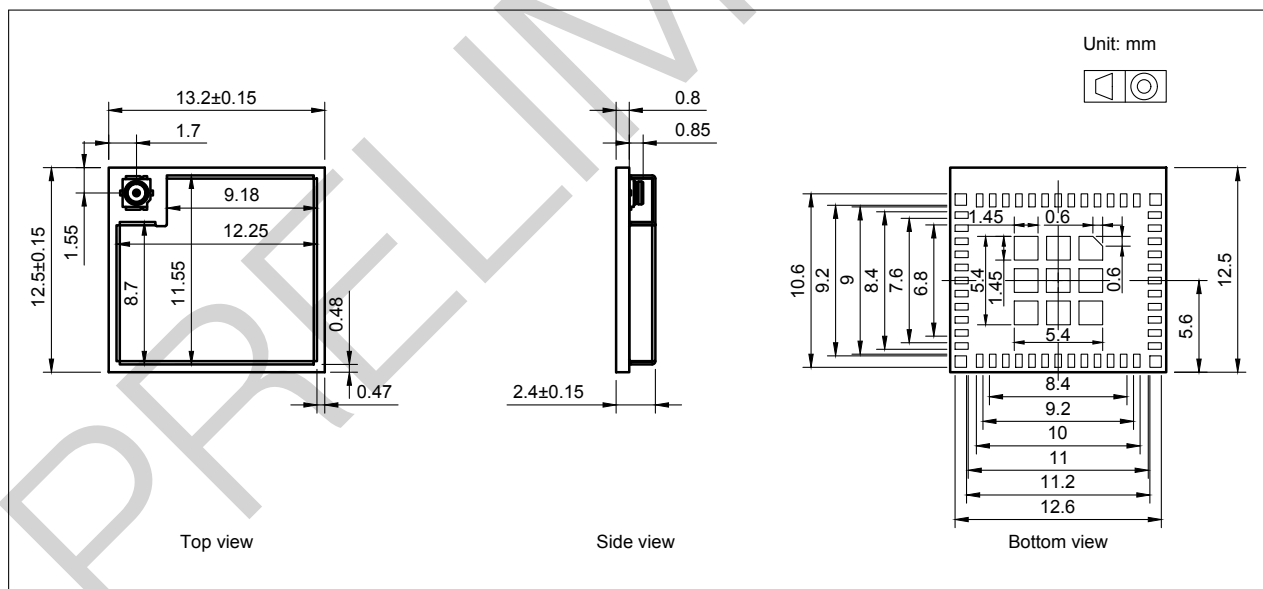


Figure 9: ESP8684-MINI-1U Physical Dimensions

Note:

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

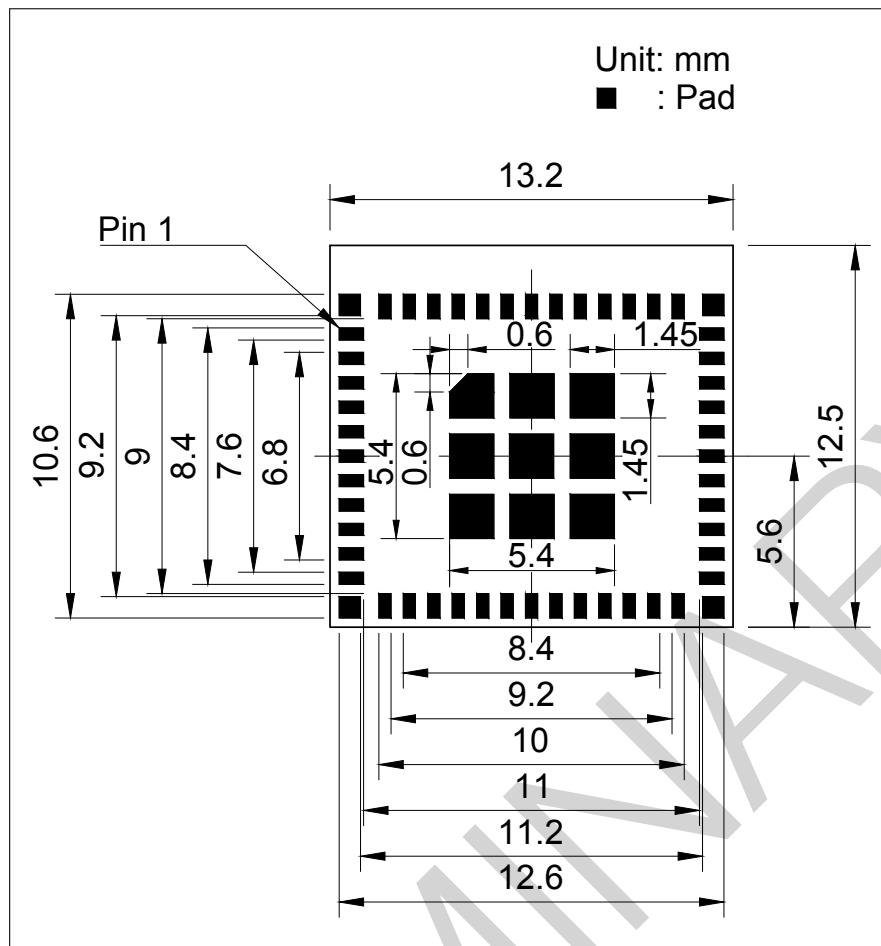


Figure 11: ESP8684-MINI-1U Recommended PCB Land Pattern

7.3 Dimensions of External Antenna Connector

ESP8684-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

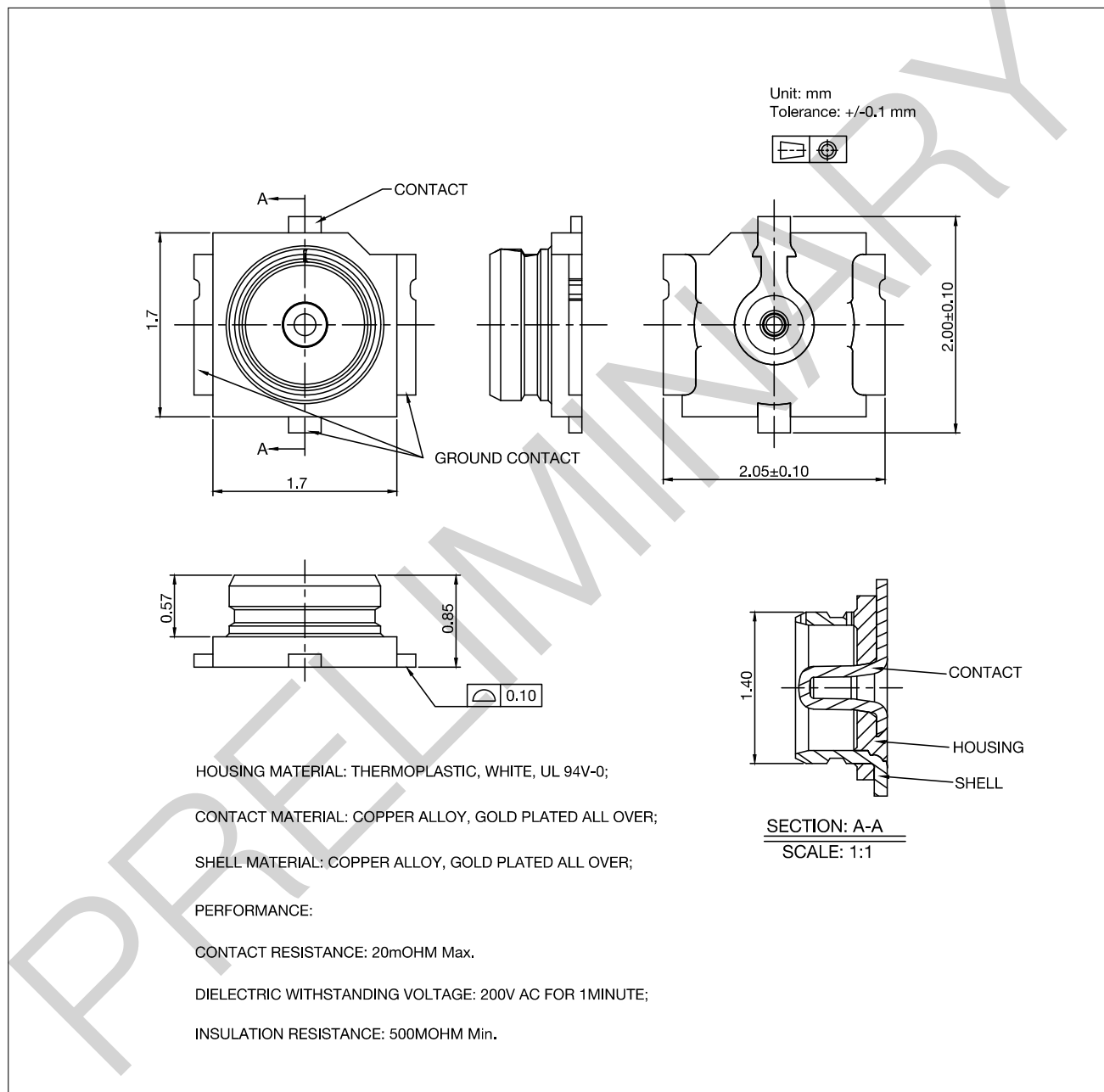


Figure 12: Dimensions of External Antenna Connector

8 Product Handling

8.1 Storage 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 $/90\%\text{RH}$. 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 $/60\%\text{RH}$. If the above conditions are not met, the module needs to be baked.

8.2 Electrostatic Discharge (ESD)

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

8.3 Reflow Profile

Solder the module in a single reflow.

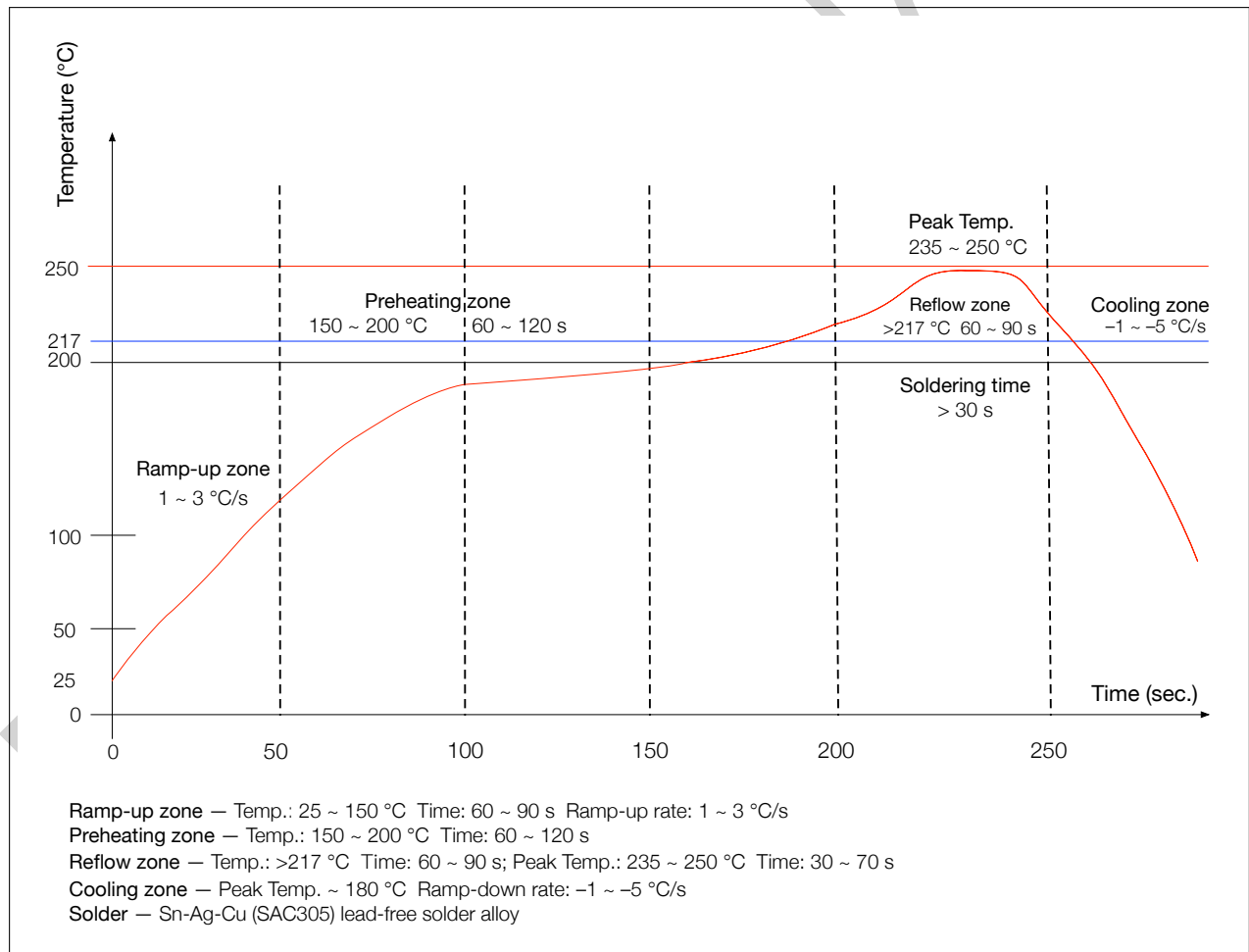


Figure 13: Reflow Profile

9 Related Documentation and Resources

Related Documentation

- *Certificates*
<http://espressif.com/en/support/documents/certificates>
- *Documentation Updates and Update Notification Subscription*
<http://espressif.com/en/support/download/documents>

Developer Zone

- *ESP-IDF* and other development frameworks on GitHub.
<http://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.
<http://esp32.com/>
- *The ESP Journal* – Best Practices, Articles, and Notes from Espressif folks.
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- See the tabs *SDKs and Demos*, *Apps*, *Tools*, *AT Firmware*.
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Products

- *ESP8684 Series SoCs* – Browse through all ESP8684 SoCs.
<http://espressif.com/en/products/socs?id=ESP8684>
- *ESP8684 Series Modules* – Browse through all ESP8684-based modules.
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Revision History

Date	Version	Release notes
2022-02-16	v0.1	Preliminary release

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