

ESP8685-WROOM-01

Datasheet

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

Built around ESP8685 series of SoC, RISC-V single-core microprocessor

2 MB or 4 MB flash in chip package

15 GPIOs

On-board PCB antenna



ESP8685-WROOM-01



Version 1.1
Espressif Systems
Copyright © 2023

1 Module Overview

Note:

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

https://espressif.com/documentation/esp8685-wroom-01_datasheet_en.pdf



1.1 Features

CPU and On-Chip Memory

- ESP8685H2 or ESP8685H4 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
- 2 MB or 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 ESP8685 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

Peripherals

- GPIO, 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

Integrated Components on Module

- 40 MHz crystal oscillator

Antenna Options

- On-board PCB antenna

Operating Conditions

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

Certification

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

Test

- HTOL/HTSL/uHAST/TCT/ESD

1.2 Description

ESP8685-WROOM-01 is a powerful, generic Wi-Fi and Bluetooth LE module that has a rich set of peripherals. This module is an ideal choice for smart homes, industrial automation, health care, consumer electronics, etc.

ESP8685-WROOM-01 comes with an on-board PCB antenna. It can be mounted onto the surface of a PCB board, or connected to a PCB board via pin headers.

The ordering information for ESP8685-WROOM-01 is as follows:

Table 1: ESP8685-WROOM-01 Ordering Information

Module	Ordering code	Chip Embedded	Module Dimensions (mm)
ESP8685-WROOM-01	ESP8685-WROOM-01-H2	ESP8685H2	16.0 × 24.0 × 3.1
	ESP8685-WROOM-01-H4	ESP8685H4	

The ESP8685H2 chip and the ESP8685H4 chip fall into the same category, namely ESP8685 chip series. ESP8685 series of chips have a 32-bit RISC-V single-core processor. They integrate a rich set of peripherals, ranging from UART, I2C, I2S, remote control peripheral, LED PWM controller, general DMA controller, TWAI[®] controller, USB Serial/JTAG controller, temperature sensor, and ADC.

The ESP8685H2 chip and the ESP8685H4 chip vary only in the size of the flash in chip package. For details, please refer to *ESP8685 Series Comparison* in [ESP8685 Series Datasheet](#).

1.3 Applications

- Smart Home
 - Light control
 - Smart button
 - Smart plug
 - Indoor positioning
- Industrial Automation
 - Industrial robot
 - Mesh network
 - Human machine interface (HMI)
 - Industrial field bus
- Health Care
 - Health monitor
- Baby monitor
- Consumer Electronics
 - Smart watch and bracelet
 - Over-the-top (OTT) devices
 - Wi-Fi speaker
 - Logger toys and proximity sensing toys
- Smart Agriculture
 - Smart greenhouse
 - Smart irrigation
 - Agriculture robot
- Retail and Catering
 - POS machines

- Service robot
- Audio Device
 - Internet music players
 - Live streaming devices
- Internet radio players
- Generic Low-power IoT Sensor Hubs
- Generic Low-power IoT Data Loggers

Contents

1	Module Overview	2
1.1	Features	2
1.2	Description	3
1.3	Applications	3
2	Block Diagram	9
3	Pin Definitions	10
3.1	Pin Layout	10
3.2	Pin Description	10
3.3	Strapping Pins	11
4	Electrical Characteristics	14
4.1	Absolute Maximum Ratings	14
4.2	Recommended Operating Conditions	14
4.3	DC Characteristics (3.3 V, 25 °C)	14
4.4	Current Consumption Characteristics	15
4.4.1	RF Current Consumption in Active Mode	15
4.4.2	Current Consumption in Other Modes	15
4.5	Wi-Fi Radio	16
4.5.1	Wi-Fi RF Standards	16
4.5.2	Wi-Fi RF Transmitter (TX) Specifications	16
4.5.3	Wi-Fi RF Receiver (RX) Specifications	17
4.6	Bluetooth LE Radio	19
4.6.1	Bluetooth LE RF Transmitter (TX) Specifications	19
4.6.2	Bluetooth LE RF Receiver (RX) Specifications	20
5	Module Schematics	23
6	Peripheral Schematics	24
7	Physical Dimensions and PCB Land Pattern	25
7.1	Physical Dimensions	25
7.2	Recommended PCB Land Pattern	26
8	Product Handling	27
8.1	Storage Conditions	27
8.2	Electrostatic Discharge (ESD)	27
8.3	Reflow Profile	27
8.4	Ultrasonic Vibration	28
9	Related Documentation and Resources	29

Revision History

30

List of Tables

1	ESP8685-WROOM-01 Ordering Information	3
2	Pin Definitions	11
3	Strapping Pins	12
4	Parameter Descriptions of Setup and Hold Times for the Strapping Pins	13
5	Absolute Maximum Ratings	14
6	Recommended Operating Conditions	14
7	DC Characteristics (3.3 V, 25 °C)	14
8	Current Consumption Depending on RF Modes	15
9	Current Consumption in Modem-sleep Mode	15
10	Current Consumption in Low-Power Modes	15
10	Current Consumption in Low-Power Modes	16
11	Wi-Fi RF Standards	16
12	TX Power with Spectral Mask and EVM Meeting 802.11 Standards	16
13	TX EVM Test	17
14	RX Sensitivity	17
15	Maximum RX Level	18
16	RX Adjacent Channel Rejection	18
17	Transmitter General Characteristics	19
18	Transmitter Characteristics - Bluetooth LE 1 Mbps	19
19	Transmitter Characteristics - Bluetooth LE 2 Mbps	19
20	Transmitter Characteristics - Bluetooth LE 125 Kbps	19
21	Transmitter Characteristics - Bluetooth LE 500 Kbps	20
22	Receiver Characteristics - Bluetooth LE 1 Mbps	20
23	Receiver Characteristics - Bluetooth LE 2 Mbps	21
24	Receiver Characteristics - Bluetooth LE 125 Kbps	21
25	Receiver Characteristics - Bluetooth LE 500 Kbps	22

List of Figures

1	ESP8685-WROOM-01 Block Diagram	9
2	Pin Layout	10
3	Setup and Hold Times for the Strapping Pins	13
4	ESP8685-WROOM-01 Schematics	23
5	Peripheral Schematics	24
6	Physical Dimensions	25
7	Recommended PCB Land Pattern	26
8	Reflow Profile	27

2 Block Diagram

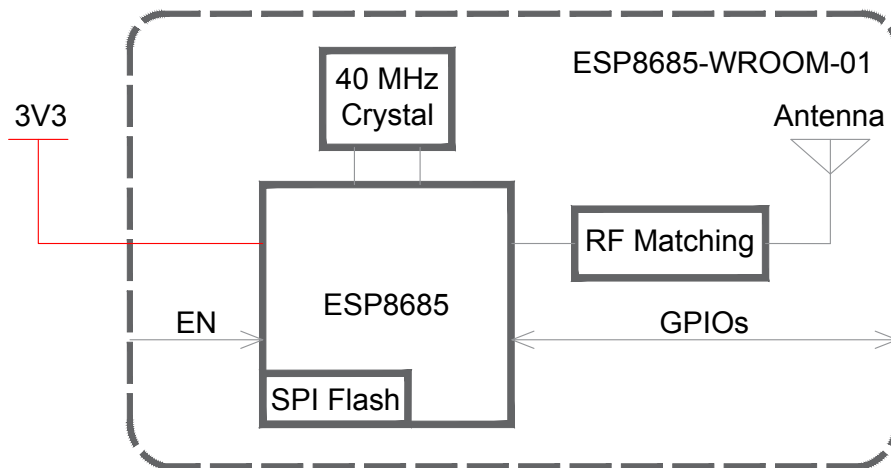


Figure 1: ESP8685-WROOM-01 Block Diagram

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*.

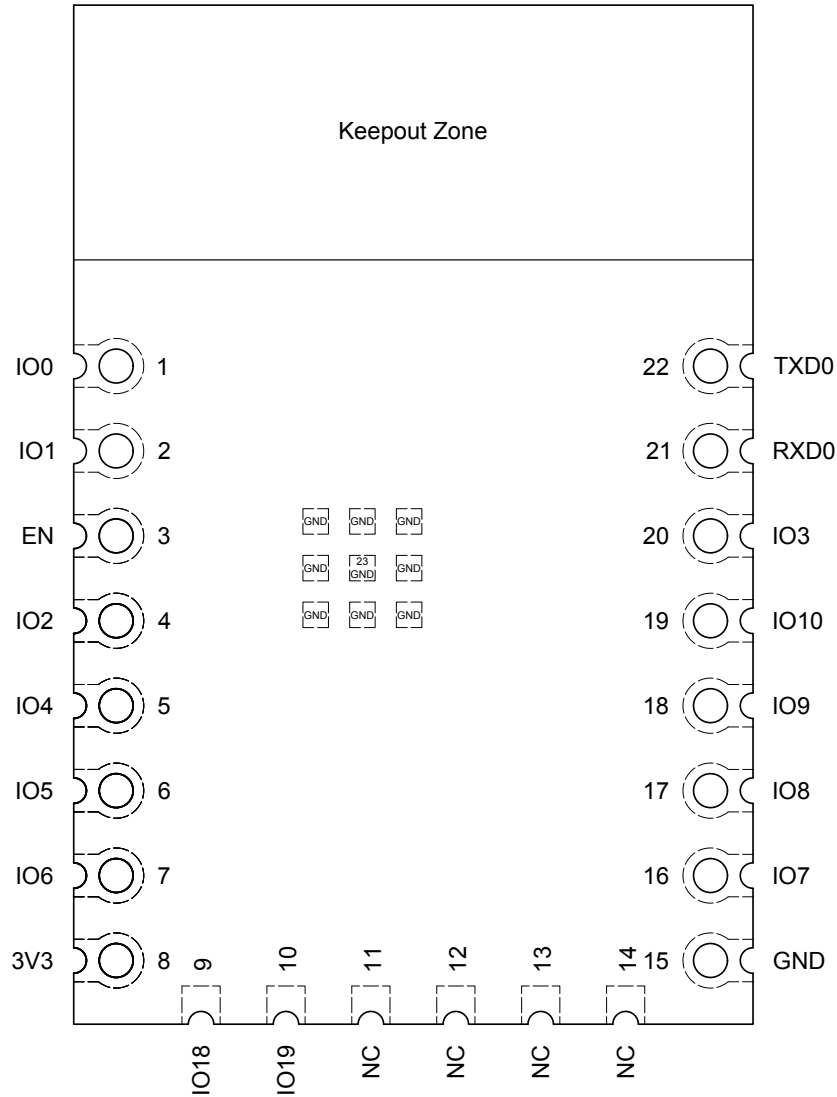


Figure 2: Pin Layout

3.2 Pin Description

The module has 22 pins. See pin definitions in Table 2.

For peripheral pin configurations, please refer to [ESP8685 Series Datasheet](#).

Table 2: Pin Definitions

Name	No.	Type ¹	Function
IO0	1	I/O/T	GPIO0, ADC1_CH0, XTAL_32K_P
IO1	2	I/O/T	GPIO1, ADC1_CH1, XTAL_32K_N
EN	3	I	High: on, enables the chip. Low: off, the chip powers off. By default, this pin is internally pulled high.
IO2	4	I/O/T	GPIO2, ADC1_CH2, FSPIQ
IO4	5	I/O/T	GPIO4, ADC1_CH4, FSPIHD, MTMS, LED PWM
IO5	6	I/O/T	GPIO5, ADC2_CH0, FSPIWP, MTDI, LED PWM
IO6	7	I/O/T	GPIO6, FSPICLK, MTCK, LED PWM
3V3	8	P	Power supply
IO18	9	I/O/T	GPIO18, USB_D-
IO19	10	I/O/T	GPIO19, USB_D+
NC	11-14	—	NC
GND	15, 23	P	Ground
IO7	16	I/O/T	GPIO7, FSPID, MTDO, LED PWM
IO8	17	I/O/T	GPIO8
IO9	18	I/O/T	GPIO9
IO10	19	I/O/T	GPIO10, FSPICS0, LED PWM
IO3	20	I/O/T	GPIO3, ADC1_CH3, LED PWM
RXD0	21	I/O/T	GPIO20, U0RXD
TXD0	22	I/O/T	GPIO21, U0TXD

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

3.3 Strapping Pins

Note:

The content below is excerpted from Section Strapping Pins in [ESP8685 Series Datasheet](#). For the strapping pin mapping between the chip and modules, please refer to Chapter 5 *Module Schematics*.

ESP8685 series has three strapping pins:

- GPIO2
- GPIO8
- GPIO9

Software can read the values of GPIO2, GPIO8 and GPIO9 from GPIO_STRAPPING field in GPIO_STRAP_REG register.

During the chip's system 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.

Types of system reset include:

- power-on reset

- RTC watchdog reset
- brownout reset
- analog super watchdog reset
- crystal clock glitch detection reset

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 ESP8685 series.

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

Table 3 lists detailed booting configurations of the strapping pins.

Table 3: Strapping Pins

Booting Mode ¹			
Pin	Default	SPI Boot	Download Boot
GPIO2	N/A	1	1
GPIO8	N/A	Don't care	1
GPIO9	Internal weak pull-up	1	0
Enabling/Disabling ROM Messages Print During Booting			
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 3 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.

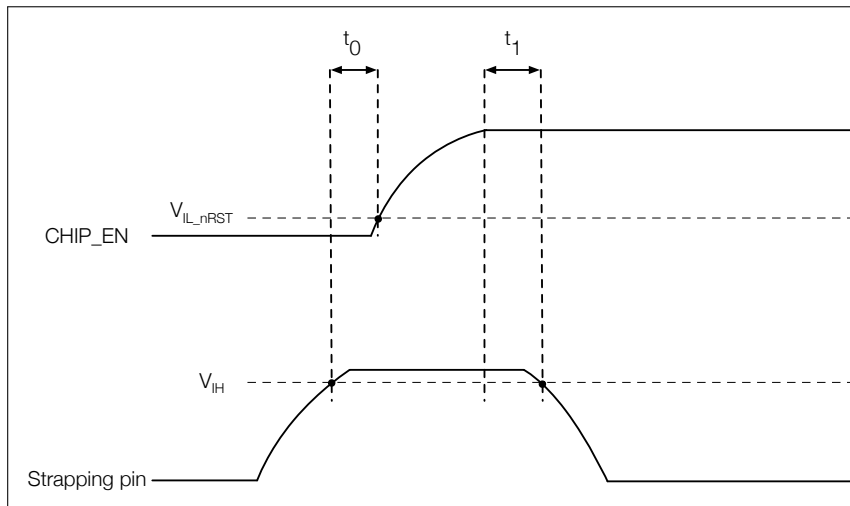


Figure 3: Setup and Hold Times for the Strapping Pins

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

4.1 Absolute Maximum Ratings

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

Table 5: 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 6: 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	—	105	°C

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 × 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.

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 *Low Power Management* in [ESP8685 Series Datasheet](#).

4.4.1 RF Current Consumption in Active Mode

Table 8: Current Consumption Depending on RF Modes

Work mode	Description		Peak (mA)
Active (RF working)	TX	802.11b, 1 Mbps, @20 dBm	330
		802.11g, 54 Mbps, @17.5 dBm	280
		802.11n, HT20, MCS7, @17 dBm	275
		802.11n, HT40, MCS7, @16.5 dBm	202
	RX	802.11b/g/n, HT20	82
		802.11n, HT40	84.5

¹ 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.

² The current consumption figures for in RX mode are for cases when the peripherals are disabled and the CPU idle.

Note:

The content below is excerpted from *Section Power Consumption in Other Modes* in [ESP8685 Series Datasheet](#).

4.4.2 Current Consumption in Other Modes

Table 9: 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 10: 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

Table 10: Current Consumption in Low-Power Modes

Mode	Description	Typ (μA)
Deep-sleep	RTC timer + RTC memory	5
Power off	CHIP_EN is set to low level, the chip is powered off	1

4.5 Wi-Fi Radio

4.5.1 Wi-Fi RF Standards

Table 11: Wi-Fi RF Standards

Name	Description
Center frequency range of operating channel ¹	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

¹ Device should operate in the center frequency range allocated by regional regulatory authorities. Target center frequency range is configurable by software.

4.5.2 Wi-Fi RF Transmitter (TX) Specifications

Target TX power is configurable based on device or certification requirements. The default characteristics are provided in Table 12.

Table 12: TX Power with Spectral Mask and EVM Meeting 802.11 Standards

Rate	Min (dBm)	Typ (dBm)	Max (dBm)
802.11b, 1 Mbps	—	20.0	—
802.11b, 11 Mbps	—	20.0	—
802.11g, 6 Mbps	—	19.5	—
802.11g, 54 Mbps	—	17.5	—
802.11n, HT20, MCS0	—	18.5	—
802.11n, HT20, MCS7	—	17.0	—
802.11n, HT40, MCS0	—	18.0	—
802.11n, HT40, MCS7	—	16.5	—

Table 13: TX EVM Test

Rate	Min (dB)	Typ (dB)	SL ¹ (dB)
802.11b, 1 Mbps, @20 dBm	—	-25.5	-10
802.11b, 11 Mbps, @20 dBm	—	-25.5	-10
802.11g, 6 Mbps, @19.5 dBm	—	-24.0	-5
802.11g, 54 Mbps, @17.5 dBm	—	-29.5	-25
802.11n, HT20, MCS0, @18.5 dBm	—	-24.5	-5
802.11n, HT20, MCS7, @17 dBm	—	-30.0	-27
802.11n, HT40, MCS0, @18 dBm	—	-27.0	-5
802.11n, HT40, MCS7, @16.5 dBm	—	-30.0	-27

¹ SL stands for standard limit value.

4.5.3 Wi-Fi RF Receiver (RX) Specifications

Table 14: 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	—	-92.0	—
802.11g, 12 Mbps	—	-90.5	—
802.11g, 18 Mbps	—	-88.0	—
802.11g, 24 Mbps	—	-85.0	—
802.11g, 36 Mbps	—	-82.0	—
802.11g, 48 Mbps	—	-78.0	—
802.11g, 54 Mbps	—	-76.4	—
802.11n, HT20, MCS0	—	-93.0	—
802.11n, HT20, MCS1	—	-90.5	—
802.11n, HT20, MCS2	—	-88.2	—
802.11n, HT20, MCS3	—	-84.5	—
802.11n, HT20, MCS4	—	-81.5	—
802.11n, HT20, MCS5	—	-78.0	—
802.11n, HT20, MCS6	—	-75.5	—
802.11n, HT20, MCS7	—	-74.5	—
802.11n, HT40, MCS0	—	-90.0	—
802.11n, HT40, MCS1	—	-87.0	—
802.11n, HT40, MCS2	—	-84.6	—
802.11n, HT40, MCS3	—	-81.8	—

Cont'd on next page

Table 14 – cont'd from previous page

Rate	Min (dBm)	Typ (dBm)	Max (dBm)
802.11n, HT40, MCS4	—	-78.0	—
802.11n, HT40, MCS5	—	-74.0	—
802.11n, HT40, MCS6	—	-72.8	—
802.11n, HT40, MCS7	—	-71.2	—

Table 15: 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 16: 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	—	25	—
802.11n, HT40, MCS7	—	13	—

4.6 Bluetooth LE Radio

4.6.1 Bluetooth LE RF Transmitter (TX) Specifications

Table 17: Transmitter General Characteristics

Parameter	Min	Typ	Max	Unit
RF transmit power	—	0	—	dBm
Gain control step	—	3	—	dB
RF power control range	-24	—	20	dBm

Table 18: Transmitter Characteristics - Bluetooth LE 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 19: Transmitter Characteristics - Bluetooth LE 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 20: Transmitter Characteristics - Bluetooth LE 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

Cont'd on next page

Table 20 – cont'd from previous page

Parameter	Description	Min	Typ	Max	Unit
	$F = F_0 \pm > 3 \text{ MHz}$	—	-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 21: Transmitter Characteristics - Bluetooth LE 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

4.6.2 Bluetooth LE RF Receiver (RX) Specifications

Table 22: Receiver Characteristics - Bluetooth LE 1 Mbps

Parameter	Description	Min	Typ	Max	Unit
Sensitivity @30.8% PER	—	—	-96	—	dBm
Maximum received signal @30.8% PER	—	—	5	—	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

Cont'd on next page

Table 22 – cont'd from previous page

Parameter	Description	Min	Typ	Max	Unit
Intermodulation	—	—	-44	—	dBm

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

Table 23: Receiver Characteristics - Bluetooth LE 2 Mbps

Parameter	Description	Min	Typ	Max	Unit
Sensitivity @30.8% PER	—	—	-93	—	dBm
Maximum received signal @30.8% PER	—	—	2	—	dBm
Co-channel C/I	—	—	10	—	dB
Adjacent channel selectivity C/I	$F = F_0 + 2$ MHz	—	-7	—	dB
	$F = F_0 - 2$ MHz	—	-7	—	dB
	$F = F_0 + 4$ MHz ⁽¹⁾	—	—	—	dB
	$F = F_0 - 4$ MHz	—	-34	—	dB
	$F \geq F_0 + 6$ MHz	—	-39	—	dB
	$F \leq F_0 - 6$ 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 $F = F_0 + 2$ MHz.

Table 24: Receiver Characteristics - Bluetooth LE 125 Kbps

Parameter	Description	Min	Typ	Max	Unit
Sensitivity @30.8% PER	—	—	-104	—	dBm
Maximum received signal @30.8% PER	—	—	5	—	dBm
Co-channel C/I	—	—	2	—	dB
Adjacent channel selectivity C/I	$F = F_0 + 1$ MHz	—	-6	—	dB
	$F = F_0 - 1$ MHz	—	-5	—	dB
	$F = F_0 + 2$ MHz	—	-40	—	dB
	$F = F_0 - 2$ MHz	—	-42	—	dB
	$F \geq F_0 + 3$ MHz ⁽¹⁾	—	—	—	dB
	$F \leq F_0 - 3$ 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 25: Receiver Characteristics - Bluetooth LE 500 Kbps

Parameter	Description	Min	Typ	Max	Unit
Sensitivity @30.8% PER	—	—	-99	—	dBm
Maximum received signal @30.8% PER	—	—	5	—	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 $F = F_{image} - 1 \text{ MHz}$.

5 Module Schematics

This is the reference design of the module.

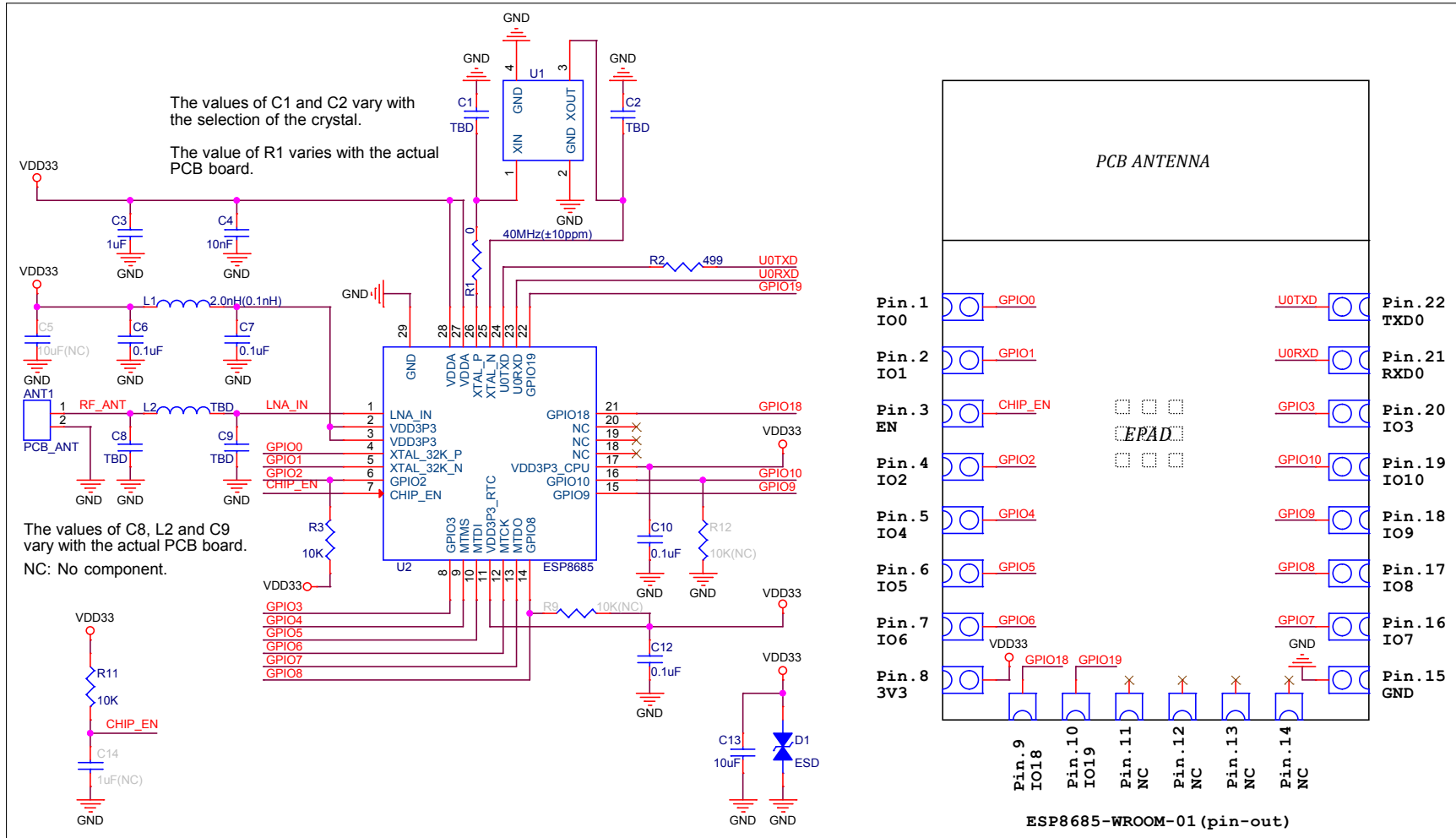


Figure 4: ESP8685-WROOM-01 Schematics

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).

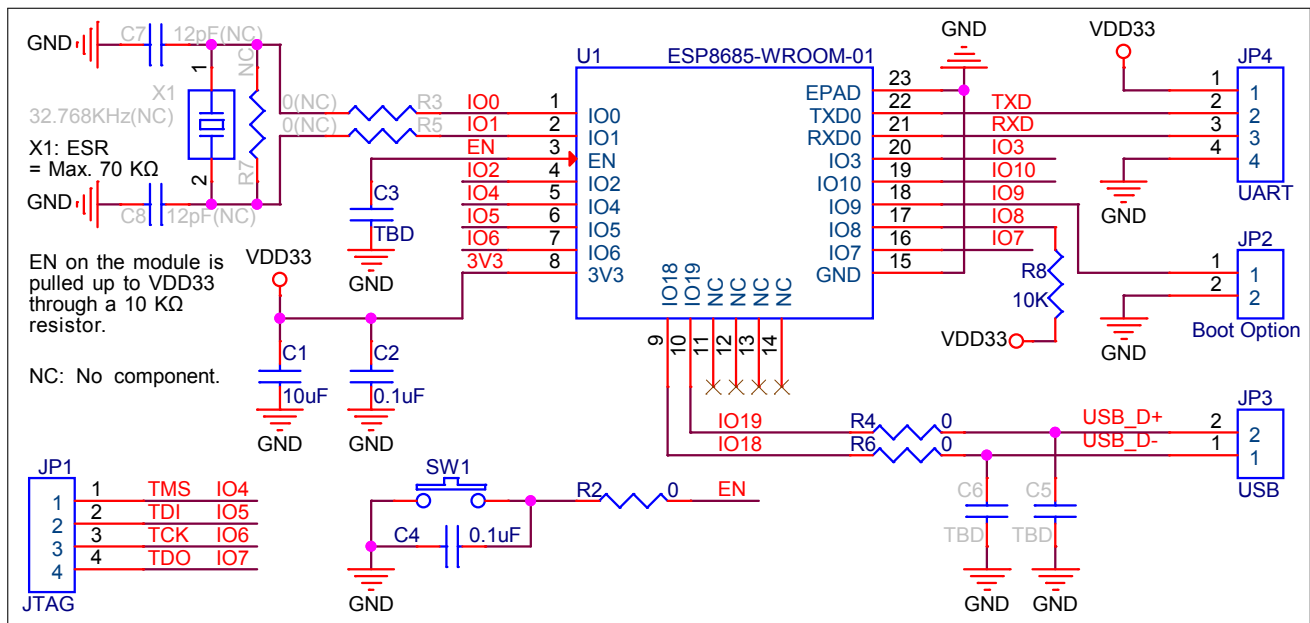


Figure 5: Peripheral Schematics

- Soldering the EPAD to the ground of the base board is not a must, though doing so can get optimized thermal performance. If you do want to solder it, please ensure that you 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 ESP8685 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 $R = 10\text{ k}\Omega$ (already built into the module) and $C = 1\ \mu\text{F}$. 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.

For ESP8685's power-up and reset sequence timing diagram, please refer to Section *Power Scheme* in [ESP8685 Series Datasheet](#).

7 Physical Dimensions and PCB Land Pattern

7.1 Physical Dimensions

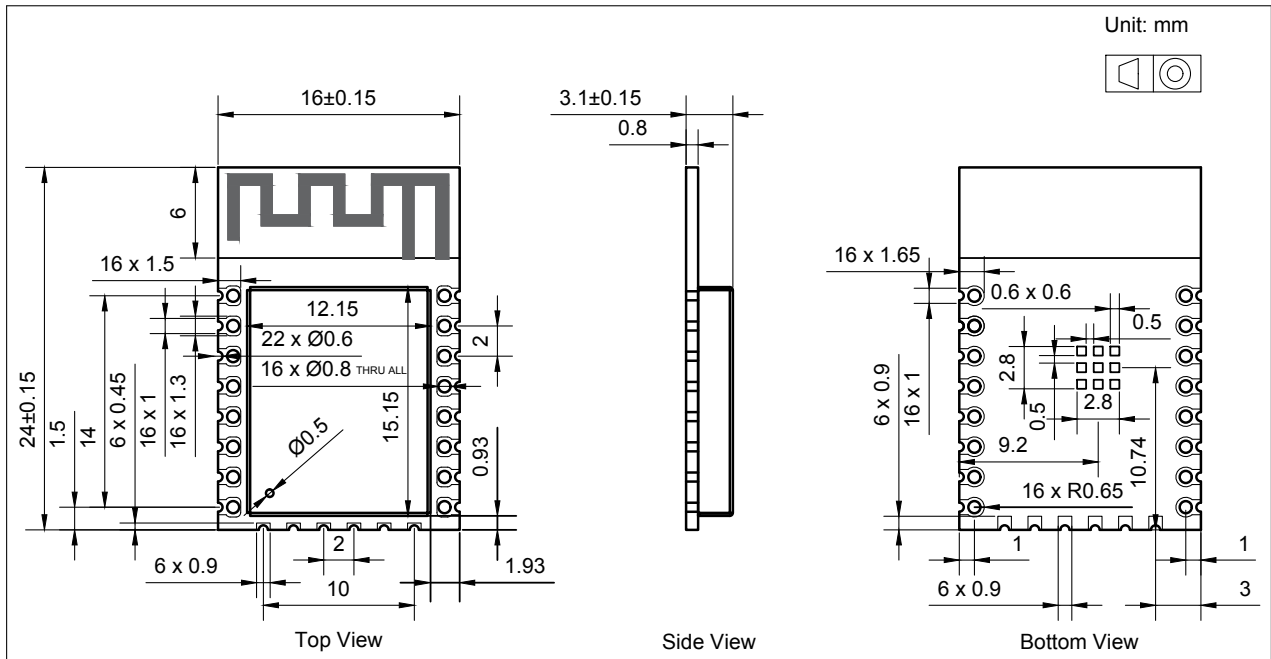


Figure 6: Physical Dimensions

Note:

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

7.2 Recommended PCB Land Pattern

This section provides the following resources for your reference:

- Figure for the recommended PCB land pattern with all the dimensions needed for PCB design. See Figure 7 *Recommended PCB Land Pattern*.
- Source file of the recommended PCB land pattern to measure dimensions not covered in Figure 7. You can view the source files for [ESP8685-WROOM-01](#) with [Autodesk Viewer](#).

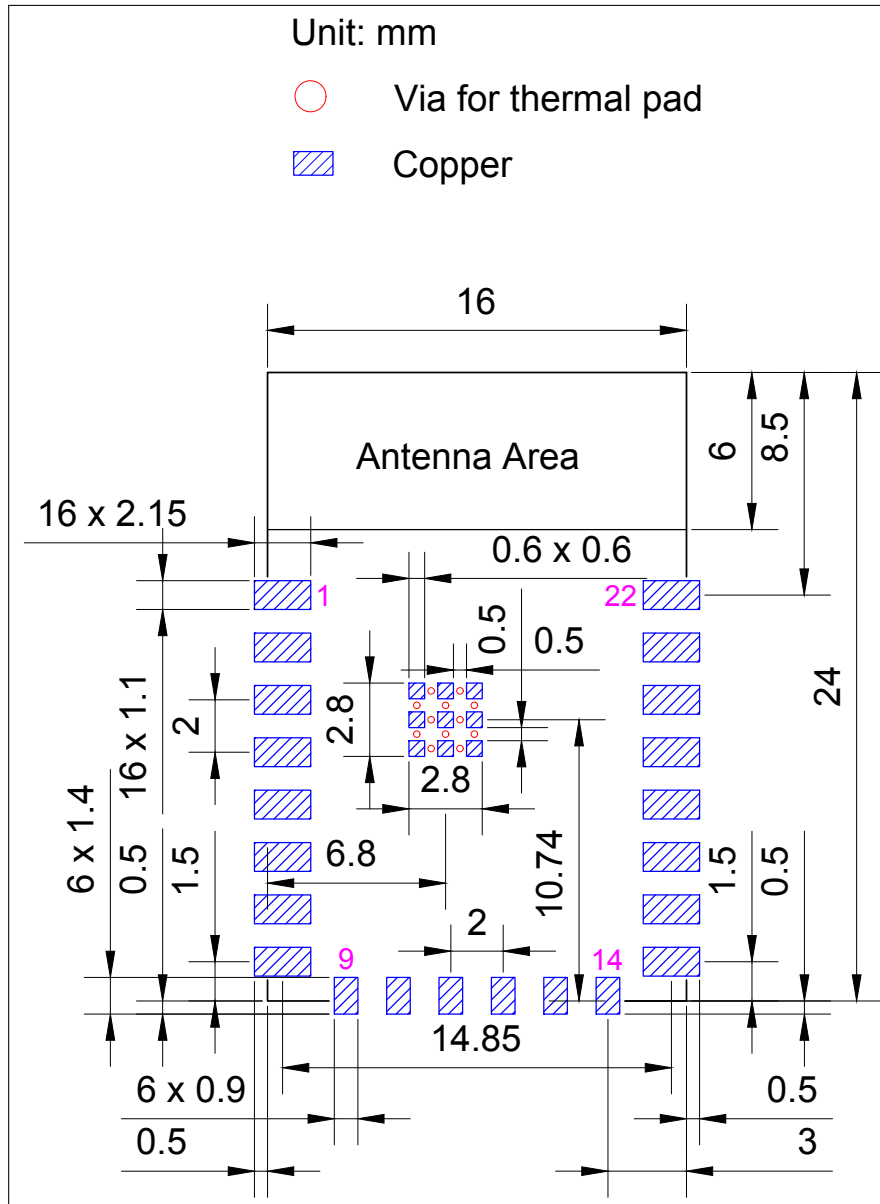


Figure 7: Recommended PCB Land Pattern

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.

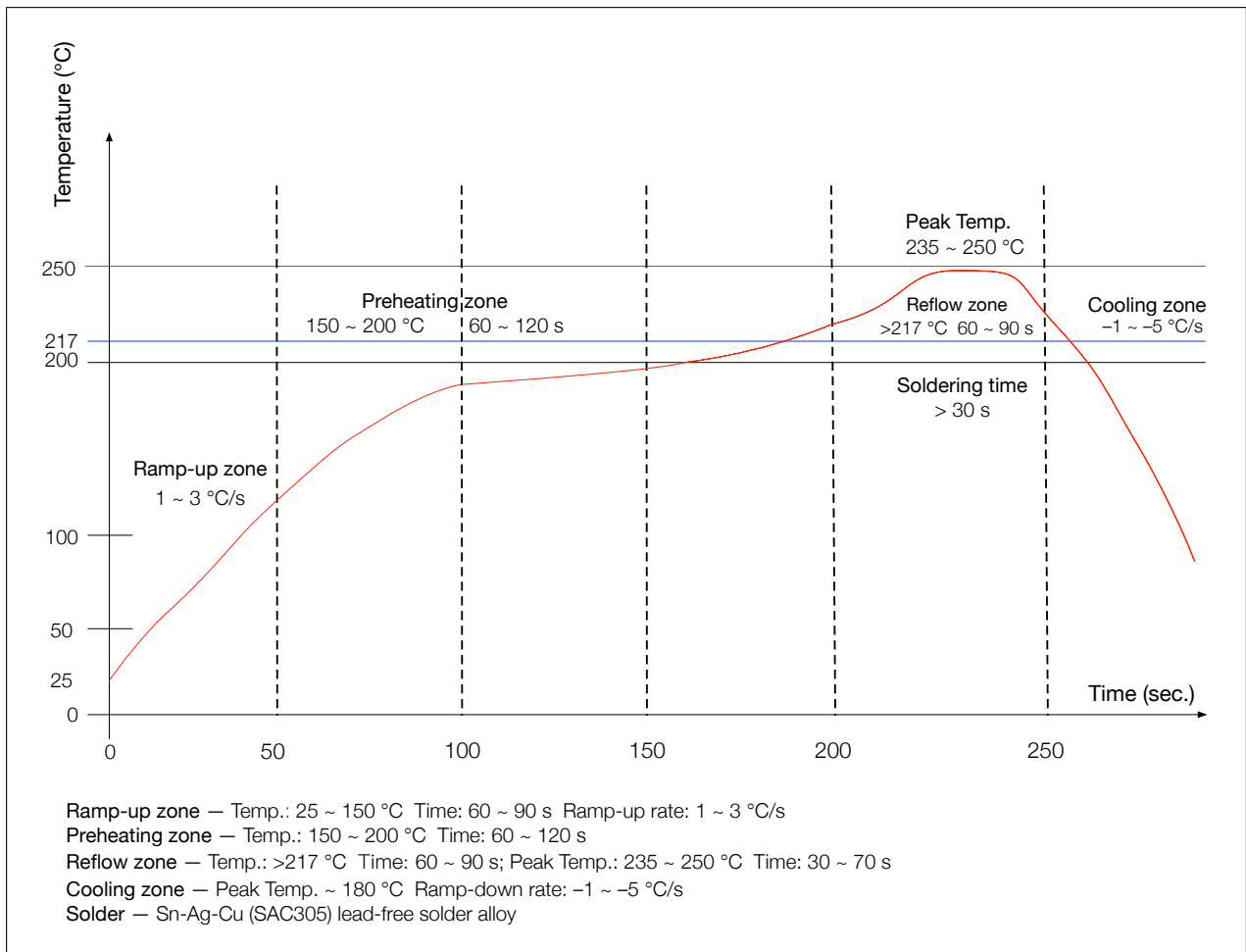


Figure 8: Reflow Profile

8.4 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.**

9 Related Documentation and Resources

Related Documentation

- [ESP8685 Series Datasheet](#) – Specifications of the ESP8685 hardware.
- *Certificates*
<https://espressif.com/en/support/documents/certificates>
- *Documentation Updates and Update Notification Subscription*
<https://espressif.com/en/support/download/documents>

Developer Zone

- [ESP-IDF Programming Guide for ESP8685](#) – 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

- *ESP8685 Series SoCs* – Browse through all ESP8685 SoCs.
<https://espressif.com/en/products/socs?id=ESP8685>
- *ESP8685 Series Modules* – Browse through all ESP8685-based modules.
<https://espressif.com/en/products/modules?id=ESP8685>
- *ESP8685 Series DevKits* – Browse through all ESP8685-based devkits.
<https://espressif.com/en/products/devkits?id=ESP8685>
- *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
2023-02-27	v1.1	<ul style="list-style-type: none">• Updated Section 4.4.2 Current Consumption in Other Modes• Updated "RF power control range" in Table Bluetooth LE RF Transmitter (TX) Specifications• Updated note 1 in Chapter 6 Peripheral Schematics• Added descriptions and link of the source file in Section 7.2 Recommended PCB Land Pattern
2022-04-25	v1.0	<ul style="list-style-type: none">• Added a new module variant ESP8685-WROOM-01-H4• Updated Chapter 6 Peripheral Schematics
2021-08-16	V0.5	Preliminary release



www.espressif.com

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 © 2023 Espressif Systems (Shanghai) Co., Ltd. All rights reserved.