ESP32-PICO-D4 Datasheet

Espressif Systems

August 31, 2017

About This Guide

This document provides an introduction to the specifications of the ESP32-PICO-D4 module.

The document structure is as follows:

Chapter	Title	Subject
Chapter 1	Overview	An overview of the ESP32-PICO-D4 module.
Chapter 2	Pin Definitions	Pinout and pin descriptions.
Chapter 3	Functional Description	Description of functional modules and protocols.
Chapter 4	Electrical Characteristics	Electrical characteristics and specifications of ESP32-PICO-D4.
Chapter 5	Schematics	Schematics of ESP32-PICO-D4.
Chapter 6	Package Information	Package information of ESP32-PICO-D4.
Chapter 7	Learning Resources	ESP32-related must-read materials and must-have resources.

Release Notes

Date	Version	Release notes
2017.08	V1.0	First release.

Documentation Change Notification

Espressif provides email notifications to keep customers updated on changes to technical documentation. Please subscribe here.

Certificates

Download certificates for Espressif products from here.

Disclaimer and Copyright Notice

Information in this document, including URL references, is subject to change without notice. THIS DOCUMENT IS PROVIDED AS IS WITH NO WARRANTIES WHATSOEVER, INCLUDING ANY WARRANTY OF MERCHANTABILITY, NON-INFRINGEMENT, FITNESS FOR ANY PARTICULAR PURPOSE, OR 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.

Contents

List of Tables

List of Figures

1. Overview

The ESP32-PICO-D4 is a System-in-Package (SIP) module that is based on ESP32, providing complete Wi-Fi and Bluetooth functionalities. The module has a size as small as 7.0±0.1 mm×7.0±0.1 mm×0.94±0.1 mm, thus requiring minimal PCB area. The module integrates a 4-MB SPI flash.

At the core of this module is the ESP32 chip*, which is a single 2.4 GHz Wi-Fi and Bluetooth combo chip designed with TSMC's 40 nm ultra-low power technology. ESP32-PICO-D4 integrates all peripheral components seamlessly, including a crystal oscillator, flash, filter capacitors and RF matching links in one single package. Given that no other peripheral components are involved, module welding and testing is not required either. As such, ESP32-PICO-D4 reduces the complexity of supply chain and improves control efficiency.

With its ultra-small size, robust performance and low-energy consumption, ESP32-PICO-D4 is well suited for any space-limited or battery-operated applications, such as wearable electronics, medical equipment, sensors and other IoT products.

Note:
* For details on ESP32, please refer to the document ESP32 Datasheet.

Table 1 provides the specifications of the ESP32-PICO-D4 module.

Table 1: ESP32-PICO-D4 Specifications

Categories	Items	Specifications
Wi-Fi	Protocols	802.11 b/g/n/e/i (802.11n up to 150 Mbps)
		A-MPDU and A-MSDU aggregation and 0.4 μs guard interval support
	Frequency range	2.4 ~ 2.5 GHz
Bluetooth	Protocols	Bluetooth V4.2 BR/EDR and BLE specification
	Radio	NZIF receiver with -97 dBm sensitivity
		Class-1, class-2 and class-3 transmitter
		AFH
	Audio	CVSD and SBC
Hardware	Module interface	ADC, LNA pre-amplifier, DAC, touch sensor, SD/SDIO/MMC Host Controller, SPI, SDIO/SPI Slave Controller, EMAC, motor PWM, LED PWM, UART, I2C, I2S, infrared remote controller, GPIO
	On-chip sensor	Hall sensor, temperature sensor
	On-board clock	40 MHz crystal
	Operating voltage/Power supply	2.3 ~ 3.6V
	Operating current	Average: 80 mA
	Minimum current delivered by power supply	500 mA
	Operating temperature range	-40°C ~ 85°C
	Ambient temperature range	Normal temperature
	Package size	7.0±0.1 mm x 7.0±0.1 mm x 0.94±0.1 mm

Categories	Items	Specifications
Software	Wi-Fi mode	Station/SoftAP/SoftAP+Station/P2P
	Wi-Fi security	WPA/WPA2/WPA2-Enterprise/WPS
	Encryption	AES/RSA/ECC/SHA
	Firmware upgrade	UART Download / OTA (via network / download and write firmware via host)
	Software development	Supports Cloud Server Development / SDK for custom firmware development
	Network protocols	IPv4, IPv6, SSL, TCP/UDP/HTTP/FTP/MQTT
	User configuration	AT instruction set, cloud server, Android/iOS app

2. Pin Definitions

2.1 Pin Layout

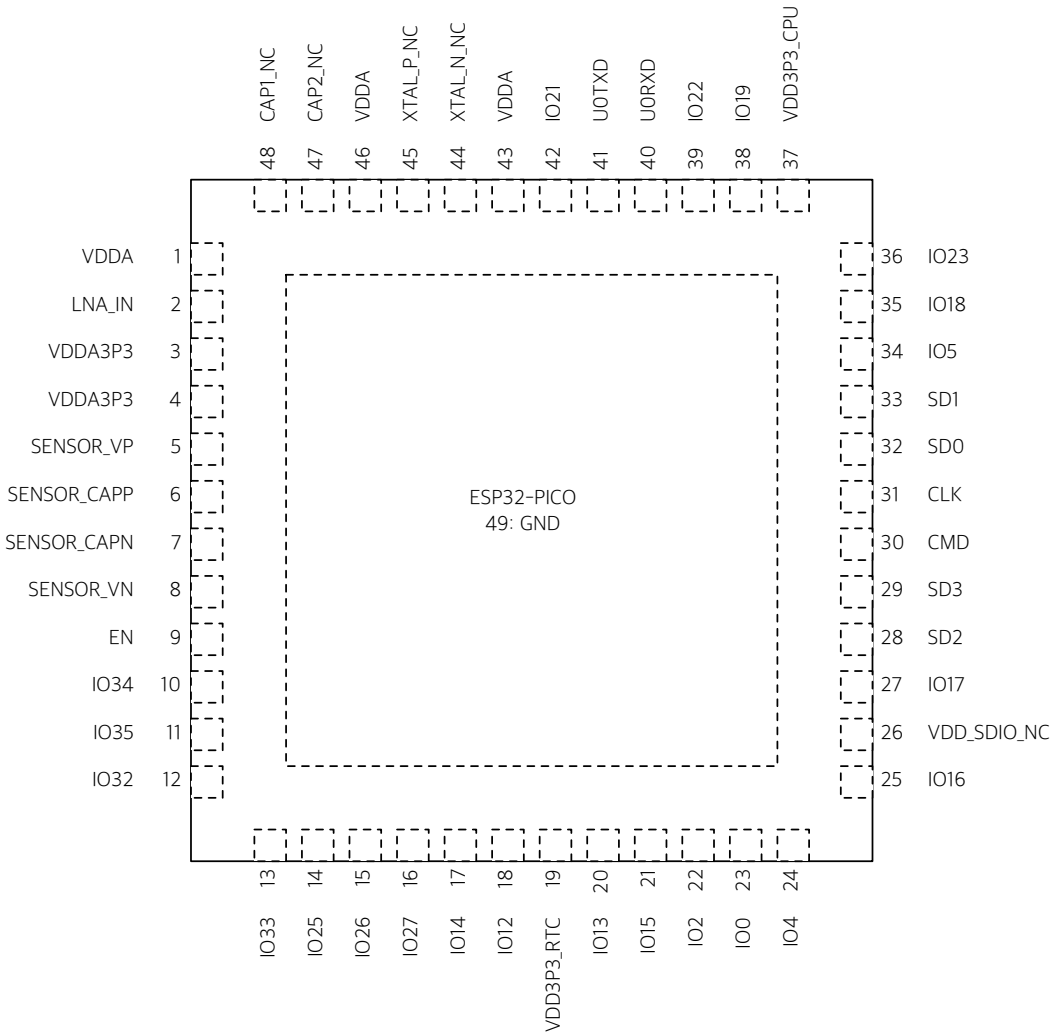


Figure 1: ESP32-PICO-D4 Pin Layout

2.2 Pin Description

The ESP32-PICO-D4 module has 49 pins. See pin definitions in Table 2.

Table 2: Pin Description

Name	No.	Type	Function
Analog			
VDDA	1	P	Analog power supply (2.3V ~ 3.6V)
LNA_IN	2	I/O	RF input and output
VDDA3P3	3	P	Power supply amplifier (2.3V ~ 3.6V)
VDDA3P3	4	P	Power supply amplifier (2.3V ~ 3.6V)

Name	No.	Type	Function
SENSOR_VP	5	I	GPIO36, ADC_PRE_AMP, ADC1_CH0, RTC_GPIO0 Note: Connects a 270 pF capacitor from SENSOR_VP to SENSOR_CAPP, when used as ADC_PRE_AMP.
SENSOR_CAPP	6	I	GPIO37, ADC_PRE_AMP, ADC1_CH1, RTC_GPIO1 Note: Connects a 270 pF capacitor from SENSOR_VP to SENSOR_CAPP, when used as ADC_PRE_AMP.
SENSOR_CAPN	7	I	GPIO38, ADC1_CH2, ADC_PRE_AMP, RTC_GPIO2 Note: Connects a 270 pF capacitor from SENSOR_VN to SENSOR_CAPN, when used as ADC_PRE_AMP.
SENSOR_VN	8	I	GPIO39, ADC1_CH3, ADC_PRE_AMP, RTC_GPIO3 Note: Connects a 270 pF capacitor from SENSOR_VN to SENSOR_CAPN, when used as ADC_PRE_AMP.
EN	9	I	Chip Enable (Active High) High: On; chip works properly Low: Off; chip works at the minimum power Note: Do not leave CHIP_PU pin floating
IO34	10	I	ADC1_CH6, RTC_GPIO4
IO35	11	I	ADC1_CH7, RTC_GPIO5
IO32	12	I/O	32K_XP (32.768 kHz crystal oscillator input), ADC1_CH4, TOUCH9, RTC_GPIO9
IO33	13	I/O	32K_XN (32.768 kHz crystal oscillator output), ADC1_CH5, TOUCH8, RTC_GPIO8
IO25	14	I/O	GPIO25, DAC_1, ADC2_CH8, RTC_GPIO6, EMAC_RXD0
IO26	15	I/O	GPIO26, DAC_2, ADC2_CH9, RTC_GPIO7, EMAC_RXD1
IO27	16	I/O	GPIO27, ADC2_CH7, TOUCH7, RTC_GPIO17, EMAC_RX_DV
IO14	17	I/O	ADC2_CH6, TOUCH6, RTC_GPIO16, MTMS, HSPICLK, HS2_CLK, SD_CLK, EMAC_TXD2
IO12	18	I/O	ADC2_CH5, TOUCH5, RTC_GPIO15, MTDI, HSPIQ, HS2_DATA2, SD_DATA2, EMAC_TXD3
VDD3P3_RTC	19	P	RTC IO power supply input (1.8V ~ 3.6V)
IO13	20	I/O	ADC2_CH4, TOUCH4, RTC_GPIO14, MTCK, HSPID, HS2_DATA3, SD_DATA3, EMAC_RX_ER
IO15	21	I/O	ADC2_CH3, TOUCH3, RTC_GPIO13, MTDO, HSPICS0, HS2_CMD, SD_CMD, EMAC_RXD3
IO2	22	I/O	ADC2_CH2, TOUCH2, RTC_GPIO12, HSPIWP, HS2_DATA0, SD_DATA0
IO0	23	I/O	ADC2_CH1, TOUCH1, RTC_GPIO11, CLK_OUT1, EMAC_TX_CLK
IO4	24	I/O	ADC2_CH0, TOUCH0, RTC_GPIO10, HSPIHD, HS2_DATA1, SD_DATA1, EMAC_TX_ER
IO16	25	I/O	GPIO16, HS1_DATA4, U2RXD, EMAC_CLK_OUT
VDD_SDIO_NC	26	-	NC
IO17	27	I/O	GPIO17, HS1_DATA5, U2TXD, EMAC_CLK_OUT_180
SD2	28	I/O	GPIO9, SD_DATA2, SPIHD, HS1_DATA2, U1RXD
SD3	29	I/O	GPIO10, SD_DATA3, SPIWP, HS1_DATA3, U1TXD

Name	No.	Type	Function
CMD	30	I/O	GPIO11, SD_CMD, SPICS0, HS1_CMD, U1RTS
CLK	31	I/O	GPIO6, SD_CLK, SPICLK, HS1_CLK, U1CTS
SD0	32	I/O	GPIO7, SD_DATA0, SPIQ, HS1_DATA0, U2RTS
SD1	33	I/O	GPIO8, SD_DATA1, SPID, HS1_DATA1, U2CTS
IO5	34	I/O	GPIO5, VSPICS0, HS1_DATA6, EMAC_RX_CLK
IO18	35	I/O	GPIO18, VSPICLK, HS1_DATA7
IO23	36	I/O	GPIO23, VSPID, HS1_STROBE
VDD3P3_CPU	37	P	CPU IO power supply input (1.8V ~ 3.6V)
IO19	38	I/O	GPIO19, VSPIQ, U0CTS, EMAC_TXD0
IO22	39	I/O	GPIO22, VSPIWP, U0RTS, EMAC_TXD1
U0RXD	40	I/O	GPIO3, U0RXD, CLK_OUT2
U0TXD	41	I/O	GPIO1, U0TXD, CLK_OUT3, EMAC_RXD2
IO21	42	I/O	GPIO21, VSPIHD, EMAC_TX_EN
VDDA	43	P	Analog power supply (2.3V ~ 3.6V)
XTAL_N_NC	44	-	NC
XTAL_P_NC	45	-	NC
VDDA	46	P	Digital power supply for PLL (2.3V ~ 3.6V)
CAP2_NC	47	-	NC
CAP1_NC	48	-	NC
GND	49	P	Ground

Note:
Pins IO16, IO17, CMD, CLK, SD0 and SD1 are used for connecting the embedded flash, and are not recommended for other uses.

2.3 Strapping Pins

ESP32 has five strapping pins, which can be seen in Section 5 Schematics:

- MTDI
- GPIO0
- GPIO2
- MTDO
- GPIO5

Software can read the value of these five bits from the register "GPIO_STRAPPING".

During the chip power-on 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. The strapping bits configure the device boot mode, the operating voltage of VDD_SDIO and other system initial settings.

Each strapping pin is connected with its internal pull-up/pull-down during the chip reset. Consequently, if a strapping pin is unconnected or the connected external circuit is high-impendence, the internal weak pull-up/pull-down will determine the default input level of the strapping pins.

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

After reset, the strapping pins work as the normal functions pins.

Refer to Table 3 for detailed boot modes' configuration by strapping pins.

Table 3: Strapping Pins

Voltage of Internal LDO (VDD_SDIO)			
Pin	Default	3.3V	1.8V
MTDI	Pull-down	0	1
Booting Mode			
Pin	Default	SPI Boot	Download Boot
GPIO0	Pull-up	1	0
GPIO2	Pull-down	Don't-care	0
Debugging Log on U0TXD During Booting			
Pin	Default	U0TXD Toggling	U0TXD Silent
MTDO	Pull-up	1	0

Timing of SDIO Slave					
Pin	Default	Falling-edge Input Falling-edge Output	Falling-edge Input Rising-edge Output	Rising-edge Input Falling-edge Output	Rising-edge Input Rising-edge Output
MTDO	Pull-up	0	0	1	1
GPIO5	Pull-up	0	1	0	1

Note:
Firmware can configure register bits to change the settings of "Voltage of Internal LDO (VDD_SDIO)" and "Timing of SDIO Slave", after booting.

3. Functional Descriptions

This chapter describes the modules integrated in ESP32-PICO-D4, and their functions.

3.1 CPU and Internal Memory

ESP32 contains two low-power Xtensa® 32-bit LX6 microprocessors. The internal memory includes:

- 448 KB of ROM for booting and core functions.
- 520 KB (8 KB RTC FAST Memory included) of on-chip SRAM for data and instruction.
  - 8 KB of SRAM in RTC, which is called RTC FAST Memory and can be used for data storage; it is accessed by the main CPU during RTC Boot from the Deep-sleep mode.
- 8 KB of SRAM in RTC, which is called RTC SLOW Memory and can be accessed by the co-processor during the Deep-sleep mode.
- 1 kbit of eFuse, of which 256 bits are used for the system (MAC address and chip configuration) and the remaining 768 bits are reserved for customer applications, including Flash-Encryption and Chip-ID.

3.2 External Flash and SRAM

ESP32 supports up to four 16-MB of external QSPI flash and SRAM with hardware encryption based on AES to protect developers' programs and data.

ESP32 can access the external QSPI flash and SRAM through high-speed caches.

- Up to 16 MB of external flash are memory-mapped onto the CPU code space, supporting 8, 16 and 32-bit access. Code execution is supported.
- Up to 8 MB of external flash/SRAM are memory-mapped onto the CPU data space, supporting 8, 16 and 32-bit access. Data-read is supported on the flash and SRAM. Data-write is supported on the SRAM.

The ESP32-PICO-D4 module integrates 4 MB of external SPI flash. The 4-MB SPI flash can be memory-mapped onto the CPU code space, supporting 8, 16 and 32-bit access. Code execution is supported.

Note:
The operating voltage of ESP32-PICO-D4's integrated external SPI flash is 3.3V. Therefore, the strapping pin MTDI should hold bit "0" during the module power-on reset.

3.3 Crystal Oscillators

ESP32-PICO-D4 integrates a 40 MHz crystal oscillator.

3.4 Peripherals and Sensors

Please refer to Section 4 Peripherals and Sensors in ESP32 Datasheet.

Note:
Users should note that pins of the embedded ESP32 chip, that are used for connecting peripherals, such as the flash or PSRAM, are not recommended for other uses. For details, please see Section 5 Schematics.

3.5 RTC and Power Consumption

With the use of advanced power management technologies, ESP32 can switch between different power modes (see Table 4).

- Power modes
  - Active mode: The chip radio is powered on. The chip can receive, transmit, or listen.
  - Modem-sleep mode: The CPU is operational and the clock is configurable. The Wi-Fi/Bluetooth baseband and radio are disabled.
  - Light-sleep mode: The CPU is paused. The RTC memory and RTC peripherals, as well as the ULP co-processor are running. Any wake-up events (MAC, host, RTC timer, or external interrupts) will wake up the chip.
  - Deep-sleep mode: Only the RTC memory and RTC peripherals are powered on. Wi-Fi and Bluetooth connection data are stored in the RTC memory. The ULP co-processor can work.
  - Hibernation mode: The internal 8-MHz oscillator and ULP co-processor are disabled. The RTC recovery memory is powered down. Only one RTC timer on the slow clock and some RTC GPIOs are active. The RTC timer or the RTC GPIOs can wake up the chip from the Hibernation mode.
- Sleep Patterns
  - Association sleep pattern: The power mode switches between the Active mode, Modem- and Light-sleep mode during this sleep pattern. The CPU, Wi-Fi, Bluetooth, and radio are woken up at predetermined intervals to keep Wi-Fi/BT connections alive.
  - ULP sensor-monitored pattern: The main CPU is in the Deep-sleep mode. The ULP co-processor takes sensor measurements and wakes up the main system, based on the data collected from sensors.

Table 4: Functionalities Depending on the Power Modes

Power mode	Active	Modem-sleep	Light-sleep	Deep-sleep	Hibernation
Sleep pattern	Association sleep pattern			ULP sensor-monitored pattern	-
CPU	ON	ON	PAUSE	OFF	OFF
Wi-Fi/BT baseband and radio	ON	OFF	OFF	OFF	OFF
RTC memory and RTC peripherals	ON	ON	ON	ON	OFF
ULP co-processor	ON	ON	ON	ON/OFF	OFF

The power consumption varies with different power modes/sleep patterns and work statuses of functional modules. Please see Table 5 for details.

Table 5: Power Consumption by Power Modes

Power mode	Description	Power consumption
Active (RF working)	Wi-Fi Tx packet 14 dBm ~ 19.5 dBm	Please refer to ESP32 Datasheet.
	Wi-Fi / BT Tx packet 0 dBm	
	Wi-Fi / BT Rx and listening	
	Association sleep pattern (by Light-sleep)	1 mA ~ 4 mA @DTIM3
Modem-sleep	The CPU is powered on.	Max speed 240 MHz: 30 mA ~ 50 mA
		Normal speed 80 MHz: 20 mA ~ 25 mA
		Slow speed 2 MHz: 2 mA ~ 4 mA
Light-sleep	-	0.8 mA
Deep-sleep	The ULP co-processor is powered on.	150 μA
	ULP sensor-monitored pattern	100 μA @1% duty
	RTC timer + RTC memory	10 μA
Hibernation	RTC timer only	5 μA
Power off	CHIP_PU is set to low level, the chip is powered off	0.1 μA

Note:

- During Deep-sleep, when the ULP co-processor is powered on, peripherals such as GPIO and I2C are able to work.
- When the system works in the ULP sensor-monitored pattern, the ULP co-processor works with the ULP sensor periodically; ADC works with a duty cycle of 1%, so the power consumption is 100 μA.

4. Electrical Characteristics

Note:
The specifications in this chapter have been tested under the following general condition: VDD = 3.3V, T_A = 27°C, unless otherwise specified.

4.1 Absolute Maximum Ratings

Table 6: Absolute Maximum Ratings

Parameter	Symbol	Min	Typ	Max	Unit
Power supply[1]	VDD	2.3	3.3	3.6	V
Minimum current delivered by power supply	I_{VDD}	0.5	-	-	A
Input low voltage	V_{IL}	-0.3	-	0.25×V_{IO}[2]	V
Input high voltage	V_{IH}	0.75×V_{IO}[2]	-	V_{IO}[2]+0.3	V
Input leakage current	I_{IL}	-	-	50	nA
Input pin capacitance	C_{pad}	-	-	2	pF
Output low voltage	V_{OL}	-	-	0.1×V_{IO}[2]	V
Output high voltage	V_{OH}	0.8×V_{IO}[2]	-	-	V
Maximum output drive capability	I_{MAX}	-	-	40	mA
Storage temperature range	T_{STR}	-40	-	85	°C
Operating temperature range	T_{OPR}	-40	-	85	°C

1. The power supplies include VDDA, VDD3P3, VDD3P3_RTC, VDD3P3_CPU, VDD_SDIO. The VDD_SDIO also supports 1.8V mode.
2. V_{IO} is the power supply for a specific pad. More details can be found in the ESP32 Datasheet, Appendix IO_MUX. For example, the power supply for SD_CLK is the VDD_SDIO.

4.2 Wi-Fi Radio

Table 7: Wi-Fi Radio Characteristics

Description	Min	Typical	Max	Unit
Input frequency	2412	-	2484	MHz
Output impedance	-	50	-	Ω
Input reflection	-	-	-10	dB
Tx power				
Output power of PA for 72.2 Mbps	13	14	15	dBm
Output power of PA for 11b mode	19.5	20	20.5	dBm
Sensitivity				
DSSS, 1 Mbps	-	-98	-	dBm
CCK, 11 Mbps	-	-91	-	dBm
OFDM, 6 Mbps	-	-93	-	dBm

Description	Min	Typical	Max	Unit
OFDM, 54 Mbps	-	-75	-	dBm
HT20, MCS0	-	-93	-	dBm
HT20, MCS7	-	-73	-	dBm
HT40, MCS0	-	-90	-	dBm
HT40, MCS7	-	-70	-	dBm
MCS32	-	-89	-	dBm
Adjacent channel rejection				
OFDM, 6 Mbps	-	37	-	dB
OFDM, 54 Mbps	-	21	-	dB
HT20, MCS0	-	37	-	dB
HT20, MCS7	-	20	-	dB

4.3 Bluetooth LE Radio

4.3.1 Receiver

Table 8: Receiver Characteristics – BLE

Parameter	Conditions	Min	Typ	Max	Unit
Sensitivity @30.8% PER	-	-	-97	-	dBm
Maximum received signal @30.8% PER	-	0	-	-	dBm
Co-channel C/I	-	-	+10	-	dB
Adjacent channel selectivity C/I	F = F0 + 1 MHz	-	-5	-	dB
	F = F0 - 1 MHz	-	-5	-	dB
	F = F0 + 2 MHz	-	-25	-	dB
	F = F0 - 2 MHz	-	-35	-	dB
	F = F0 + 3 MHz	-	-25	-	dB
	F = F0 - 3 MHz	-	-45	-	dB
Out-of-band blocking performance	30 MHz ~ 2000 MHz	-10	-	-	dBm
	2000 MHz ~ 2400 MHz	-27	-	-	dBm
	2500 MHz ~ 3000 MHz	-27	-	-	dBm
	3000 MHz ~ 12.5 GHz	-10	-	-	dBm
Intermodulation	-	-36	-	-	dBm

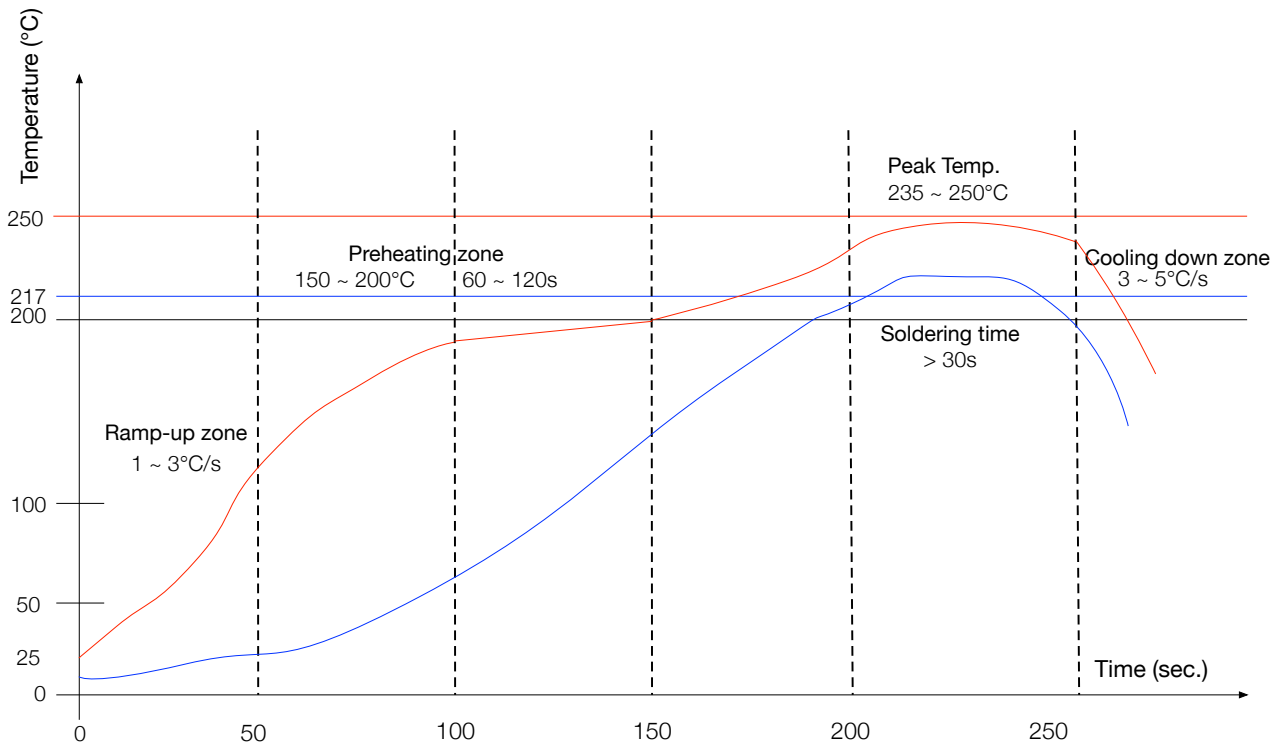
4.3.2 Transmit

Table 9: Transmit Characteristics - BLE

Parameter	Conditions	Min	Typ	Max	Unit
RF transmit power	-	-	0	-	dBm
Gain control step	-	-	±3	-	dBm
RF power control range	-	-12	-	+12	dBm

Parameter	Conditions	Min	Typ	Max	Unit
Adjacent channel transmit power	F = F0 + 1 MHz	-	-14.6	-	dBm
	F = F0 - 1 MHz	-	-12.7	-	dBm
	F = F0 + 2 MHz	-	-44.3	-	dBm
	F = F0 - 2 MHz	-	-38.7	-	dBm
	F = F0 + 3 MHz	-	-49.2	-	dBm
	F = F0 - 3 MHz	-	-44.7	-	dBm
	F = F0 + > 3 MHz	-	-50	-	dBm
	F = F0 - > 3 MHz	-	-50	-	dBm
$\Delta f1_{avg}$	-	-	-	265	kHz
$\Delta f2_{max}$	-	247	-	-	kHz
$\Delta f2_{avg}/\Delta f1_{avg}$	-	-	-0.92	-	-
ICFT	-	-	-10	-	kHz
Drift rate	-	-	0.7	-	kHz/50 μs
Drift	-	-	2	-	kHz

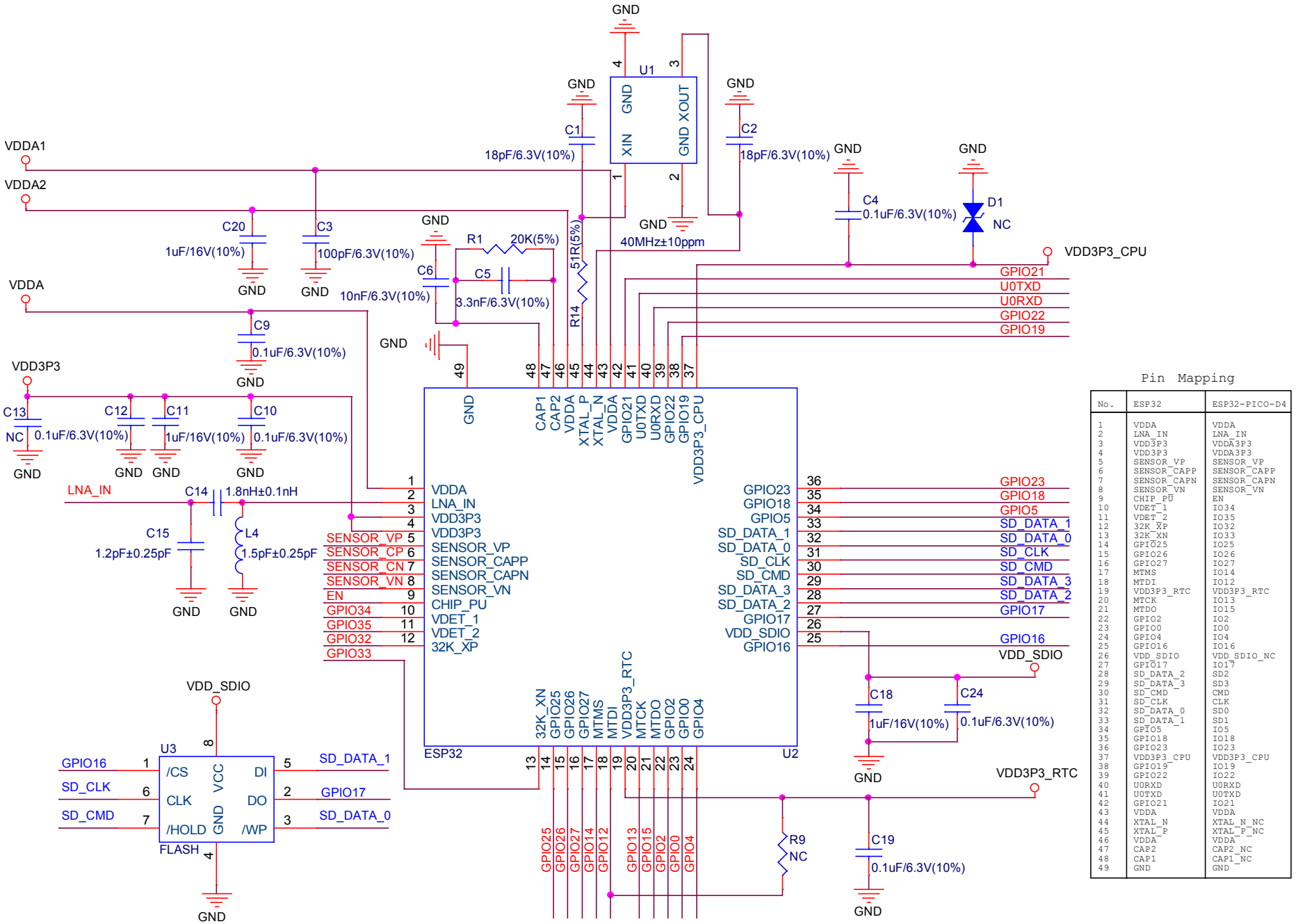
4.4 Reflow Profile



Ramp-up zone — Temp.: <150°C Time: 60 ~ 90s Ramp-up rate: 1 ~ 3°C/s
Preheating zone — Temp.: 150 ~ 200°C Time: 60 ~ 120s Ramp-up rate: 0.3 ~ 0.8°C/s
Reflow soldering zone — Peak Temp.: 235 ~ 250°C (<245°C recommended) Time: 30 ~ 70s
Cooling down zone — Temp.: 217 ~ 170°C Ramp-down rate: 3 ~ 5°C/s
Solder — Sn&Ag&Cu Lead-free solder (SAC305)

Figure 2: Reflow Profile

5. Schematics



Pin Mapping

No.	ESP32	ESP32-PICO-D4
1	VDDA	VDDA
2	LNA_IN	LNA_IN
3	VDD3P3	VDDA3P3
4	VDD3P3	VDDA3P3
5	SENSOR_VP	SENSOR_VP
6	SENSOR_CAPP	SENSOR_CAPP
7	SENSOR_CAPN	SENSOR_CAPN
8	SENSOR_VN	SENSOR_VN
9	CHIP_PU	EN
10	VDET_1	IO34
11	VDET_2	IO35
12	32K_XP	IO32
13	32K_XN	IO33
14	GPIO25	IO25
15	GPIO26	IO26
16	GPIO27	IO27
17	MTMS	IO14
18	MTDI	IO12
19	VDD3P3_RTC	VDD3P3_RTC
20	MTCK	IO13
21	MTDO	IO15
22	GPIO2	IO2
23	GPIO0	IO0
24	GPIO4	IO4
25	GPIO16	IO16
26	VDD_SDIO	VDD_SDIO_NC
27	GPIO17	IO17
28	SD_DATA_2	SD2
29	SD_DATA_3	SD3
30	SD_CMD	CMD
31	SD_CLK	CLK
32	SD_DATA_0	SD0
33	SD_DATA_1	SD1
34	GPIO5	IO5
35	GPIO18	IO18
36	GPIO23	IO23
37	VDD3P3_CPU	VDD3P3_CPU
38	GPIO19	IO19
39	GPIO22	IO22
40	U0RXD	U0RXD
41	U0TXD	U0TXD
42	GPIO21	IO21
43	VDDA	VDDA
44	XTAL_N	XTAL_N_NC
45	XTAL_P	XTAL_P_NC
46	VDDA	VDDA
47	CAP2	CAP2_NC
48	CAP1	CAP1_NC
49	GND	GND

Figure 3: ESP32-PICO-D4 Module Schematics

6. Peripheral Schematics

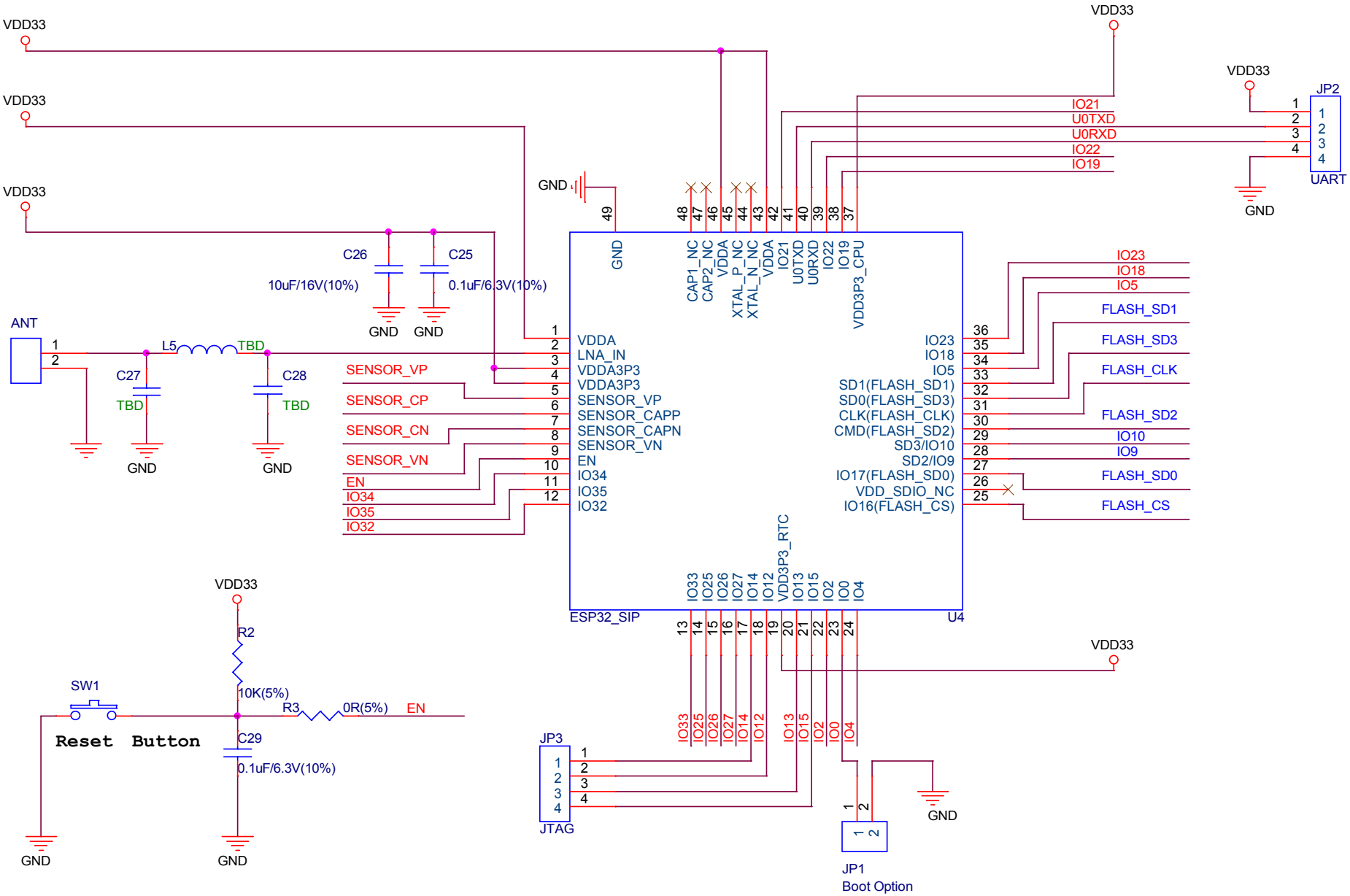
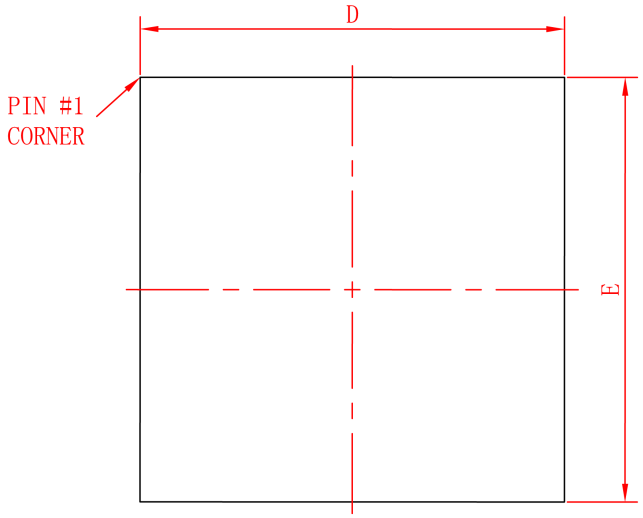
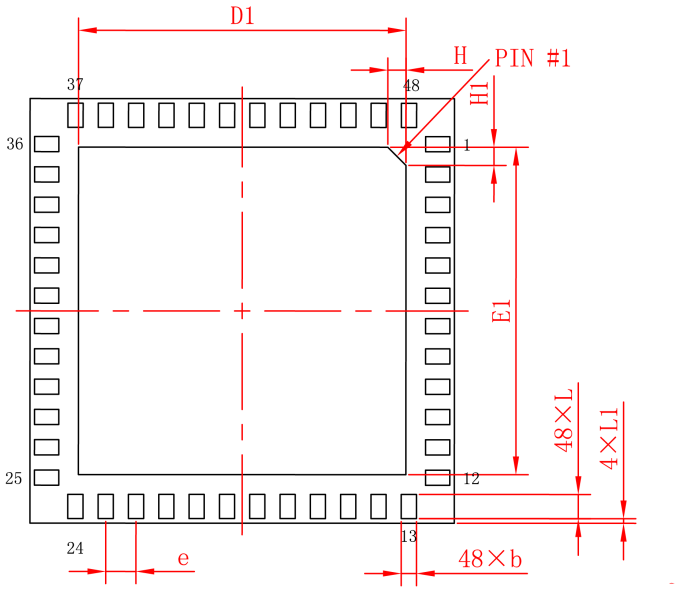


Figure 4: ESP32-PICO-D4 Module Peripheral Schematics

7. Package Information

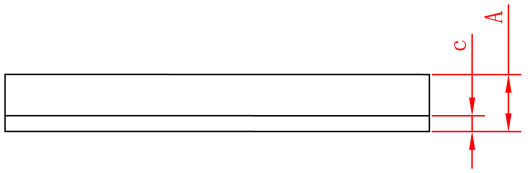


Top View



Bottom View

symbol	Dimension in mm			Dimension in inch		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.840	0.940	1.040	0.033	0.037	0.041
c	0.220	0.260	0.300	0.009	0.010	0.012
D	6.900	7.000	7.100	0.272	0.276	0.280
E	6.900	7.000	7.100	0.272	0.276	0.280
D1	5.300	5.400	5.500	0.209	0.213	0.217
E1	5.300	5.400	5.500	0.209	0.213	0.217
H	--	0.300	--	--	0.012	--
H1	--	0.300	--	--	0.012	--
L	0.325	0.400	0.475	0.013	0.016	0.019
L1	0.000	0.075	0.150	0.000	0.003	0.006
e	--	0.500	--	--	0.020	--
b	0.200	0.250	0.300	0.008	0.010	0.012



Side View

Figure 5: ESP32-PICO-D4 Package

8. Learning Resources

8.1 Must-Read Documents

The following link provides documents related to ESP32.

- ESP32 Datasheet
  This document provides an introduction to the specifications of the ESP32 hardware, including overview, pin definitions, functional description, peripheral interface, electrical characteristics, etc.
- ESP32 Technical Reference Manual
  The manual provides detailed information on how to use the ESP32 memory and peripherals.
- ESP32 Hardware Resources
  The zip files include the schematics, PCB layout, Gerber and BOM list of ESP32 modules and development boards.
- ESP32 Hardware Design Guidelines
  The guidelines outline recommended design practices when developing standalone or add-on systems based on the ESP32 series of products, including ESP32, the ESP-WROOM-32 module, and ESP32-DevKitC—the development board.
- ESP32 AT Instruction Set and Examples
  This document introduces the ESP32 AT commands, explains how to use them, and provides examples of several common AT commands.

8.2 Must-Have Resources

Here are the ESP32-related must-have resources.

- ESP32 BBS
  This is an Engineer-to-Engineer (E2E) Community for ESP32 where you can post questions, share knowledge, explore ideas, and help solve problems with fellow engineers.
- ESP32 Github
  ESP32 development projects are freely distributed under Espressif's MIT license on Github. It is established to help developers get started with ESP32 and foster innovation and the growth of general knowledge about the hardware and software surrounding ESP32 devices.
- ESP32 Tools
  This is a webpage where users can download ESP32 Flash Download Tools and the zip file "ESP32 Certification and Test".
- ESP32 IDF
  This webpage links users to the official IoT development framework for ESP32.
- ESP32 Resources
  This webpage provides the links to all available ESP32 documents, SDK and tools.