

# ESP32-PICO-D4

## Datasheet



Version 1.9  
Espressif Systems  
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## About This Document

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

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# 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  $(7.000\pm 0.100)$  mm  $\times$   $(7.000\pm 0.100)$  mm  $\times$   $(0.940\pm 0.100)$  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, see Section 6: *Schematics*. 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  |
|---------------|---|---|
| Certification | Bluetooth certification                   | BQB   |
| Wi-Fi         | Protocols                                 | 802.11 b/g/n (802.11n up to 150 Mbps)   |
|               |   | A-MPDU and A-MSDU aggregation and 0.4 $\mu$ s guard interval support  |
|               | Frequency range                           | 2.4 ~ 2.5 GHz   |
| Bluetooth     | Protocols                                 | Bluetooth V4.2 BR/EDR and Bluetooth LE specification  |
|               | Radio                                     | NZIF receiver with -97 dBm sensitivity  |
|               |   | Class-1, class-2 and class-3 transmitter  |
| Audio         | AFH                                       |   |
| Hardware      | Module interfaces                         | ADC, DAC, touch sensor, SD/SDIO/MMC Host Controller, SPI, SDIO/SPI Slave Controller, EMAC, motor PWM, LED PWM, UART, I <sup>2</sup> C, I <sup>2</sup> S, infrared remote controller, GPIO, pulse counter, Two-Wire Automotive Interface (TWAI®, compatible with ISO11898-1) |
|               | On-chip sensor                            | Hall sensor   |
|               | Integrated crystal                        | 40 MHz crystal  |
|               | Integrated SPI flash                      | 4 MB  |
|               | Operating voltage/Power supply            | 3.0 V ~ 3.6 V   |
|               | Operating current                         | Average: 80 mA  |
|               | Minimum current delivered by power supply | 500 mA  |

| Categories | Items                            | Specifications                                     |
|------------|----------------------------------|--|
|            | Operating temperature range      | -40 °C ~ 85 °C                                     |
|            | Package size                     | (7.000±0.100) mm×(7.000±0.100) mm×(0.940±0.100) mm |
|            | Moisture sensitivity level (MSL) | Level 3  |

## 2 Pin Definitions

### 2.1 Pin Layout

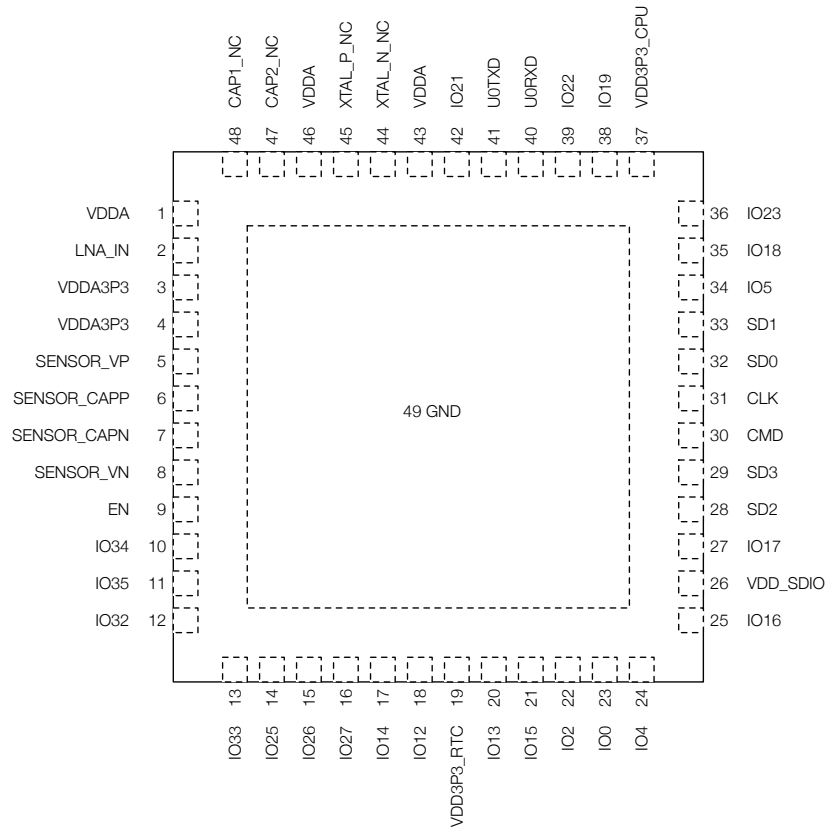


Figure 1: ESP32-PICO-D4 Pin Layout (Top View)

### 2.2 Pin Description

The ESP32-PICO-D4 module has 48 pins. See pin definitions in Table 2.

Table 2: Pin Description

| Name        | No. | Type | Function   |
|-------------|-----|------|--|
| VDDA        | 1   | P    | Analog power supply (2.3 V ~ 3.6 V)  |
| LNA_IN      | 2   | I/O  | RF input and output  |
| VDDA3P3     | 3   | P    | Analog power supply (2.3 V ~ 3.6 V)  |
| VDDA3P3     | 4   | P    | Analog power supply (2.3 V ~ 3.6 V)  |
| SENSOR_VP   | 5   | I    | GPIO36, ADC1_CH0, RTC_GPIO0  |
| SENSOR_CAPP | 6   | I    | GPIO37, ADC1_CH1, RTC_GPIO1  |
| SENSOR_CAPN | 7   | I    | GPIO38, ADC1_CH2, RTC_GPIO2  |
| SENSOR_VN   | 8   | I    | GPIO39, ADC1_CH3, RTC_GPIO3  |
| EN          | 9   | I    | High: On; enables the module<br>Low: Off; the module powers off<br>Note: Do not leave this pin floating. |



| Name       | No. | Type | Function   |
|------------|-----|------|--|
| IO34       | 10  | I    | GPIO34, ADC1_CH6, RTC_GPIO4  |
| IO35       | 11  | I    | GPIO35, ADC1_CH7, RTC_GPIO5  |
| IO32       | 12  | I/O  | GPIO32, 32K_XP (32.768 kHz crystal oscillator input), ADC1_CH4, TOUCH9, RTC_GPIO9  |
| IO33       | 13  | I/O  | GPIO33, 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  | GPIO14, ADC2_CH6, TOUCH6, RTC_GPIO16, MTMS, HSPICLK, HS2_CLK, SD_CLK, EMAC_TXD2    |
| IO12       | 18  | I/O  | GPIO12, ADC2_CH5, TOUCH5, RTC_GPIO15, MTDI, HSPIQ, HS2_DATA2, SD_DATA2, EMAC_TXD3  |
| VDD3P3_RTC | 19  | P    | Input power supply for RTC IO (3.0 V ~ 3.6 V)                                      |
| IO13       | 20  | I/O  | GPIO13, ADC2_CH4, TOUCH4, RTC_GPIO14, MTCK, HSPID, HS2_DATA3, SD_DATA3, EMAC_RX_ER |
| IO15       | 21  | I/O  | GPIO15, ADC2_CH3, TOUCH3, RTC_GPIO13, MTDO, HSPICS0, HS2_CMD, SD_CMD, EMAC_RXD3    |
| IO2        | 22  | I/O  | GPIO2, ADC2_CH2, TOUCH2, RTC_GPIO12, HSPiWP, HS2_DATA0, SD_DATA0                   |
| IO0        | 23  | I/O  | GPIO0, ADC2_CH1, TOUCH1, RTC_GPIO11, CLK_OUT1, EMAC_TX_CLK                         |
| IO4        | 24  | I/O  | GPIO4, 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   | 26  | P    | Output power supply. See <a href="#">note 1</a> under the table.                   |
| 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  |
| 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    | Input power supply for CPU IO (1.8 V ~ 3.6 V)                                      |
| 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 (2.3 V ~ 3.6 V)  |
| XTAL_N_NC  | 44  | -    | NC   |

| Name      | No. | Type | Function                            |
|-----------|-----|------|-------------------------------------|
| XTAL_P_NC | 45  | -    | NC                                  |
| VDDA      | 46  | P    | Analog power supply (2.3 V ~ 3.6 V) |
| CAP2_NC   | 47  | -    | NC                                  |
| CAP1_NC   | 48  | -    | NC                                  |

**Notice:**

1. Note that the embedded flash is connected to VDD\_SDIO which is driven directly by VDD3P3\_RTC through a 6  $\Omega$  resistor. Due to this resistor, there is some voltage drop on this pin from VDD3P3\_RTC.
2. Pins IO16, IO17, CMD, CLK, SD0 and SD1 are used to connect the embedded flash, and can not be used for other purposes. For details, please see Section 6 Schematics.
3. For connecting external PSRAM, SD3 (GPIO10) is recommended for PSRAM\_CS. For details, please see Section 7 Peripheral Schematics.

## 2.3 Strapping Pins

ESP32 has five strapping pins, which can be seen in Chapter 6 Schematics:

- MTDI
- GPIO0
- GPIO2
- MTDO
- GPIO5

Software can read the values of these five bits from register "GPIO\_STRAPPING".

During the chip's system reset release (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. The strapping bits configure the device's boot mode, the operating voltage of VDD\_SDIO and other initial system settings.

Each strapping pin is connected to its internal pull-up/pull-down during the chip reset. Consequently, if a strapping pin is unconnected or the connected external circuit is high-impedance, 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 use the host MCU's GPIOs to control the voltage level of these pins when powering on ESP32.

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

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

**Table 3: Strapping Pins**

| Voltage of Internal LDO (VDD_SDIO) |           |       |       |
|------------------------------------|-----------|-------|-------|
| Pin                                | Default   | 3.3 V | 1.8 V |
| 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                        |                          |
| Enabling/Disabling Debugging Log Print over U0TXD During Booting |           |                          |                          |                          |                          |
| Pin  | Default   | U0TXD Active             |                          | U0TXD Silent             |                          |
| MTDO   | Pull-up   | 1                        |                          | 0                        |                          |
| Timing of SDIO Slave   |           |                          |                          |                          |                          |
| Pin  | Default   | FE Sampling<br>FE Output | FE Sampling<br>RE Output | RE Sampling<br>FE Output | RE Sampling<br>RE 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.
- The operating voltage of ESP32-PICO-D4's integrated external SPI flash is 3.3 V. Therefore, the strapping pin MTDI should hold bit "0" during the module power-on reset.

## 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 of on-chip SRAM for data and instructions.
- 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: 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 multiple external QSPI flash and SRAM chips. More details can be found in Chapter SPI in the [ESP32 Technical Reference Manual](#). ESP32 also supports hardware encryption/decryption based on AES to protect developers' programs and data in flash.

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

- The external flash can be mapped into CPU instruction memory space and read-only memory space simultaneously.
  - When external flash is mapped into CPU instruction memory space, up to 11 MB + 248 KB can be mapped at a time. Note that if more than 3 MB + 248 KB are mapped, cache performance will be reduced due to speculative reads by the CPU.
  - When external flash is mapped into read-only data memory space, up to 4 MB can be mapped at a time. 8-bit, 16-bit and 32-bit reads are supported.
- External SRAM can be mapped into CPU data memory space. Up to 4 MB can be mapped at a time. 8-bit, 16-bit and 32-bit reads and writes are supported.

The ESP32-PICO-D4 module integrates 4 MB of external SPI flash.

### 3.3 Crystal Oscillators

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

### 3.4 RTC and Power Consumption

With the use of advanced power-management technologies, ESP32 can switch between different power modes.

For details on ESP32's power consumption in different power modes, please refer to section "RTC and Low-Power Management" in [ESP32 Datasheet](#).

## 4 Peripherals and Sensors

Please refer to Section Peripherals and Sensors in [ESP32 Datasheet](#).

**Note:**

- Pins IO16, IO17, CMD, CLK, SD0 and SD1 are used for connecting the embedded flash, and are not recommended for other uses. For details, please see Section 6 Schematics.
- For connecting external PSRAM, SD3 (GPIO10) is recommended for PSRAM\_CS. For details, please see Section 7 Peripheral Schematics.

## 5 Electrical Characteristics

### 5.1 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 that should follow the [recommended operating conditions](#).

**Table 4: Absolute Maximum Ratings**

| Symbol         | Parameter                    | Min  | Max   | Unit |
|----------------|------------------------------|------|-------|------|
| VDD33          | Power supply voltage         | -0.3 | 3.6   | V    |
| $I_{output}^1$ | Cumulative IO output current | -    | 1,100 | mA   |
| $T_{store}$    | Storage temperature          | -40  | 150   | °C   |

1. The module worked properly after a 24-hour test in ambient temperature at 25 °C, and the IOs in three domains (VDD3P3\_RTC, VDD3P3\_CPU, VDD\_SDIO) output high logic level to ground. Please note that pins occupied by flash and/or PSRAM in the VDD\_SDIO power domain were excluded from the test.
2. Please see Appendix IO\_MUX of [ESP32 Datasheet](#) for IO's power domain.

### 5.2 Recommended Operating Conditions

**Table 5: Recommended Operating Conditions**

| Symbol    | Parameter                                  | Min | Typical | 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         | Operating temperature                      | -40 | -       | 85  | °C   |

### 5.3 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  | $0.75 \times VDD^1$                     | -   | $VDD^1 + 0.3$       | 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   |    |
| $V_{OH}$ | High-level output voltage   | $0.8 \times VDD^1$                      | -   | -                   | V    |    |
| $V_{OL}$ | Low-level output voltage  | -                                       | -   | $0.1 \times VDD^1$  | V    |    |
| $I_{OH}$ | High-level source current<br>( $VDD^1 = 3.3$ V, $V_{OH} \geq 2.64$ V,<br>output drive strength set to the<br>maximum) | VDD3P3_CPU power domain <sup>1, 2</sup> | -   | 40                  | -    | mA |
|          |   | VDD3P3_RTC power domain <sup>1, 2</sup> | -   | 40                  | -    | mA |
|          |   | VDD_SDIO power domain <sup>1, 3</sup>   | -   | 20                  | -    | mA |

| Symbol         | Parameter  | Min | Typ | Max | Unit       |
|----------------|--|-----|-----|-----|------------|
| $I_{OL}$       | Low-level sink current<br>( $V_{DD}^1 = 3.3\text{ V}$ , $V_{OL} = 0.495\text{ V}$ ,<br>output drive strength set to the maximum) | -   | 28  | -   | mA         |
| $R_{PU}$       | Resistance of internal pull-up resistor  | -   | 45  | -   | k $\Omega$ |
| $R_{PD}$       | Resistance of internal pull-down resistor  | -   | 45  | -   | k $\Omega$ |
| $V_{IL\_nRST}$ | Low-level input voltage of CHIP_PU to power off the chip   | -   | -   | 0.6 | V          |

**Notes:**

1. Please see Appendix IO\_MUX of [ESP32 Datasheet](#) for IO's power domain. VDD is the I/O voltage for a particular power domain of pins.
2. For VDD3P3\_CPU and VDD3P3\_RTC power domain, per-pin current sourced in the same domain is gradually reduced from around 40 mA to around 29 mA,  $V_{OH} \geq 2.64\text{ V}$ , as the number of current-source pins increases.
3. Pins occupied by flash and/or PSRAM in the VDD\_SDIO power domain were excluded from the test.

## 5.4 Wi-Fi Radio

**Table 7: Wi-Fi Radio Characteristics**

| Description                            | Min  | Typical | Max  | Unit     |
|--|------|---------|------|----------|
| Operating frequency range <i>note1</i> | 2412 | -       | 2484 | MHz      |
| Output impedance <i>note2</i>          | -    | 50      | -    | $\Omega$ |
| TX power <i>note3</i>                  |      |         |      |          |
| 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      |
| 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       |

1. Device should operate in the frequency range allocated by regional regulatory authorities. Target operating frequency range is configurable by software.
2. For the modules that use IPEX antennas, the output impedance is 50  $\Omega$ . For other modules without IPEX antennas, users do not need to concern about the output impedance.
3. Target TX power is configurable based on device or certification requirements.



## 5.5 Bluetooth LE Radio

### 5.5.1 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  |

### 5.5.2 Transmitter

**Table 9: Transmitter Characteristics – BLE**

| Parameter                         | Conditions       | Min | Typ   | Max | Unit           |
|-----------------------------------|------------------|-----|-------|-----|----------------|
| RF transmit power                 | -                | -   | 0     | -   | dBm            |
| Gain control step                 | -                | -   | 3     | -   | dBm            |
| RF power control range            | -                | -12 | -     | +9  | dBm            |
| Adjacent channel transmit power   | F = F0 ± 2 MHz   | -   | -52   | -   | dBm            |
|                                   | F = F0 ± 3 MHz   | -   | -58   | -   | dBm            |
|                                   | F = F0 ± > 3 MHz | -   | -60   | -   | dBm            |
| $\Delta f_{1avg}$                 | -                | -   | -     | 265 | kHz            |
| $\Delta f_{2max}$                 | -                | 247 | -     | -   | kHz            |
| $\Delta f_{2avg}/\Delta f_{1avg}$ | -                | -   | -0.92 | -   | -              |
| ICFT                              | -                | -   | -10   | -   | kHz            |
| Drift rate                        | -                | -   | 0.7   | -   | kHz/50 $\mu$ s |
| Drift                             | -                | -   | 2     | -   | kHz            |

## 5.6 Reflow Profile

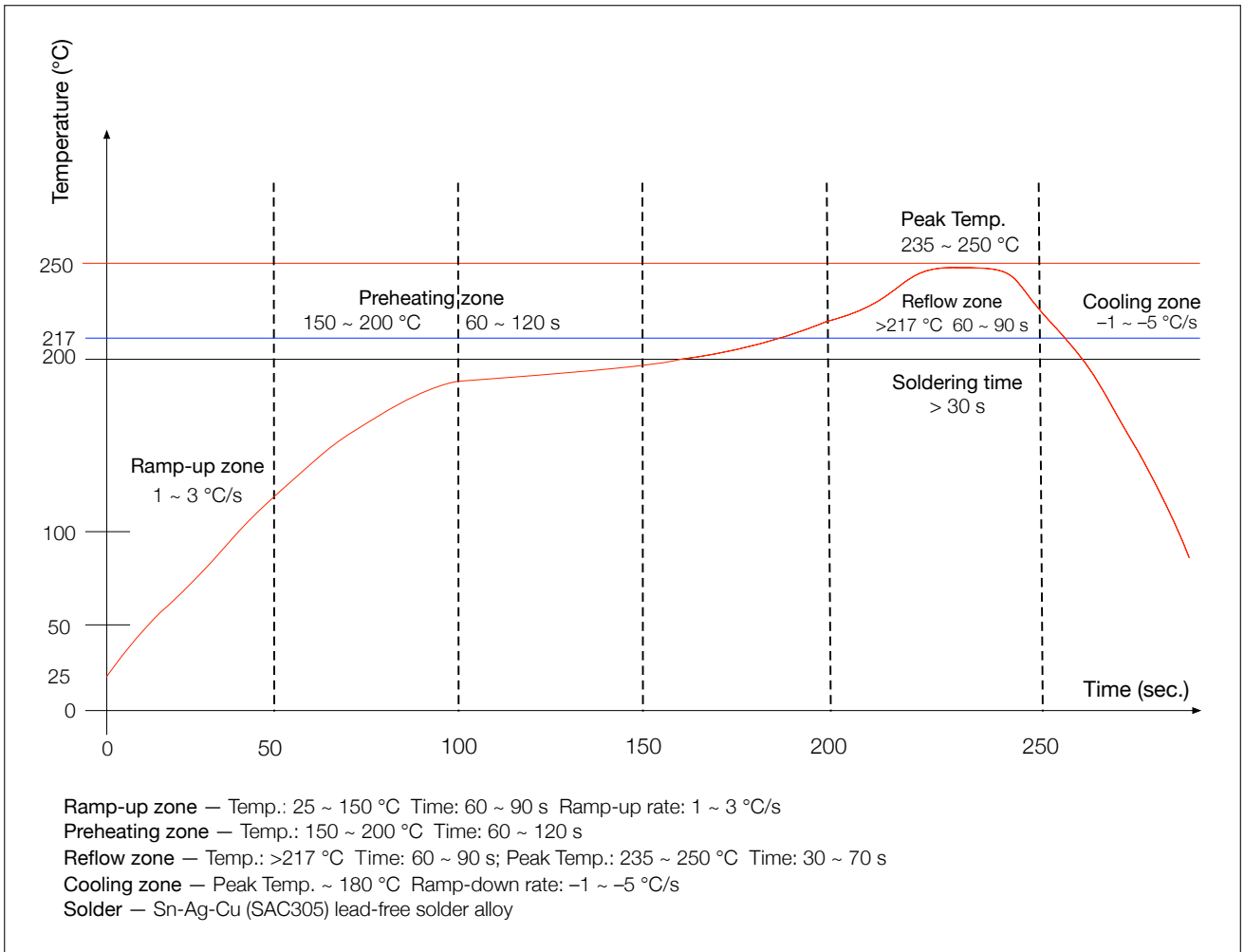


Figure 2: Reflow Profile

**Note:**

Solder the module in a single reflow.

# 6 Schematics

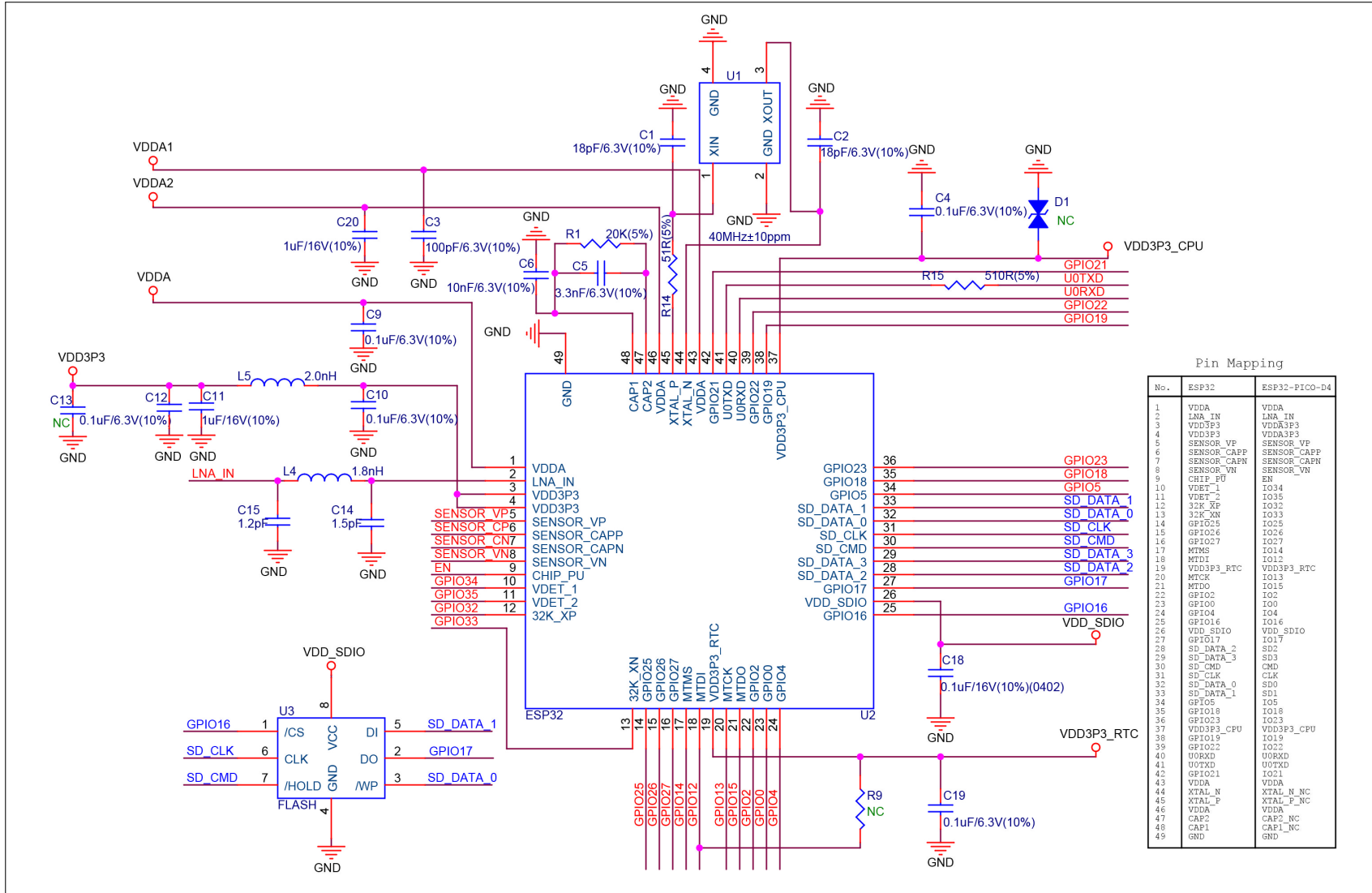


Figure 3: ESP32-PICO-D4 Module Schematics

# 7 Peripheral Schematics

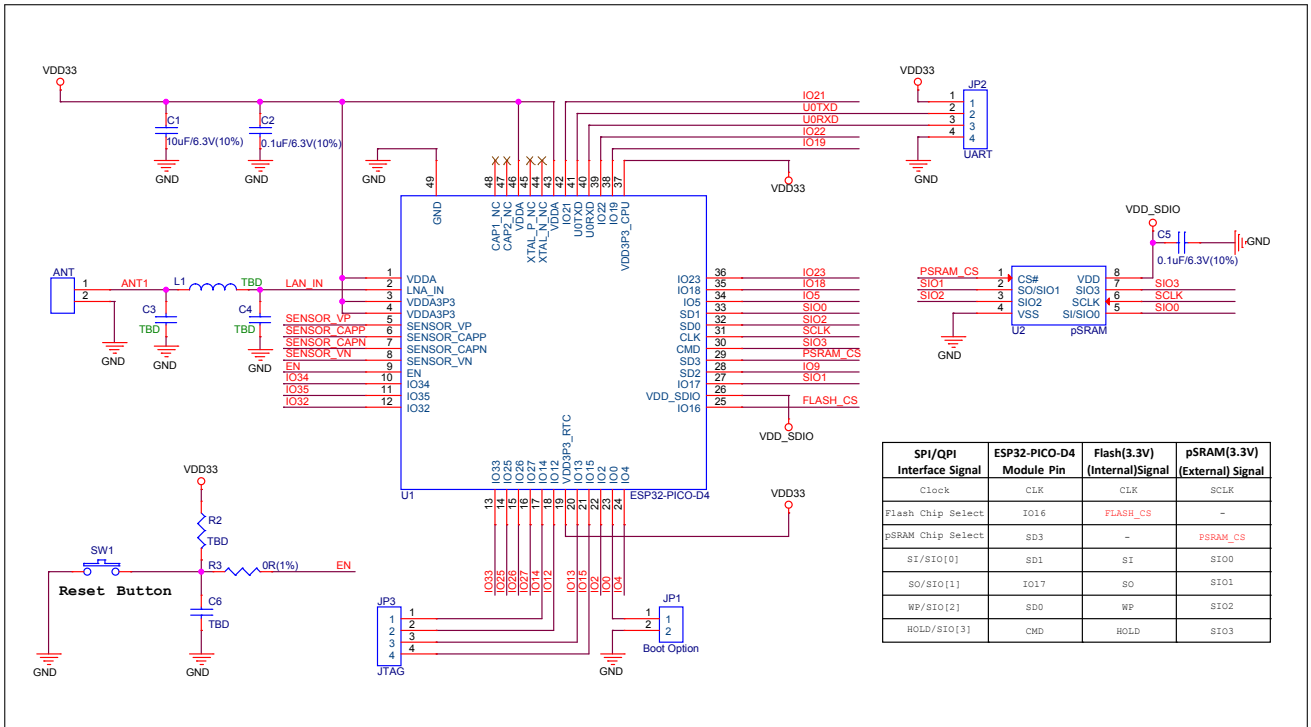


Figure 4: ESP32-PICO-D4 Module Peripheral Schematics

**Note:**

To ensure the power supply to the ESP32 chip 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's power-up and reset sequence timing diagram, please refer to Section *Power Scheme* in [ESP32 Datasheet](#).

# 8 Package Information

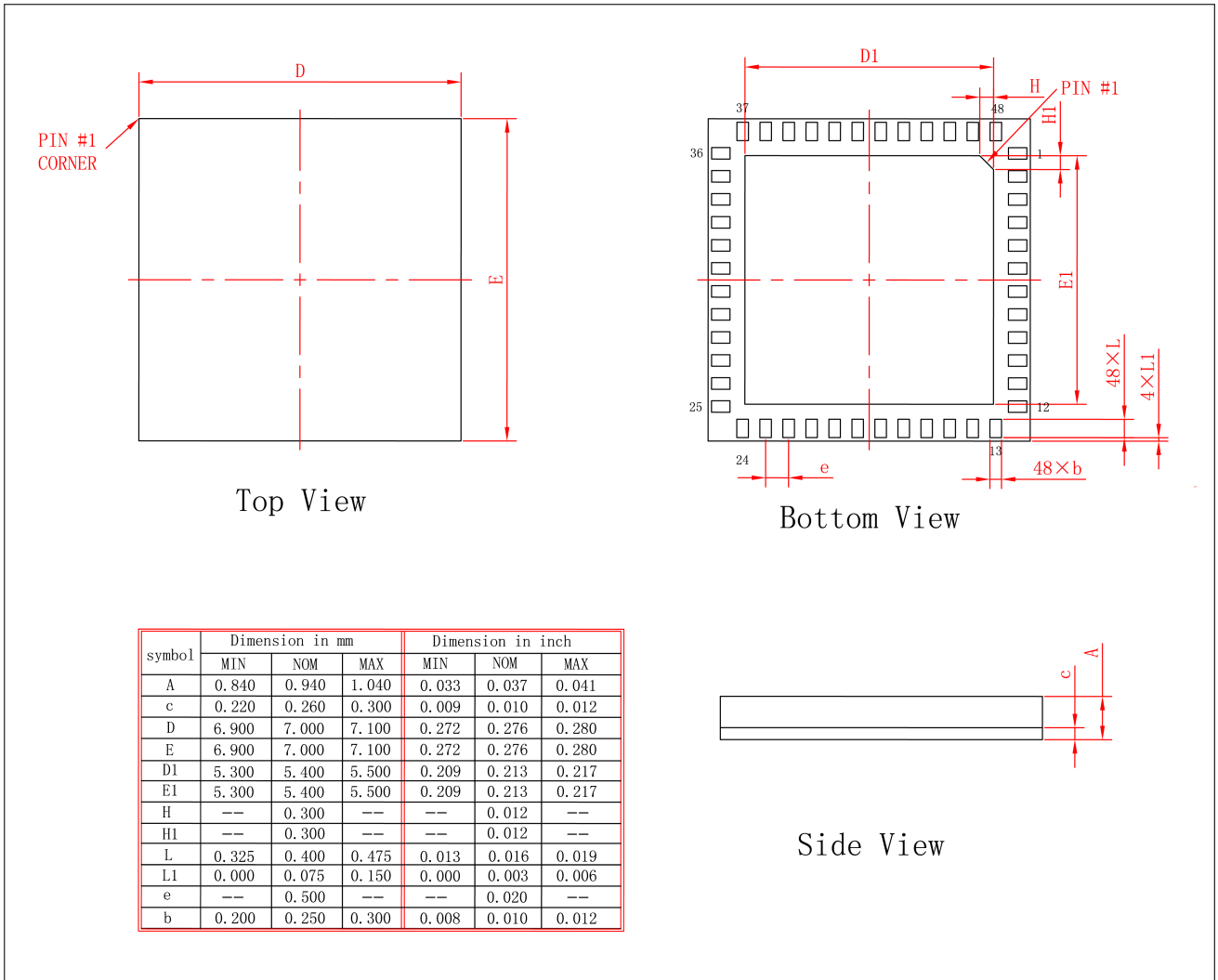
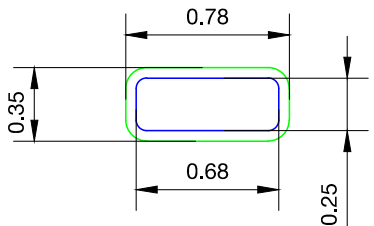
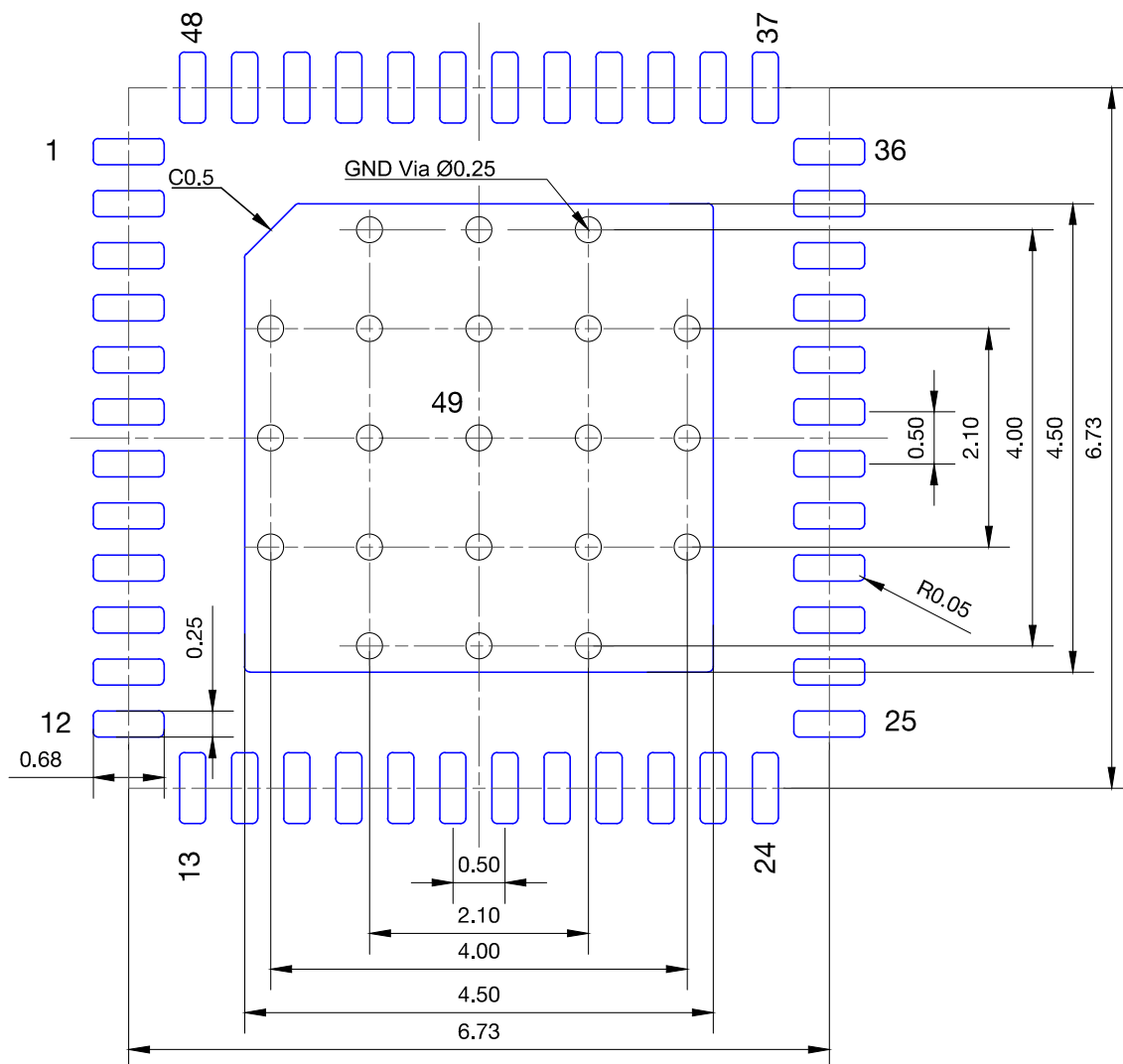





Figure 5: ESP32-PICO-D4 Package



Details of recommended copper-defined pad.

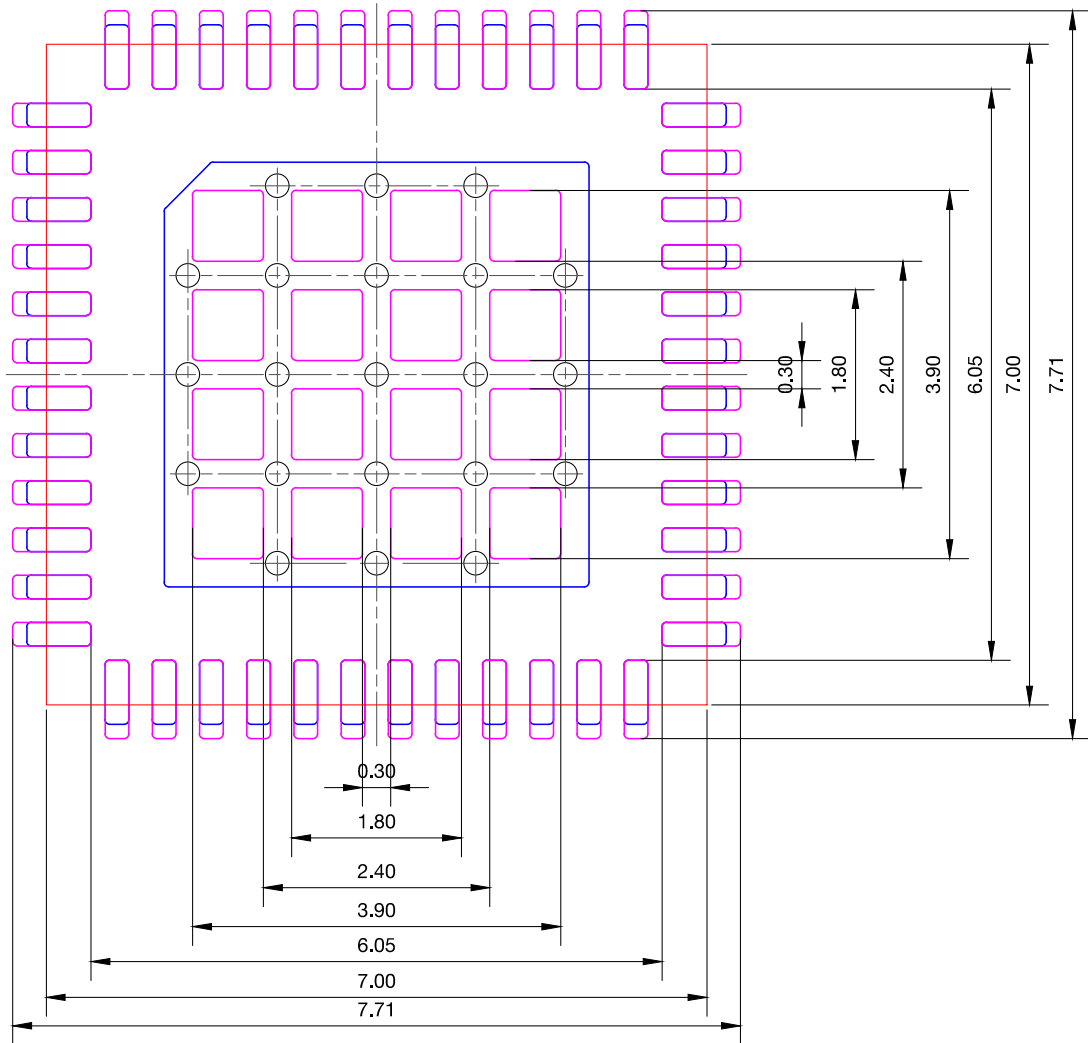
-  Copper
-  Solder mask opening
-  Via

Unit: mm  
Tolerance: +/- 0.05 mm

Notes:

1. It is recommended to use copper-defined pad for Pin 1 to Pin 48 and solder-mask-defined pad for Pin 49 (thermal pad).
2. This drawing is subject to change without notice.

Figure 6: ESP32-PICO-D4 PCB Land Pattern



Notes:

1. It is recommended to use a stencil of 80  $\mu\text{m}$  thickness.
2. This drawing is subject to change without notice.

- Copper
- Paste mask opening
- Recommended via drill size: 0.25 mm

Unit: mm  
Tolerance: +/- 0.05 mm

Figure 7: ESP32-PICO-D4 STENCIL

## 9 Learning Resources

### 9.1 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 ECO V3 User Guide](#)  
This document describes differences between V3 and previous ESP32 silicon wafer revisions.
- [ECO and Workarounds for Bugs in ESP32](#)  
This document details hardware errata and workarounds in the ESP32.
- [ESP-IDF Programming Guide](#)  
It hosts extensive documentation for ESP-IDF ranging from hardware guides to API reference.
- [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 the ESP32 chip, the ESP32 modules and development boards.
- [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.
- [Espressif Products Ordering Information](#)

### 9.2 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".



- [ESP-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.

## Revision History

| Date    | Version | Release notes  |
|---------|---------|--|
| 2021.02 | V1.9    | Deleted Reset Circuit and Discharge Circuit for VDD33 Rail.<br>Modified the note below Figure 2: <a href="#">Reflow Profile</a> .<br>Updated the trade mark from TWAI™ to TWAI®.   |
| 2020.11 | V1.8    | Added TWAI™ in Table 1.<br>Updated Table 2.<br>Updated the C value in RC circuit from 0.1 $\mu$ F to 1 $\mu$ F.<br>Added Figure 6 and Figure 7.  |
| 2019.12 | V1.7    | <ul style="list-style-type: none"> <li>• Changed the voltage range of pin VDD3P3_RTC to be consistent with the supply voltage range.</li> <li>• Added a note about pin VDD_SDIO under Table 2.2.</li> <li>• Added a note under Figure 2: <a href="#">Reflow Profile</a>.</li> <li>• Added <a href="#">documentation feedback link</a>.</li> </ul>  |
| 2019.09 | V1.6    | <ul style="list-style-type: none"> <li>• Changed the supply voltage range from 2.7 V ~ 3.6 V to 3.0 V ~ 3.6 V;</li> <li>• Added Bluetooth certification and Moisture sensitivity level (MSL) 3 in Table 1 <a href="#">ESP32-PICO-D4 Specifications</a>;</li> <li>• Added notes about "Operating frequency range" and "TX power" under Table 7 <a href="#">Wi-Fi Radio Characteristics</a>;</li> <li>• Updated Section 7 <a href="#">Peripheral Schematics</a> and added a note about RC delay circuit under it.</li> </ul> |
| 2019.01 | V1.5    | Updated the note under Table 2 and that in Section 4;<br>Updated the ESP32-PICO-D4 Module Peripheral Schematics in Chapter 7 by adding the connection between the module and external PSRAM;<br>Changed the RF power control range in Table 9 from -12 ~ +12 to -12 ~ +9 dBm.  |
| 2018.10 | V1.4    | Removed software-specific information from Table 1: <a href="#">ESP32-PICO-D4 Specifications</a> ;<br>Added "Cumulative IO output current" entry to Table 4: <a href="#">Absolute Maximum Ratings</a> ;<br>Added more parameters to Table 6: <a href="#">DC Characteristics</a> .  |

| Date    | Version | Release notes  |
|---------|---------|--|
| 2018.06 | V1.3    | <ul style="list-style-type: none"> <li>• Changed the voltage range of VDD3P3_RTC from 1.8-3.6V to 2.3-3.6V in Table 2: Pin Description;</li> <li>• Changed the voltage range of VDD_SDIO from "1.8V or the same voltage as VDD3P3_RTC" to "the same voltage as VDD3P3_RTC" in Table 2: Pin Description;</li> <li>• Deleted the content about temperature sensor and LNA pre-amplifier;</li> <li>• Updated Chapter 3: Functional Description;</li> <li>• Updated the note in Chapter 4: Peripherals and Sensors;</li> <li>• Deleted the note on pad49 and added two other notes in Chapter 7: Peripheral Schematics;</li> </ul> <p>Changes to electrical characteristics:</p> <ul style="list-style-type: none"> <li>• Updated Table 4: Absolute Maximum Ratings;</li> <li>• Added Table 5: Recommended Operating Conditions;</li> <li>• Added Table 6: DC Characteristics;</li> <li>• Updated the values of "Gain control step", "Adjacent channel transmit power" in Table 9: Transmitter Characteristics - BLE.</li> </ul> |
| 2018.03 | V1.2    | <p>Updated the pin description of VDD_SDIO in Section 2.2;</p> <p>Updated the ESP32-PICO-D4 Pin Layout in Section 2.1;</p> <p>Updated the ESP32-PICO-D4 Module Schematics in Chapter 6;</p> <p>Updated the ESP32-PICO-D4 Module Peripheral Schematics in Chapter 7.</p>  |
| 2017.09 | V1.1    | <p>Operating voltage/power supply range updated to 2.7 ~ 3.6V;</p> <p>Added a note in Chapter 7.</p>   |
| 2017.08 | V1.0    | First release.   |



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