WT9932P4 TINY User Guide

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深圳市启明云端科技有限公司

2026-10-21

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Note

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Revision History

Version	Date	Changed By	Change Item
V1.0	2025/08/6	Kirto	Initial Document Creation
V1.3	2026/6/22	Kirto	Fixed incorrect pin descriptions.
V2.0	2026/10/20	Haitang Li	Refined figure captions, image sizes and spacing, schematic pagination and reference links; synchronized English content and layout. Removed warning symbols, the subtitle and FPC pin-sequence diagrams; updated FPC wiring instructions and hardware diagrams; corrected JTAG and SDIO pin descriptions; added official ESP32-P4 documentation and technical reference manual links.
V2.1	2026/10/21	Iris	Updated the usage guide and cover layout.

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1. Development Board Overview

1.1 Development Board Introduction

The WT9932P4-TINY development board is centered around the Espressif ESP32P4 chip, making it a powerful tool for embedded development. Measuring only 69 × 28 mm, its compact design is well-suited for space-constrained applications.

The board is based on the WT0132P4-A1 module and features a two-layer PCB design, ensuring stability while reducing cost. It comes with onboard MIPI DSI and CSI FPC interfaces, supporting display and image capture, making it ideal for applications such as security monitoring and robotic navigation.

All pins are fully exposed, and the header pins are compatible with breadboards, greatly enhancing expansion flexibility. The onboard RGB LED enables colorful status indications and interactive effects. Additionally, the board is equipped with Type-C FUSB and HUSB interfaces, offering fast data transfer and reversible connections, providing convenience for debugging and power supply. This makes it an ideal choice for IoT and other development scenarios.

1.2 Product Features

1. **Core Configuration:** Powered by the high-performance Espressif ESP32P4 chip, meeting the performance requirements of embedded development.
2. **Compact Size:** Small form factor of only 69 × 28 mm, suitable for space-constrained applications.
3. **Stable Design:** Built on the WT0132P4-A1 module with a two-layer PCB design, ensuring stability while reducing cost.
4. **Image Interfaces:** Onboard MIPI DSI and CSI FPC interfaces support display output and image capture functions.
5. **Flexible Expansion:** All pins are exposed, and the header pins are compatible with breadboards, facilitating peripheral expansion.
6. **Status Indication:** Equipped with an onboard RGB LED for colorful status indications and interactive effects.
7. **Convenient Interfaces:** Features Type-C FUSB and HUSB ports, providing fast data transfer and reversible connections for easy debugging and power supply.

1.3 Development Board Images

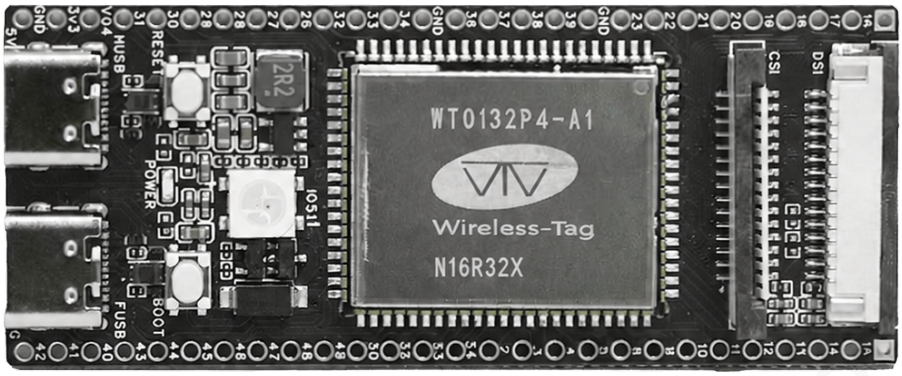

Figure 1 – Development Board Front View

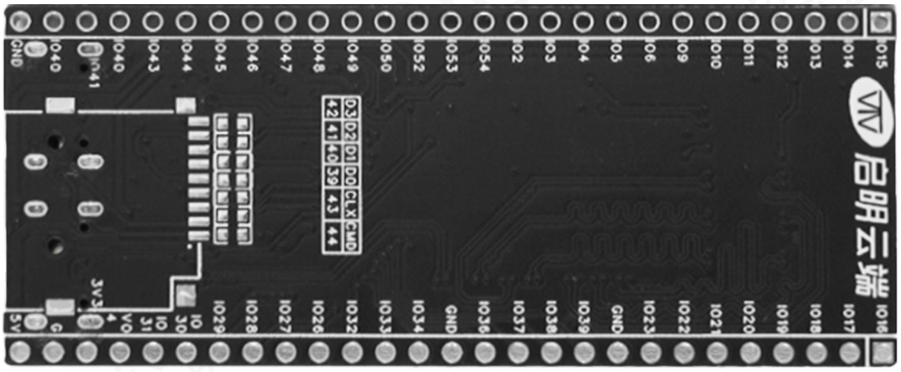

Figure 2 – Development Board Rear View

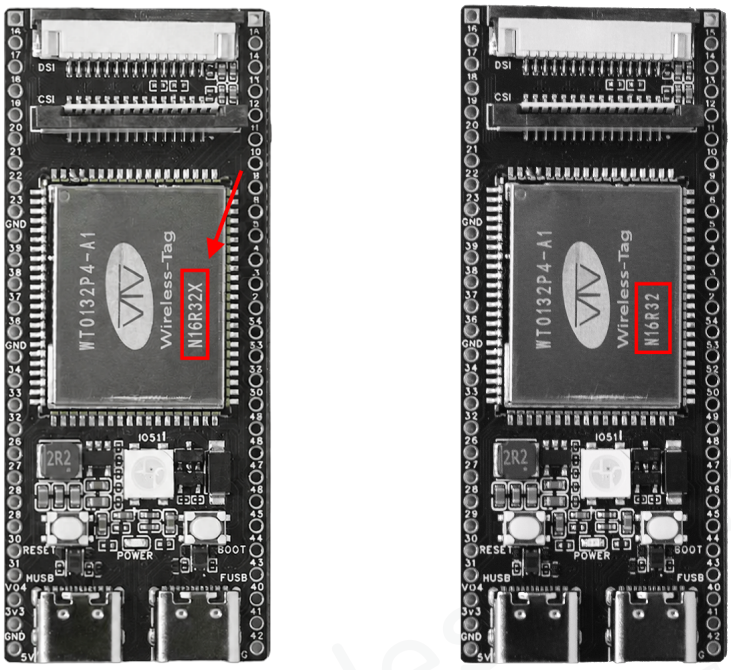

Figure 3 – Comparison of the Two WT9932P4-TINY Versions

> Note: WT9932P4-TINY is available in two versions, which can be distinguished by the marking on the metal shield, as shown in the comparison image. A shield marked with "X" indicates ESP32-P4X (chip revision v3.x), and the corresponding development board model is WT9932P4X-TINY. A shield without "X" indicates ESP32-P4 (chip revision v1.x), and the corresponding development board model is WT9932P4-TINY. These two chip revisions differ significantly, and firmware built for one version is not compatible with the other. For details, see the ESP32-P4 Chip Revision v3.x User Guide.

2. Hardware Reference

2.1 Functional Block Diagram

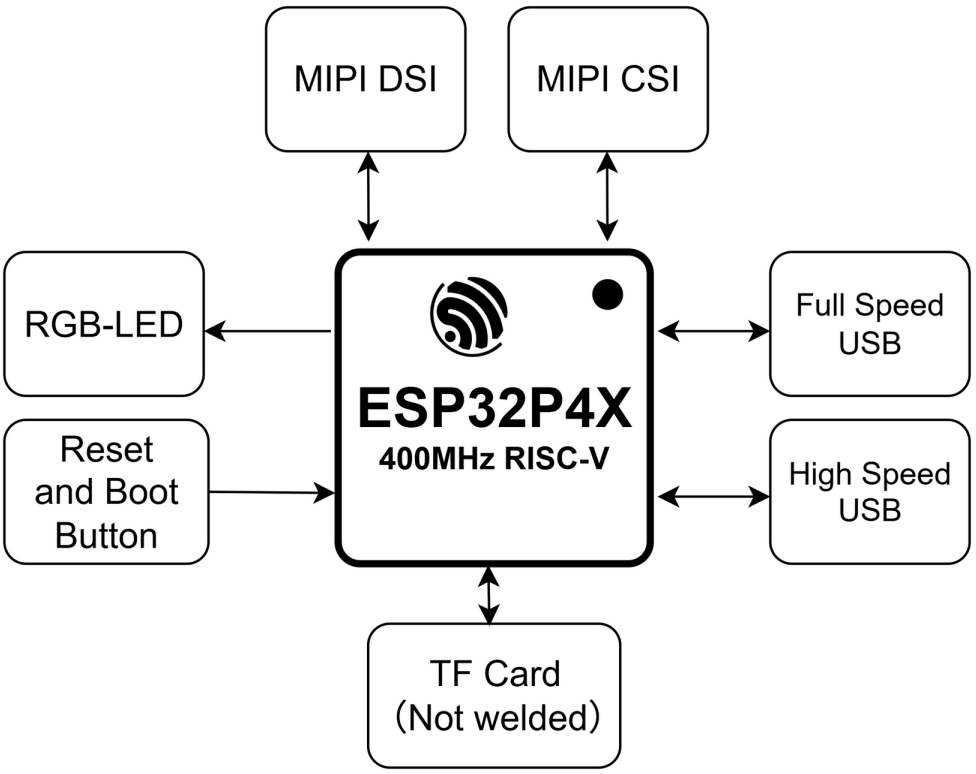

Figure 4 – Functional Block Diagram

2.2 Hardware Peripherals

Peripheral Name	Description
WS2812	Single-wire RGB LED connected to IO51.
RESET Button	Used for resetting the board.
BOOT Button	Used to manually enter flashing mode, connected to IO25.
FUSB	Full-speed USB, used for power and firmware updates.
HUSB	High-speed USB.
MIPI CSI FPC	1.0 pitch Raspberry Pi-compatible camera interface.
MIPI DSI FPC	1.0 pitch Raspberry Pi-compatible display interface.
MicroSD Card (not soldered)	4-wire MicroSD card slot, not soldered at factory.

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2.3 Component Introduction

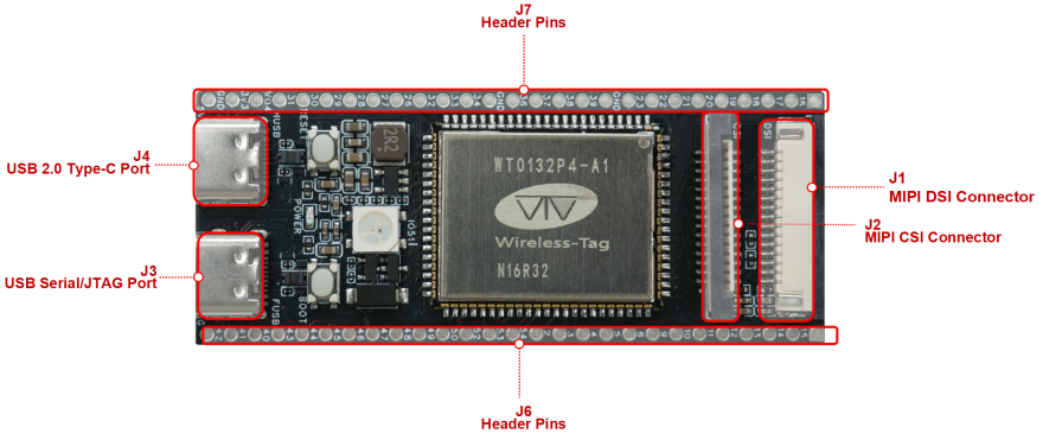

Figure 5 – Front Component Introduction

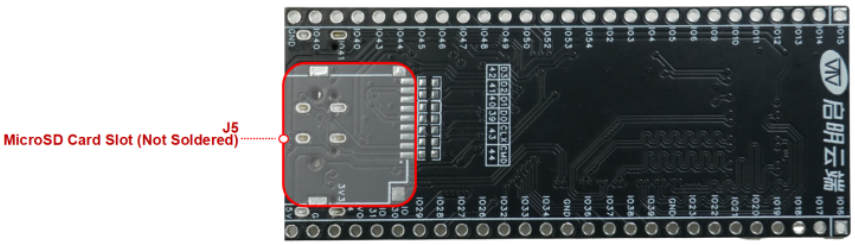

Figure 6 – Rear Component Introduction

No.	Component Name	Description
J1	MIPI DSI Connector	FPC connector for connecting an LCD expansion board. Compatible FPC specifications: 1.0 mm pitch, 0.7 mm pin width, 0.3 mm thickness, 15 pins.
J2	MIPI CSI Connector	FPC connector for connecting an external camera module for image transmission. Compatible FPC specifications: 1.0 mm pitch, 0.7 mm pin width, 0.3 mm thickness, 15 pins.
J3	USB Serial/JTAG Port	USB Type-C interface supporting USB 2.0 Full-speed. Can be used to flash firmware to the ESP32-P4 chip, communicate via USB protocol, or perform JTAG debugging.
J4	USB 2.0 Type-C Port	USB 2.0 Type-A interface connected to the ESP32-P4 chip's USB 2.0 OTG High-Speed interface, supporting USB 2.0 standard. When used for USB communication, the ESP32-P4 acts as a USB Host and can supply up to 500 mA to connected USB devices.
J5	MicroSD Card Slot (Not Soldered)	Supports 4-bit mode MicroSD cards; not soldered at factory.
J6/J7	Header Pins	All available GPIO pins are exposed to header J1. For detailed information, see Header Pins.

2.4 Interface Package

Interface Description	Interface Package	Note
MIPI DSI FPC	FPC_SMD_1.0K-FX-15PWBG	Carefully check the orientation
MIPI CSI FPC	FPC_SMD_15P-P1.00_HDGC_1.0K-GT-15PB	Carefully check the orientation
MicroSD Card Interface	MicroSD-SMD_MicroSD-PUSH	Not soldered at factory
Header Pins x2	HDR-TH_27P-P2.54-V-M	Pitch supports perfboard/breadboard

2.5 Interface Description

[J1] MIPI DSI FPC

The FPC connector is an SMD type with 1.0 mm pitch and 15 pins, a drawer-style latch, bottom contacts, and horizontal mounting. Carefully check the VCC and GND orientation when connecting the cable.

FPC Pinout:

No.	Pin	Description	Voltage Range	Note
1	VCC	Power output	3.3V	Do not use as power input
2	VCC	Power output	3.3V	Do not use as power input
3	GND	Ground	0V	
4	IO7	I2C SDA pin	0V/3.3V	
5	IO8	I2C SCL pin	0V/3.3V	
6	GND	Ground	0V	
7	DSI_DATAP0	DSI Data 0 positive differential	0V/3.3V	
8	DSI_DATAN0	DSI Data 0 negative differential	0V/3.3V	
9	GND	Ground	0V	
10	DSI_CLKP	DSI Clock positive differential	0V/3.3V	
11	DSI_CLKN	DSI Clock negative differential	0V/3.3V	
12	GND	Ground	0V	
13	DSI_DATAP1	DSI Data 1 positive differential	0V/3.3V	
14	DSI_DATAN1	DSI Data 1 positive differential	0V/3.3V	
15	GND	Ground	0V	

[J2] MIPI CSI FPC

The FPC connector is an SMD type with 1.0 mm pitch and 15 pins, a drawer-style latch, single-sided contacts, and vertical mounting. Carefully check the VCC and GND orientation when connecting the cable.

FPC Pinout:

No.	Pin	Description	Voltage Range	Note
1	VCC	Power output	3.3V	Do not use as power input
2	IO7	I2C SDA pin	0V/3.3V	
3	IO8	I2C SCL pin	0V/3.3V	
4	IO0	Unused pin	0V/3.3V	
5	IO1	Camera reset pin	0V/3.3V	
6	GND	Ground	0V	
7	CSI_CLKP	CSI Clock positive differential	0V/3.3V	
8	CSI_CLKN	CSI Clock negative differential	0V/3.3V	
9	GND	Ground	0V	
10	CSI_DATAP1	CSI Data 1 positive differential	0V/3.3V	
11	CSI_DATAN1	CSI Data 1 negative differential	0V/3.3V	
12	GND	Ground	0V	
13	CSI_DATAP0	CSI Data 0 positive differential	0V/3.3V	
14	CSI_DATAN0	CSI Data 0 negative differential	0V/3.3V	
15	GND	Ground	0V	

[J3] [J4] USB Power Interfaces

USB 2.0 Type-C interfaces for firmware download and power supply.

- **J3:** Full-speed USB 2.0 with a maximum theoretical speed of **12 Mbps**, using IO24 and IO25.
- **J4:** High-speed USB 2.0 with a maximum theoretical speed of **480 Mbps**, using dedicated IO pins.

[J5] MicroSD Card Interface

Spring-loaded MicroSD card slot:

> Note: The power here uses LDO_VO4 and can be configured to support 1.8V supply.

No.	Pin	Description	Voltage Range	Note
1	IO41	DATA2 in 4-wire SDIO	0V / LDO_VO4	
2	IO42	DATA3 in 4-wire SDIO	0V / LDO_VO4	
3	IO44	CMD in 4-wire SDIO	0V / LDO_VO4	
4	LDO_VO4	SD card power supply	LDO_VO4	
5	IO43	CLK in 4-wire SDIO	0V / LDO_VO4	
6	GND	Ground	0V	
7	IO39	DATA0 in 4-wire SDIO	0V / LDO_VO4	
8	IO40	DATA1 in 4-wire SDIO	0V / LDO_VO4	

[J6] [J7] Header Pins

The header pins are standard 2.54 mm pitch.

[J6] Pin Definition:

No.	Pin	Description	Voltage Range	Note
1	IO15	General-purpose I/O 15	0V/3.3V	
2	IO14	General-purpose I/O 14	0V/3.3V	

No.	Pin	Description	Voltage Range	Note
3	IO13	General-purpose I/O 13	0V/3.3V	
4	IO12	General-purpose I/O 12	0V/3.3V	
5	IO11	General-purpose I/O 11	0V/3.3V	
6	IO10	General-purpose I/O 10	0V/3.3V	
7	IO9	General-purpose I/O 9	0V/3.3V	
8	IO6	General-purpose I/O 6	0V/3.3V	
9	IO5	General-purpose I/O 5	0V/3.3V	Also JTAG MTDO
10	IO4	General-purpose I/O 4	0V/3.3V	Also JTAG MTMS
11	IO3	General-purpose I/O 3	0V/3.3V	Also JTAG MTDI
12	IO2	General-purpose I/O 2	0V/3.3V	Also JTAG MTCK
13	IO54	General-purpose I/O 54	0V/3.3V	
14	IO53	General-purpose I/O 53	0V/3.3V	
15	IO52	General-purpose I/O 52	0V/3.3V	
16	IO50	General-purpose I/O 50	0V/3.3V	
17	IO49	General-purpose I/O 49	0V/3.3V	
18	IO48	SD Card DATA7	0V/LDO_VO4	Can also be used as GPIO
19	IO47	SD Card DATA6	0V/LDO_VO4	Can also be used as GPIO
20	IO46	SD Card DATA5	0V/LDO_VO4	Can also be used as GPIO
21	IO45	SD Card DATA4	0V/LDO_VO4	Can also be used as GPIO
22	IO44	SD Card CMD	0V/LDO_VO4	Can also be used as GPIO
23	IO43	SD Card CLK	0V/LDO_VO4	Output only if used as GPIO
24	IO40	SD Card DATA1	0V/LDO_VO4	Can also be used as GPIO
25	IO41	General-purpose I/O 41	0V/3.3V	
26	IO42	General-purpose I/O 42	0V/3.3V	
27	GND	Ground	0V	

[J7] Pin Definition:

No.	Pin	Description	Voltage Range	Note
1	IO16	General-purpose I/O 16	0V/3.3V	
2	IO17	General-purpose I/O 17	0V/3.3V	
3	IO18	General-purpose I/O 18	0V/3.3V	
4	IO19	General-purpose I/O 19	0V/3.3V	
5	IO20	General-purpose I/O 20	0V/3.3V	
6	IO21	General-purpose I/O 21	0V/3.3V	
7	IO22	General-purpose I/O 22	0V/3.3V	
8	IO23	General-purpose I/O 23	0V/3.3V	
9	GND	Ground	0V	
10	IO39	SD Card DATA0	0V/LDO_VO4	Can also be used as GPIO
11	IO38	UART0 RXD for debugging or flashing	0V/3.3V	Strapping pin
12	IO37	UART0 TXD for debugging or flashing	0V/3.3V	Strapping pin
13	IO36	General-purpose I/O 36	0V/3.3V	Strapping pin
14	GND	Ground	0V	
15	IO34	General-purpose I/O 34	0V/3.3V	Strapping pin
16	IO33	General-purpose I/O 32	0V/3.3V	
17	IO32	General-purpose I/O 32	0V/3.3V	
18	IO26	General-purpose I/O 26	0V/3.3V	
19	IO27	General-purpose I/O 27	0V/3.3V	
20	IO28	General-purpose I/O 28	0V/3.3V	
21	IO29	General-purpose I/O 29	0V/3.3V	
22	IO30	General-purpose I/O 30	0V/3.3V	
23	IO31	General-purpose I/O 31	0V/3.3V	
24	LDO_VO4	SD Card Power	LDO_VO4	
25	3.3V	3.3V Power Output	3.3V	Do not input 3.3V

No.	Pin	Description	Voltage Range	Note
26	GND	Ground	0V	
27	5V	5V Power	5V	If both J3 and J4 are connected, J3 takes priority for power

> Note: After reset, the strapping pin values determine whether the board enters flashing mode.

Boot Mode	GPIO35	GPIO36	GPIO37	GPIO38
SPI Boot	1	Any	Any	Any
Joint Download Boot	0	1	Any	Any

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3. Schematic Diagram

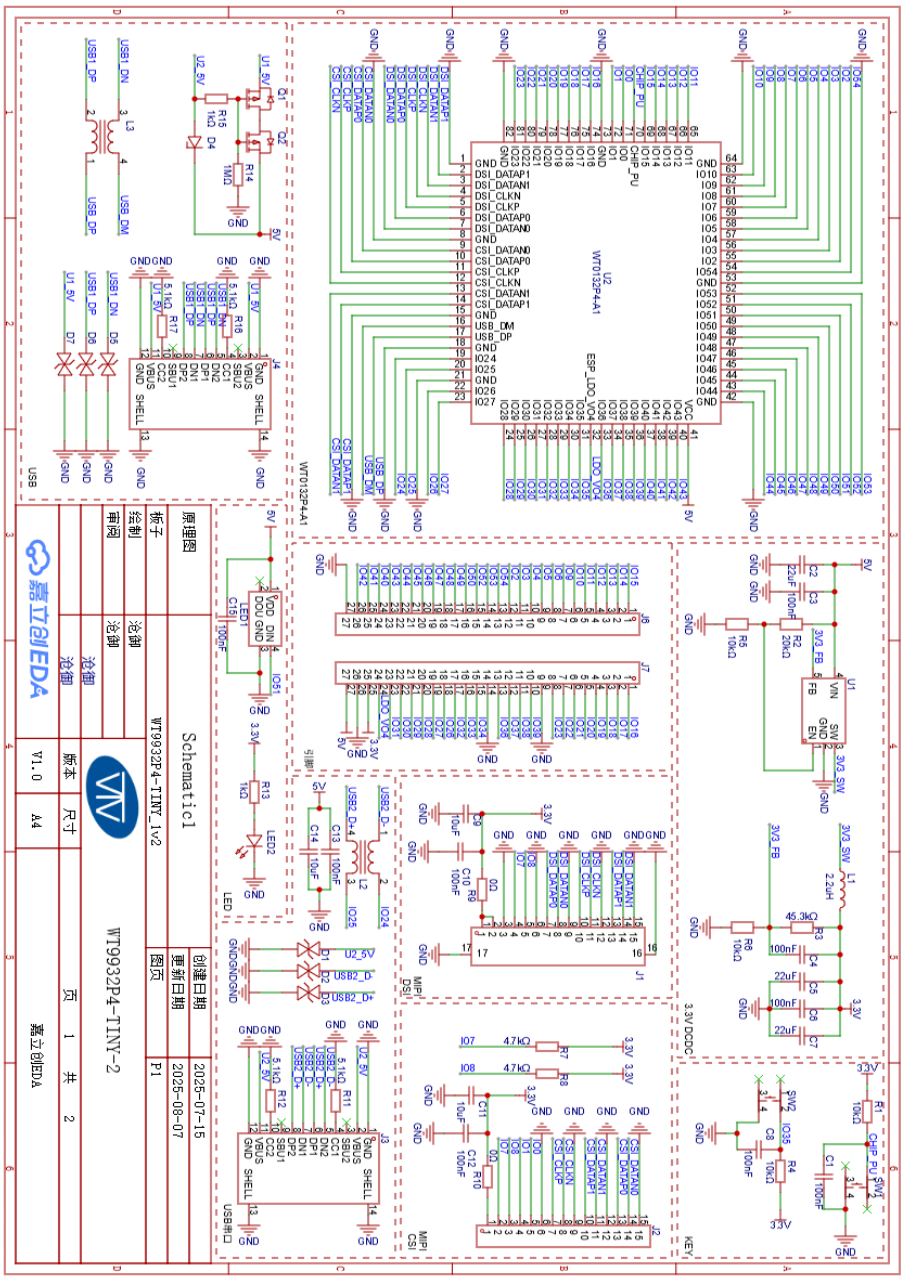

Figure 7 – Schematic Diagram

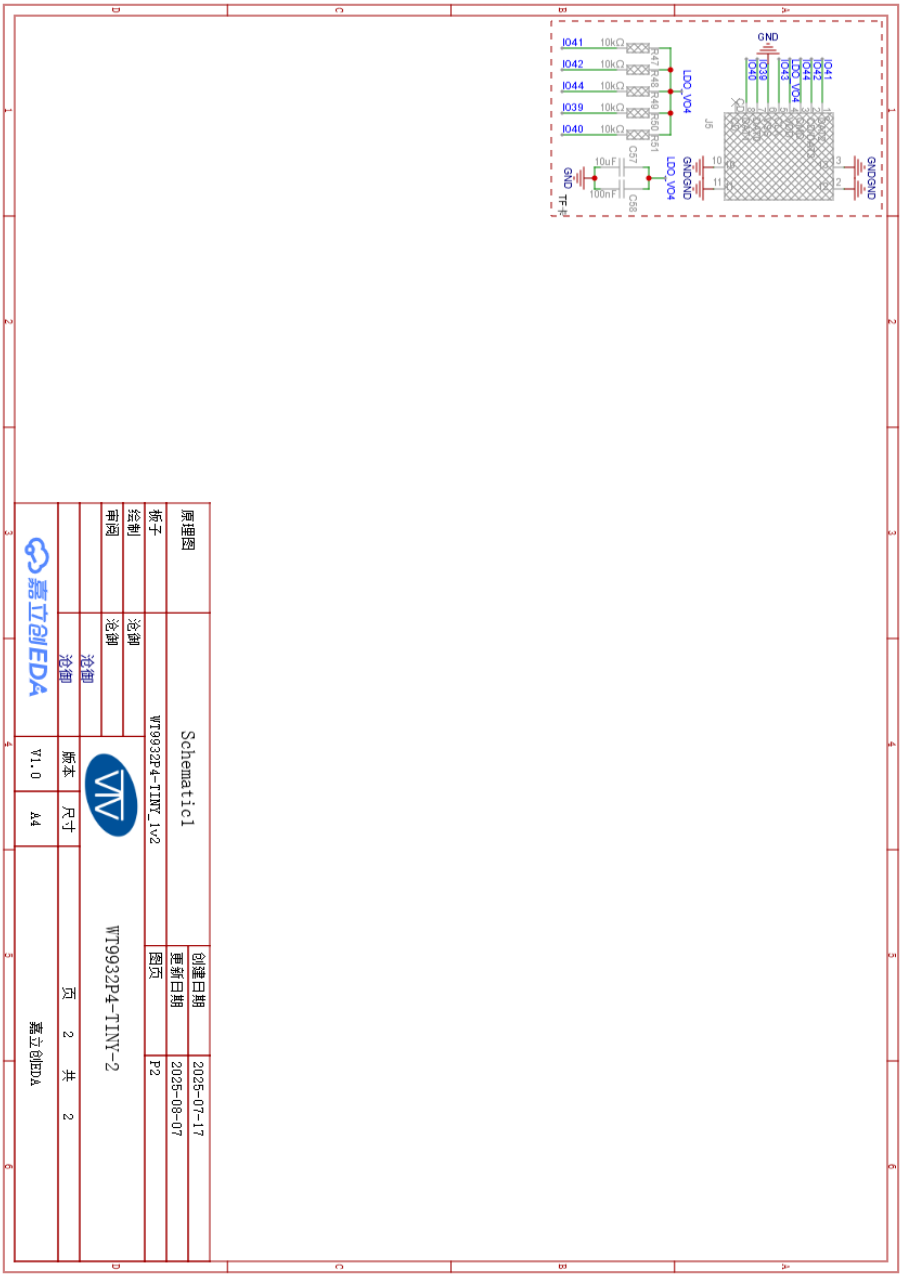

Figure 8 – Schematic Diagram

4. Structural Support

4.1 PCBA Dimension Diagram

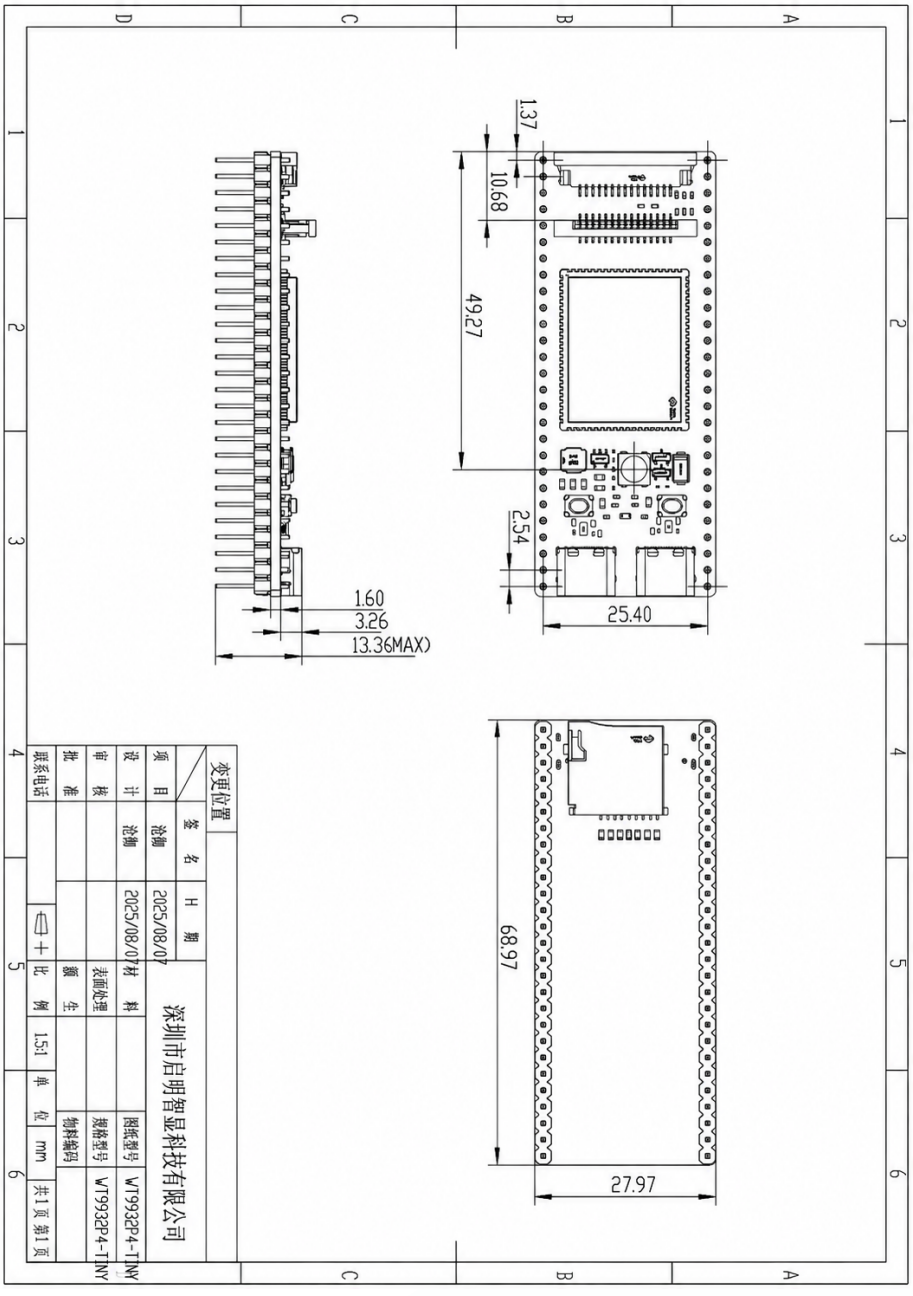

Figure 9 – Main Board Dimension Diagram

5. Usage Guide

5.1 Preparation Steps

Complete the following preparations before using the hardware.

Hardware preparation:

1. **WT9932P4X-TINY Development Board** × 1 *Required; the core hardware device of this product.*
2. **USB-C Data Cable** × 1 *Required for board power or a computer connection. Use the original cable or a high-quality cable for stable power.*
3. **Computer** × 1: Required; the procedure in this section was tested with Windows 10 and ESP-IDF v6.1.

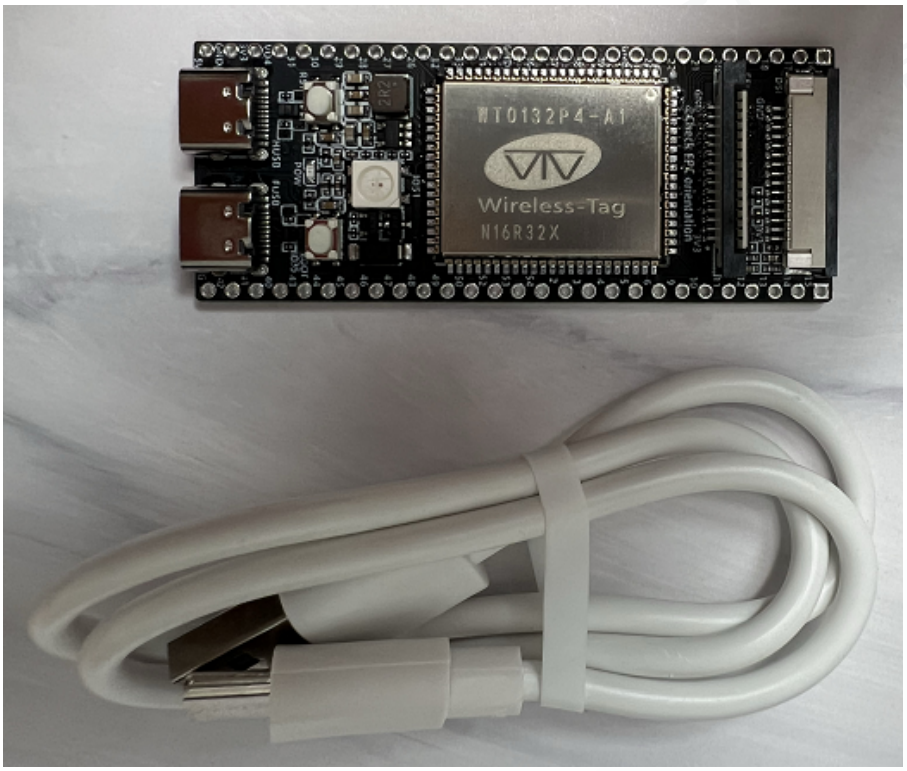

Figure 10 – Hardware Preparation

> **Tip:** If using USB power from a computer, use a USB port that can supply at least 5V@1A; insufficient power may prevent the device from starting properly.

Software preparation:

1. Install Git. See the installation instructions.

2. Use the ESP-IDF Installation Manager (EIM) to install ESP-IDF, the build tools and the required toolchains. EIM supports multiple operating systems. See the installation instructions.
3. Use **git clone** to clone the BSP repository for this hardware: https://github.com/Wireless-TAG-Maker/WT_BSP.git.

> Note: If you use Windows, Windows with WSL is recommended for development. In the ESP-IDF installation documentation linked above, follow the section for installing ESP-IDF and the toolchain on Linux.

5.2 Hardware Setup

Connect one end of the USB-C data cable to the development board and the other end to the computer, as shown below. The indicator lights to show that the device is powered on.

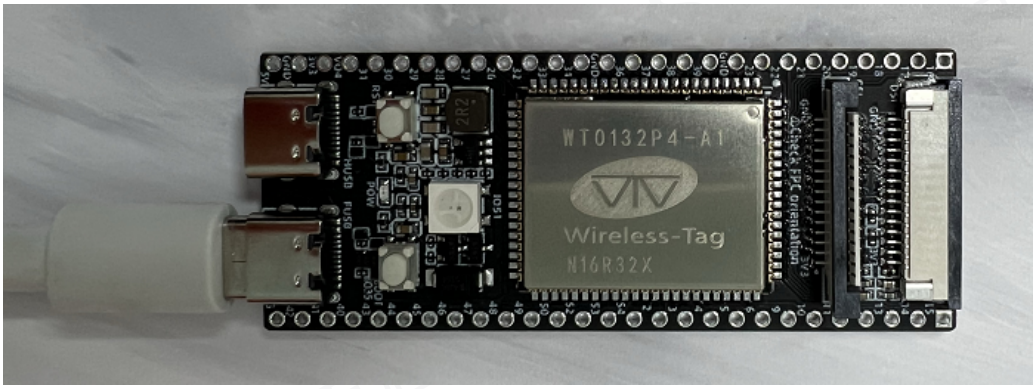

Figure 11 – Hardware Setup

5.3 Usage Guide

Before proceeding, ensure that the steps under Software preparation above are complete. Start with the BSP repository for this hardware.

Choose a directory for the BSP project, then clone the repository:

```
mkdir -p ~/work
cd ~/work
git clone https://github.com/Wireless-TAG-Maker/WT_BSP.git
cd WT_BSP
```

The repository should normally be on the main branch. The following examples assume that it is located at:

```
~/work/WT_BSP
```

> You can use a different directory. Replace the paths in the commands with your actual paths.

Create a new branch for modifications and experiments instead of editing the main branch directly:

```
git switch -c my_branch
```

To switch back to the main branch and pull updates later, run:

```
git switch main
git pull --ff-only origin main
```

> Keep custom applications outside the WT_BSP repository or on a separate Git branch where possible. This allows you to synchronize official updates through the main branch with fewer conflicts with your application code. When working as a team, record the verified WT_BSP commit so that other developers can reproduce the same build environment.

5.3.1 Verify with a Simple Example

After each WT_BSP update, build the minimal blink example first to verify that ESP-IDF, the BSP and the board selection tool work correctly:

```
cd ~/work/WT_BSP/examples/get-started/blink

# Note:
# 1. set-board is our custom command that simplifies setup.
#    After running it, use build, flash and monitor as usual.
# 2. set-board simplifies many configuration steps.
#    Do not use idf.py set-target unless you understand what
#    set-board does.
# 3. Select the number for your development board when prompted.
~/work/WT_BSP/examples/get-started/blink$ idf.py set-board
...
Supported boards in this example:
0: WT9932C2-TINY (esp32c2)
1: WT9932C3-TINY (esp32c3)
2: WT9932C5-TINY (esp32c5)
3: WT9932C61-TINY (esp32c61)
4: WT9932P4-TINY (esp32p4)
5: WT9932P4C61-TINY (esp32p4)
6: WT9932P4X-TINY (esp32p4)
7: WT9932S31-TINY (esp32s31)

Please select the target board by entering the corresponding number.
Enter board number:  # Enter the number for your development board.
6 # This example uses WT9932P4X-TINY; enter 6 and press Enter.
# set-board also generates the board preset configuration for
```

```
# this project. When changing to a board with a different target
# chip, it automatically runs fullclean.
Target changed from esp32 to esp32p4; running idf.py fullclean
Executing action: fullclean
Executing action: remove_managed_components
Done
Generated sdkconfig.board
Generated sdkconfig.board.Kconfig
Updated build/sdkconfig
Selected WT9932P4X-TINY (esp32p4)
Done

# Then build the example.
~/work/WT_BSP/examples/get-started/blink$ idf.py build
```

> Follow the same procedure for the other BSP examples.

After the build succeeds, connect the board's FUSB port to a USB port on your computer with the USB-C data cable, then flash the firmware:

```
idf.py -p <COM> flash
```

> **Tip:** If the computer's COM port repeatedly appears and disappears after FUSB is connected, and the UART connection is intermittent in the serial terminal, try entering flashing mode manually: hold the board's BOOT button, press RESET, then release BOOT.

After flashing succeeds, power-cycle the hardware. The board's RGB LED should change color once every second:

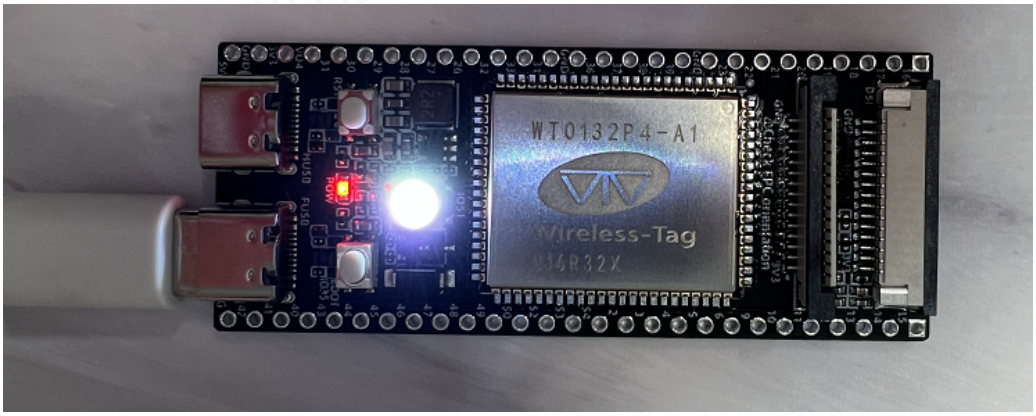

Figure 12 – RGB LED Blink Example

6. Related Documentation

Document Name	Link	Description
WT9932P4-TINY Getting Started Guide	WT9932P4-TINY Getting Started Guide	WT9932P4-TINY getting started guide
ESP-IDF Programming Guide (ESP32-P4)	Programming Guide	Framework, APIs and examples
ESP-IDF Get Started (ESP32-P4)	Get Started	Setup, building and flashing
ESP32-P4 Datasheet and Technical Reference Manual	Hardware Reference	Chip specifications, registers and peripherals
ESP32-P4 Technical Reference Manual	Official TRM PDF	Hardware modules, registers and peripherals
ESP32-P4 Hardware Design Guidelines	Hardware Guidelines	Schematic and PCB layout design

Select hardware documentation for the ESP32-P4 chip revision fitted to the board, and select the ESP-IDF version used by your project.

7. Contact Us

- Official Website: https://www.wireless-tag.com/
- Taobao Store: https://shop538225597.taobao.com/
- Sales Email: sales@wireless-tag.com
- Technical Support: technical@wireless-tag.com
- Phone: 18122057087
- WeChat Official Account QR Code



Figure 13 – WeChat Official Account QR Code