



T5AI-Board Development Board

Version: 20250707

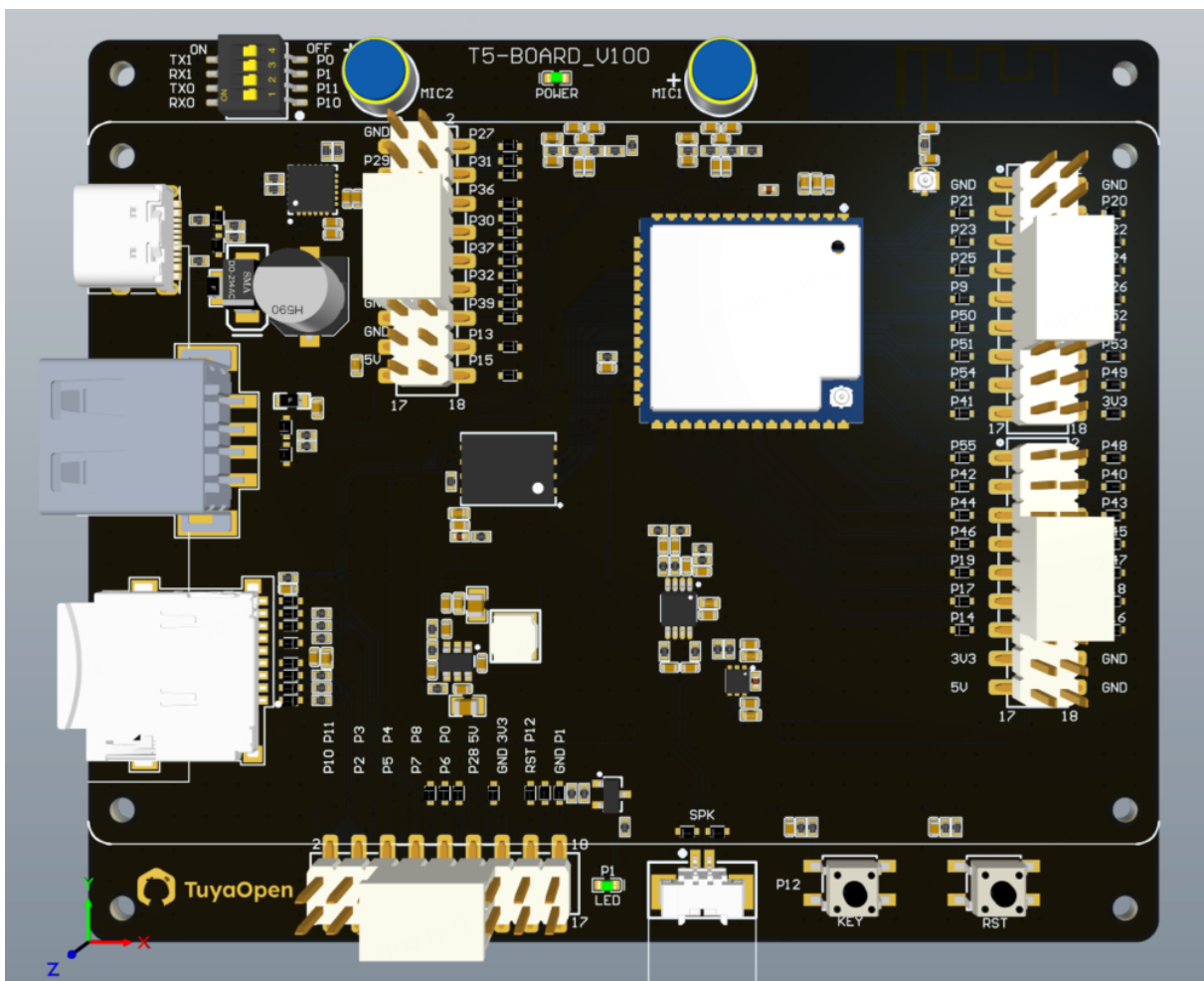
Online Version

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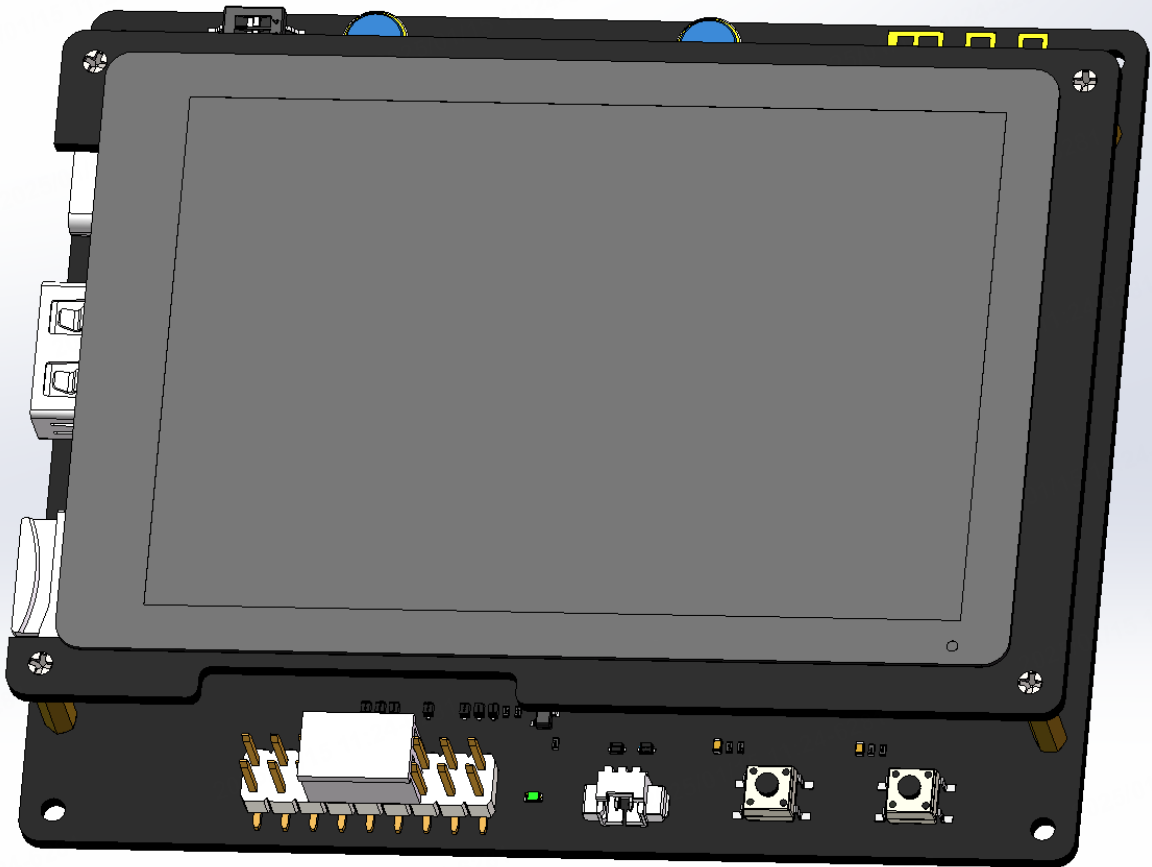
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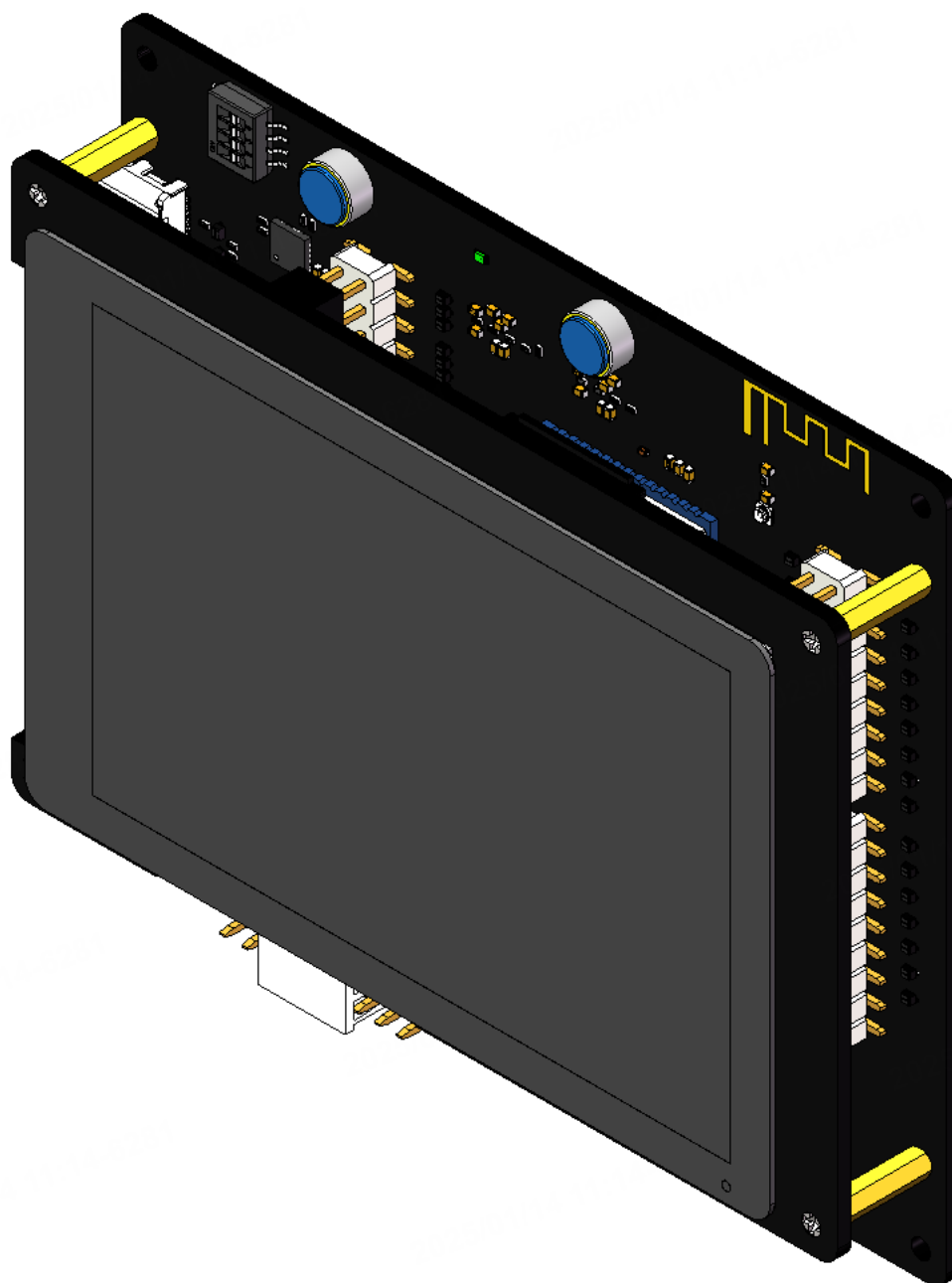
Tuya T5AI-Board is a voice and screen multi-interaction development board based on the T5-E1-IPEX, an embedded Wi-Fi and Bluetooth combo module developed by Tuya Smart. Equipped with two microphones and one speaker, the development board supports voice recognition and playback, offering voice interaction capabilities.

Through the I/O connector on the development board, you can use an LCD display sub-board to implement the touch screen and camera capture features. You can also design your own LCD screen with various interfaces, including I2C, SPI, 8080, and RGB interfaces. This way, implement human-machine interaction and meet the users' development requirements for products used in various scenarios.



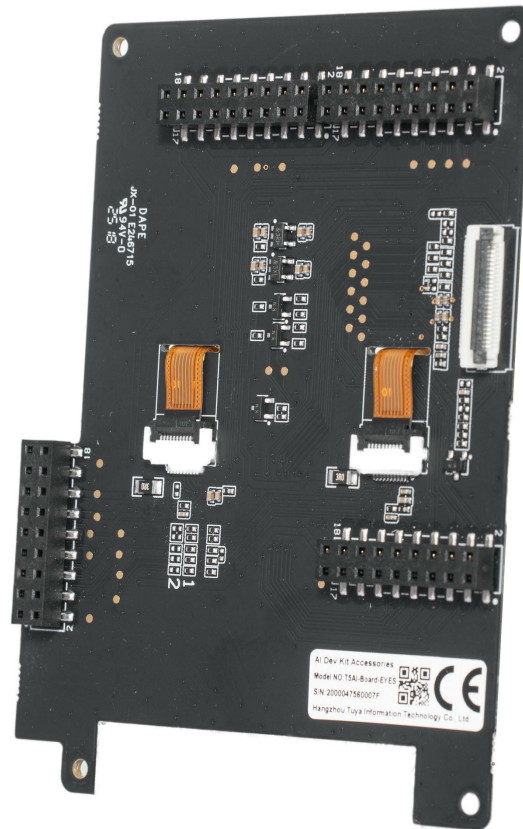
The following LCD display sub-boards are supported:





The following binocular LCD display sub-boards are supported:





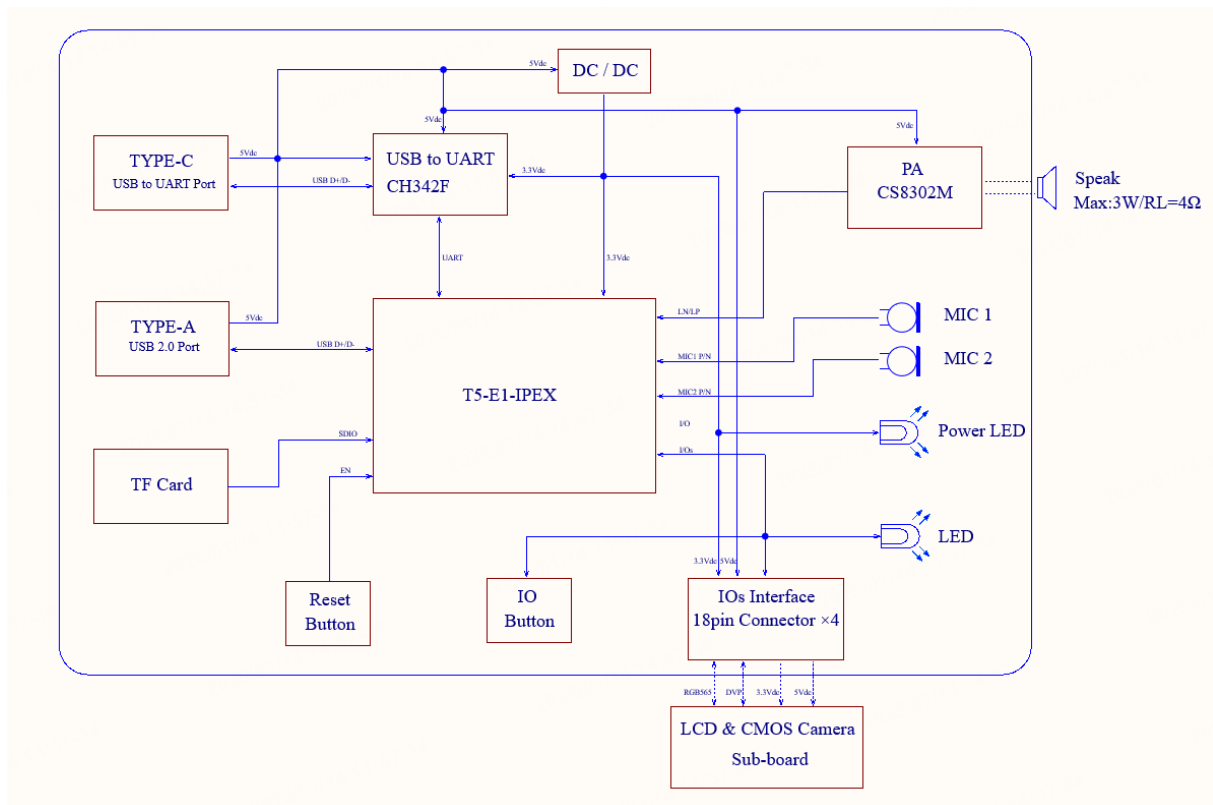
1. Features

- Module: T5-E1-IPEX
- ARMv8-M Star (M33F) @480MHz
- 16KB ITCM and 16KB DTCM
- 8 MB SiP flash memory
- 16 MB SiP PSRAM
- 640 KB shared SRAM
- Audio: 2-channel 16-bit audio ADC, 1-channel 16-bit audio DAC, and a 4-band digital equalizer.
- Screen: Can be matched with different screen displays, supporting screens with I2C, SPI, RGB, and 8080 interfaces.
- Camera: Camera module with DVP and USB interfaces.
- USB: USB 2.0 on USB type-A interface and USB type-C interface for download and debugging.
- TF card: Expand the storage capacity.
- I/O connectors: 56x GPIOs, configurable peripherals, 2x SPI, 2x QSPI, 3x UART, 2x I2C, 1x SDIO, 1x CAN, 12x PWM, and 3x I2S.
- Wi-Fi
- IEEE 802.11b/g/n/ax compliant
- 20 MHz and 40 MHz channel bandwidth
- Support downlink multi-user multiple input, multiple output (DL MU-MIMO)
- Integrated Bluetooth and Wi-Fi coexistence (packet traffic arbitration, PTA)
- Support target wake time (TWT)
- Bluetooth
- Support Bluetooth LE 5.4 standard
- TX power of +6 dBm
- RX sensitivity of -97 dBm

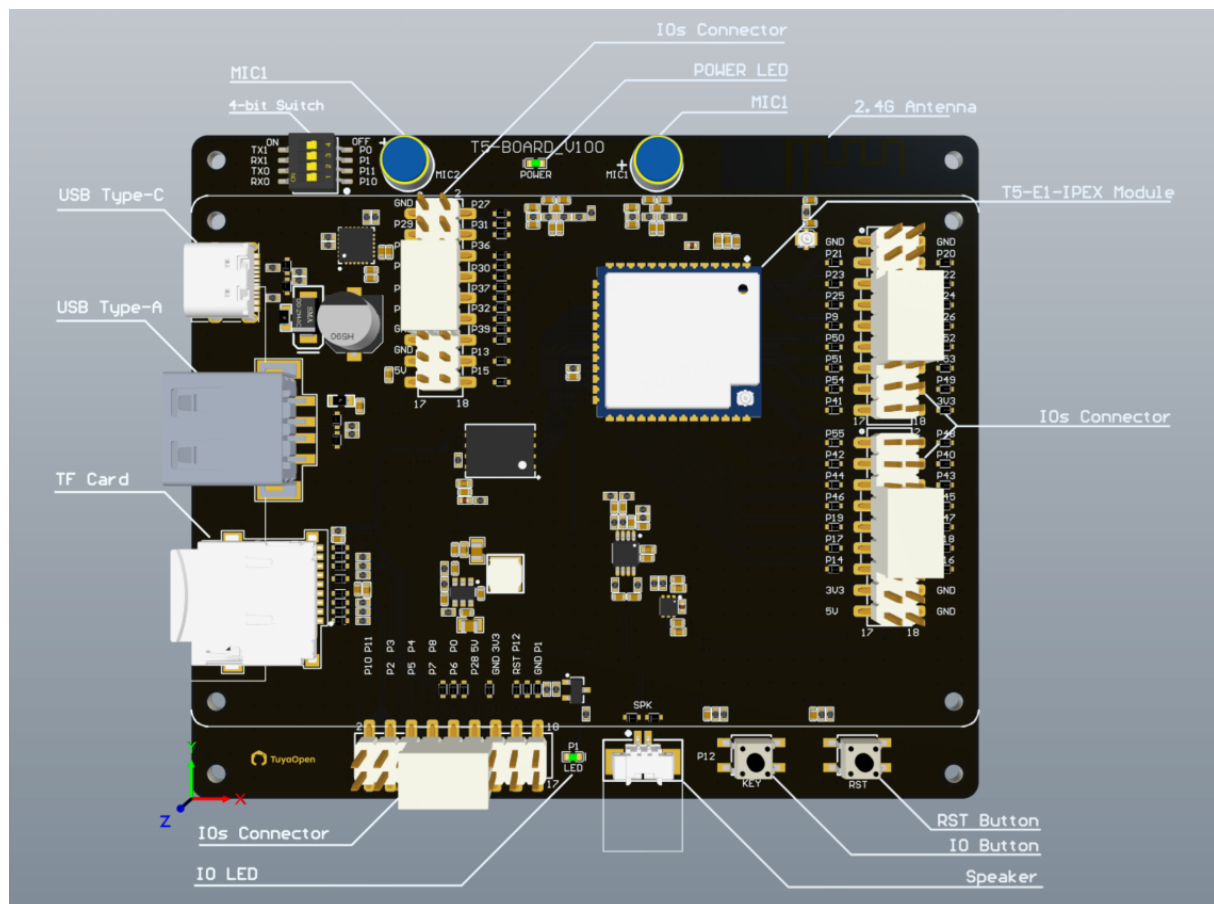
2. Obtaining method

Please go to [Product details page on the Taobao website](#) to purchase.

3. Functional block diagram



4. Peripherals



Peripheral	Description
T5-E1-IPEX module	An embedded Wi-Fi and Bluetooth combo module used to control the development board. With rich peripheral interfaces and powerful signal processing capabilities, this module is suitable for various scenarios in the AIOT field.
I/O connector	This connector features a 2.54 mm pitch and 56 GPIOs, configurable for driving a touchscreen, camera module, segment display, and more. For more information about the pins, refer to the I/O connector description section.

Peripheral	Description
RST button	The enable (EN) pin of the T5-E1-IPEX module is used to reset the module.
I/O button	Connected to P12 of the T5-E1-IPEX module, it can be configured as a button.
Speaker	The speaker connector has a 1.25 mm pitch and can drive speakers up to 3W/ RL=4Ω.
I/O LED	Connected to P01 of the T5-E1-IPEX module, it can be configured as an LED indicator.
TF card	The TF card connector can be used to expand the memory capacity of the T5-E1-IPEX module.
USB type-A	High-speed USB 2.0 interface supports cameras with USB interfaces.
USB type-C	The power port includes an onboard USB-to-serial chip, providing two virtual serial ports for module flashing and debugging.
4-bit switch	The DIP switch is used to open and close the circuit between two serial ports on the USB-to-serial chip.
MIC1 and MIC2	The audio input port, along with the onboard microphone, is connected to the module's dual-channel audio ADC.
Power LED	Power indicator of the development board.
2.4 GHz antenna	2.4 GHz Wi-Fi onboard antenna

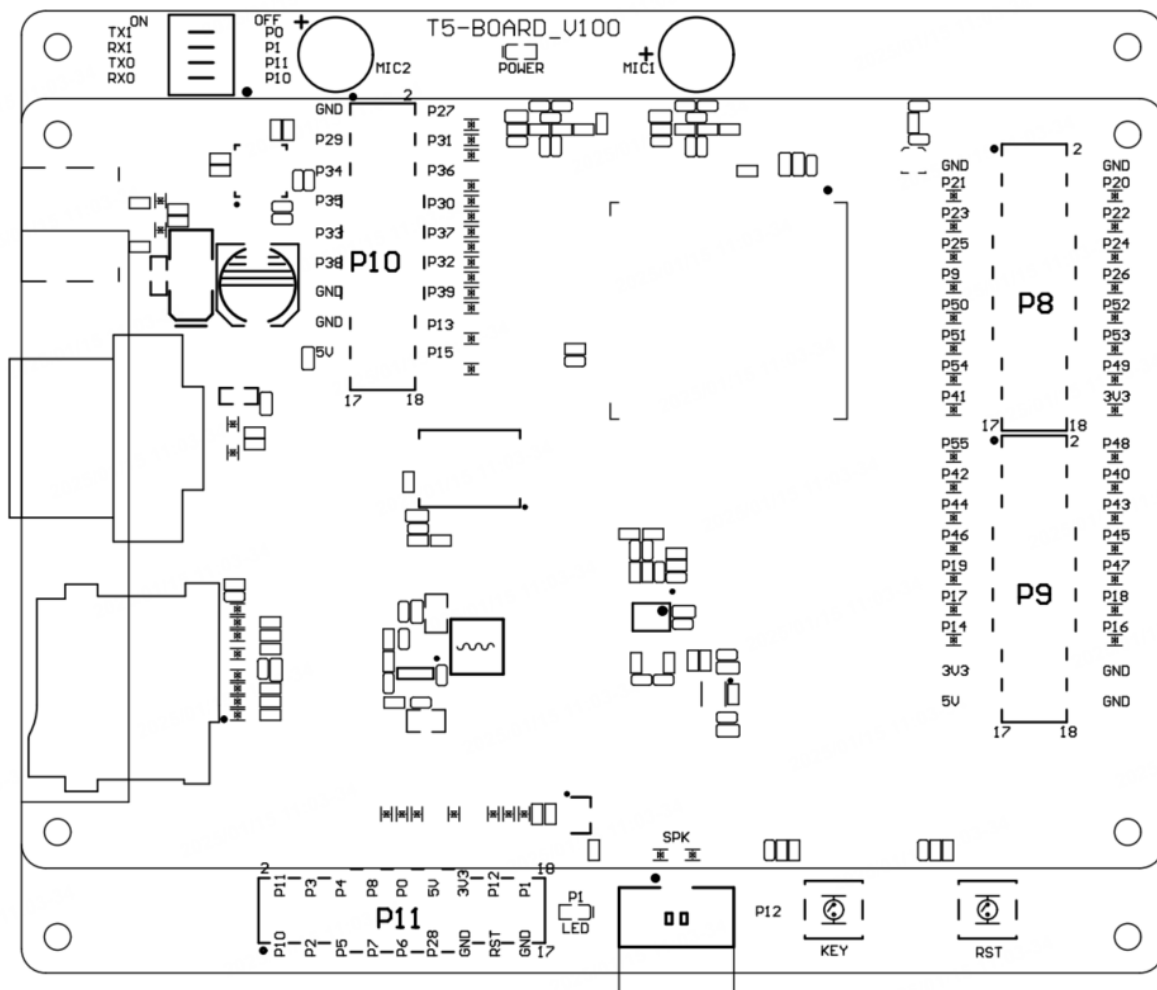
5. I/O connector description

		P8				P9				
GND	GND	1	2	GND	GND	B0 TP INT	1	2	R2 CS	P48
P21	R5	3	4	R6	P20	G2	3	4	G4	P40
P23	R3	5	6	R4	P22	B6	5	6	B7	P43
P25	G6	7	8	G7	P24	B4	7	8	B5	P45
P9	LCD PWM	9	10	G5	P26	R7	9	10	B3	P47
P50	R0 SDI	11	12	G0 LCD_TE	P52	LCD HSYN	11	12	LCD VSYNC	P18
P51	G1 DVP	13	14	B2 LCD_RST	P53	LCDC PCL	13	14	LCDC DE	P16
P54	B1 TP RS	15	16	R1 SCK	P49	VDD 3V3	15	16	GND	GND
P41	G3	17	18	VDD 3V3	3.3V	VCC 5V	17	18	GND	GND

		P10				P11				
GND	GND	1	2	DVP MCLK	P27	SD D2	1	2	SD D3	P11
P29	DVP PCLK	3	4	DVP VSYNC	P31	SD SCK	3	4	SD CMD	P03
P34	DVP D2	5	6	DVP D4	P36	SD D1	5	6	SD D0	P04
P35	DVP D3	7	8	DVP HSYN	P30	SFC IO3	7	8	SD CD	P08
P33	DVP D1	9	10	DVP D5	P37	SFC IO2	9	10	P0	P00
P38	DVP D6	11	12	DVP D0	P32	SPK CTL	11	12	VCC 5V	5V
GND	GND	13	14	DVP D7	P39	GND	13	14	VDD 3V3	3.3V
GND	GND	15	16	SCL	P13	T5 RST	15	16	ADC KEY	P12
5V	VCC 5V	17	18	SDA	P15	GND	17	18	P1	P01

		P8				P9				
GND	GND	1	2	GND	GND	B0 TP INT	1	2	R2 CS	P48
P21	R5	3	4	R6	P20	G2	3	4	G4	P40
P23	R3	5	6	R4	P22	B6	5	6	B7	P43
P25	G6	7	8	G7	P24	B4	7	8	B5	P45
P9	LCD PWM	9	10	G5	P26	R7	9	10	B3	P47
P50	R0 SDI	11	12	G0 LCD_TE	P52	LCD HSYN	11	12	LCD VSYNC	P18
P51	G1 DVP	13	14	B2 LCD_RST	P53	LCDC PCL	13	14	LCDC DE	P16
P54	B1 TP RS	15	16	R1 SCK	P49	VDD 3V3	15	16	GND	GND
P41	G3	17	18	VDD 3V3	3.3V	VCC 5V	17	18	GND	GND

		P10				P11				
GND	GND	1	2	DVP MCLK	P27	SD D2	1	2	SD D3	P11
P29	DVP PCLK	3	4	DVP VSYNC	P31	SD SCK	3	4	SD CMD	P03
P34	DVP D2	5	6	DVP D4	P36	SD D1	5	6	SD D0	P04
P35	DVP D3	7	8	DVP HSYN	P30	SFC IO3	7	8	SD CD	P08
P33	DVP D1	9	10	DVP D5	P37	SFC IO2	9	10	P0	P00
P38	DVP D6	11	12	DVP D0	P32	SPK CTL	11	12	VCC 5V	5V
GND	GND	13	14	DVP D7	P39	GND	13	14	VDD 3V3	3.3V
GND	GND	15	16	SCL	P13	T5 RST	15	16	ADC KEY	P12
5V	VCC 5V	17	18	SDA	P15	GND	17	18	P1	P01



For more information about I/O features, refer to the [pin definition in the T5-E1-IPEX module datasheet](#).

6. Recommended I/O configuration of RGB565 LCD, camera module, and TF card

RGB565 LCD		Touch Pad		CIS_DVP		TF Card		Flash Download	
P23	R3	P13	SCL (IO)	P13	SCL (IO)	TXD/P11	SDIO_D3	TXD/P11	DL_UART_RX
P22	R4	P15	SDA (IO)	P15	SDA (IO)	RXD/P10	SDIO_D2	RXD/P10	DL_UART_TX
P21	R5	P54	TP_RSTn	P27	DVP_MCLK	P5	SDIO_D1		
P20	R6	P55	TP_INTn	P29	DVP_PCLK	P4	SDIO_D0		
P19	R7			P31	DVP_VSYNC	P3	SDIO_CMD		
P42	G2			P30	DVP_HSYNC	P2	SDIO_CLK		
P41	G3			P33	DVP_D1	P8	SDIO_CD		
P40	G4			P32	DVP_D0				
P26	G5			P34	DVP_D2				
P25	G6			P35	DVP_D3				
P24	G7			P36	DVP_D4				
P47	B3			P37	DVP_D5				
P46	B4			P38	DVP_D6				
P45	B5			P39	DVP_D7				
P44	B6			P51	DVP_RST				
P43	B7								
P14	LCDC_PCLK								
P16	LCDC_DE								
P17	LCD_HSYNC								
P18	LCD_VSYNC								
P50	LCD_SDI (IO)								
P49	LCD_CLK (IO)								
P48	LCD_CS								
P53	LCD_RST								
P52	LCDC_TE								
P9	PWM_BL								



- The camera and touch pad share an I2C interface.
- The DATA3 and DATA2 pins of the TF card are multiplexed with the module's UART port for flashing.

7. Recommended I/O configuration of SPI LCD

SPI LCD	
P23	QSPI0_CS
P17	RS
P22	QSPI0_SCK
P24	QSPI0_DI
P18	RST
P19	TE
P25	PWM_BL

8. Radio frequency (RF) parameters

8.1. Basic RF features

Parameter	Description
Operating frequency	2.412 to 2.484 GHz
Wi-Fi standard	IEEE 802.11b/g/n/ax (channels 1-14) • IEEE 802.11b: 1, 2, 5.5, and 11 Mbit/s • IEEE 802.11g: 6, 9, 12, 18, 24, 36, 48, and 54 Mbit/s • IEEE 802.11n: HT20 MCS0-7 and HT40 MCS0-7 • IEEE 802.11ax: HE20 MCS0-7 and HE40 MCS0-7
Data transmission rate	
Antenna type	PCB onboard antenna

8.2. Wi-Fi transmitter (TX) performance

Parameter	Min value	Typical value	Max value	Unit
RF average output power, 802.11b CCK mode, 11 Mbit/s	15	17	19	dBm
RF average output power, 802.11g OFDM mode, 54 Mbit/s	13	15	17	dBm

Parameter	Min value	Typical value	Max value	Unit
RF average output power, 802.11n OFDM mode, HT20 MCS7	12	14	16	dBm
RF average output power, 802.11n OFDM mode, HT40 MCS7	11	13	15	dBm
RF average output power, 802.11ax OFDMA mode, HE20 MCS7	12	14	16	dBm
RF average output power, 802.11ax OFDMA mode, HE40 MCS7	11	13	15	dBm
Frequency error	-20	-	20	ppm

8.3. Wi-Fi receiver (RX) performance

Parameter	Min value	Typical value	Max value	Unit
PER < 8%, RX sensitivity, 802.11b DSSS mode, 11 Mbit/s	-	-88	-	dBm

Parameter	Min value	Typical value	Max value	Unit
PER < 10%, RX sensitivity, 802.11g OFDM mode, 54 Mbit/s	-	-74	-	dBm
PER < 10%, RX sensitivity, 802.11n OFDM mode, HT40 MCS7	-	-73	-	dBm
PER < 10%, RX sensitivity, 802.11ax OFDMA mode, HE40 MCS7	-	-73	-	dBm
PER < 10%, RX sensitivity, Bluetooth LE, 1 Mbit/s	-	-97	-	dBm

8.4. Bluetooth TX performance

Parameter	Min value	Typical value	Max value	Unit
Operating frequency	2402	-	2480	MHz
Transmission rate over the air	-	-	-	Mbit/s
Transmission power	-20	6	15	dBm
Frequency error	-150	-	150	MHz

8.5. Bluetooth RX performance

Parameter	Min value	Typical value	Max value	Unit
RX sensitivity	-	-97	-	dBm
Max RF signal input	-10	-	-	dBm
Intermodulation	-	-	-23	dBm
Co-channel rejection ratio	-	10	-	dB

9. Reference

9.1. LCD sub-board screen

Display type	Color number	Number of dots	Driver IC	TP IC
3.5" TFT	16.7M	320(RGB) × 480 dots	ILI9488	GT1151QM
0.9" IPS	16.7M	128 × 128	ST7735	-

9.2. LCD sub-board camera

Sensor type	Array size	Resolution	Sensor IC	I2C Addr
OVX4388	1600 × 1200	800 × 600	GC2145	0x78, 0x79

9.3. Explore more

- [Schematic diagram of the development board](#)
- [Pinout of the development board](#)
- [I/O connector location](#)
- [Schematic diagram of LCD sub-board](#)
- [Schematic diagram of LCD dual-lens sub-board](#)

10. USB-to-serial chip driver

Download the USB-to-serial chip driver for your operating system.

- [For Windows](#)
- [For Linux](#)
- [For macOS](#)

11. Appendix: Statement

FCC Caution:Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this device.This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

List of applicable FCC rules This module has been granted modular approval as below listed FCC rule parts. -FCC Rule parts 15C (15.247)

List of applicable ISED rules This module has been certificated modular approval as below listed ISED Radio Standards Specifications.

- RSS 247 Issue 3

This device generates, uses, and can radiate radio frequency energy and, if not installed and used following the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this device does cause harmful interference to radio or television reception, which can be determined by turning the device off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the device and receiver.
- Connect the device to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Radiation Exposure Statement

This device complies with FCC radiation exposure limits set forth for an uncontrolled rolled environment. This device should be installed and operated with a minimum distance of 20cm between the radiator and your body.

Important Note

This radio module must not be installed to co-locate and operate simultaneously with other radios in the host system except by following FCC multi-transmitter

product procedures. Additional testing and device authorization may be required to operate simultaneously with other radios.

The availability of some specific channels and/or operational frequency bands are country dependent and are firmware programmed at the factory to match the intended destination. The firmware setting is not accessible to the end-user.

Declaration of Conformity European Notice



Hereby, Hangzhou Tuya Information Technology Co., Ltd declares that this module product is in compliance with essential requirements and other relevant provisions of Directive 2014/53/EU, 2011/65/EU. A copy of the Declaration of Conformity can be found at <https://www.tuya.com>.



This product must not be disposed of as normal household waste, in accordance with the EU directive for waste electrical and electronic equipment (WEEE-2012/19/EU). Instead, it should be disposed of by returning it to the point of sale or to a municipal recycling collection point.

The device could be used with a separation distance of 20cm from the human body.

Industry Canada Statement This device complies with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions: (1) This device may not cause interference. (2) This device must accept any interference, including interference that may cause undesired operation of the device. Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage. (2)

l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Radiation Exposure Statement This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator & your body.

Déclaration d'exposition aux radiations: Cet équipement est conforme aux limites d'exposition aux rayonnements ISED établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps. L'appareil peut interrompre automatiquement la transmission en cas d'absence d'informations à transmettre ou de panne opérationnelle. Notez que ceci n'est pas destiné à interdire la transmission d'informations de contrôle ou de signalisation ou l'utilisation de codes répétitifs lorsque cela est requis par la technologie.