WT32-S2-WROVER Datasheet

V1.0.0

Sept 16, 2021

Wireless-Tag Technology Co., Ltd

About this document

This document provides users with the technical specifications for WT32-S2-WROVER.

Document updates

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Revision history

Please go to the document revision history page to view the revisions of the document.

Statement

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Revision History

No.	Version	Changes	Change (+/-) Descriptions	Author	Date
1	V1.0.0	C	First release	Fiona	Sept 16, 2021

*Changes：C——create, A——add, M——modify, D——delete

Contents

1 Module Overview

1.1 Features

MCU

- ESP32-S2 chip embedded, 32-bit LX7 single-core microprocessor, up to 240MHz
  - SRAM 320KB
  - RTC SRAM 16KB
  - ROM 128KB

WIFI

- IEEE 802.11b/g/n protocol
- Data rate up to 150 Mbps
- Frame aggregation (TX/RX A-MPDU, TX/RX A-MSDU)
- 0.4 µs guard interval
- Center frequency range of operating channel: 2412~2484 MHz

Hardware

- Module interface: GPIO, SPI, LCD interface, UART, I2C, I2S, Camera interface, IR, pulse counter, LED PWM, TWAITM (compatible with ISO 11898-1), USB 1.1 OTG, ADC, DAC, touch sensor, temperature sensor
- 40MHz crystal oscillator
- 4 MB SPI flash
- 8 MB PSRAM
- Operating voltage/Power supply: 3.0~3.6 V
- Operating ambient temperature: -40~85℃
- Package size: (18 × 31 × 3.3) mm

1.2 Description

WT32-S2-WROVER is a universal Wi-Fi MCU module with powerful functions and rich peripheral interfaces, which can be used in scenarios such as wearable electronic devices and smart homes.

WT32-S2-WROVER adopts IPEX onboard antenna, equipped with 4 MB SPI flash and 8 MB SPI PSRAM.

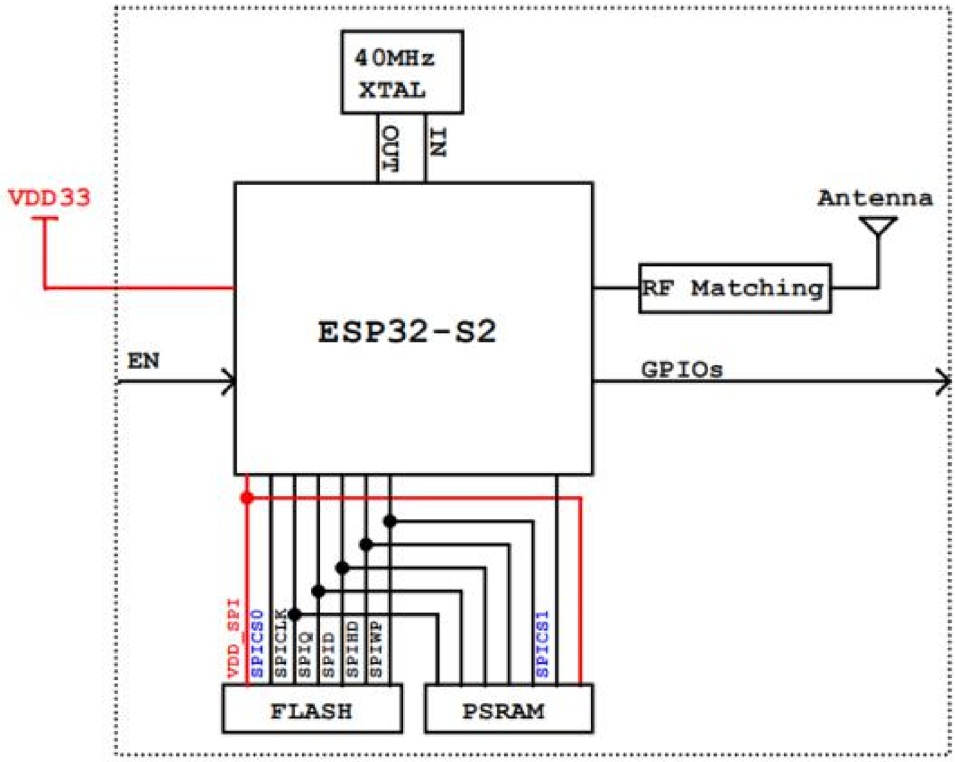
WT32-S2-WROVER uses ESP32-S2 chip. The ESP32-S2 chip is equipped with an Xtensa® 32-bit LX7 single-core processor with a working frequency of up to 240 MHz. The user can turn off the power of the CPU and use the low-power coprocessor to monitor the status changes of peripherals or whether certain analog quantities exceed the threshold. ESP32-S2 also integrates a wealth of peripherals, including SPI, I2S, UART, I2C, LED PWM, TWAITM, LCD interface, Camera interface, ADC, DAC, touch sensor, temperature sensor and up to 43 GPIOs, as well as a full-speed USB 1.1 On-The-Go (OTG) interface.

1.3 Applications

- Generic low-power IoT sensor hub
- Generic low-power IoT data logger
- Camera video streaming
- OTT TV box/set-top box equipment
- USB device
- Voice recognition
- Image recognition
- Mesh network
- Home automation
- Smart home control panel
- Smart buildings
- Industrial Automation
- Smart agriculture
- Audio equipment
- Health/Medical/Nursing
- Wi-Fi toys
- Wearable electronic products
- Retail & Catering
- Smart POS application
- Smart door lock

2 Block Diagram

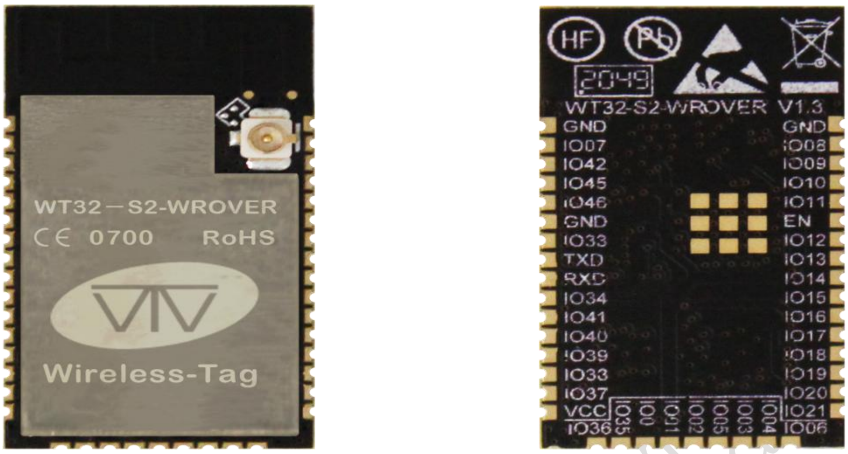
Figure 1 Block Diagram



3 Pin Definitions

3.1 Pin Layout

Figure 2 Pin Layout



3.2 Pin description

Table 1 Pin Definitions and Descriptions

Pin	Name	Description
1	GND	Ground
2	IO07	RTC_GPIO7, GPIO7, TOUCH7, ADC1_CH6
3	IO42	MTMS, GPIO42
4	IO45	GPIO45
5	IO46	GPIO46
6	GND	Ground
7	IO33	SPIIO4, GPIO33, FSPIHD
8	TXD	U0TXD, GPIO43, CLK_OUT1
9	RXD	U0RXD, GPIO44, CLK_OUT2
10	IO34	SPIIO5, GPIO34, FSPICS0
11	IO41	MTDI, GPIO41, CLK_OUT1
12	IO40	MTDO, GPIO40, CLK_OUT2
13	IO39	MTCK, GPIO39, CLK_OUT3
14	IO38	GPIO38, FSPIWP
15	IO37	SPIDQS, GPIO37, FSPIQ
16	VCC	Power supply
17	IO36	SPIIO7, GPIO36, FSPICLK
18	IO35	SPIIO6, GPIO35, FSPID

Pin	Name	Description
19	IO0	RTC_GPIO0, GPIO0
20	IO01	RTC_GPIO1, GPIO1, TOUCH1, ADC1_CH0
21	IO02	RTC_GPIO2, GPIO2, TOUCH2, ADC1_CH1
22	IO05	RTC_GPIO5, GPIO5, TOUCH5, ADC1_CH4
23	IO03	RTC_GPIO3, GPIO3, TOUCH3, ADC1_CH2
24	IO04	RTC_GPIO4, GPIO4, TOUCH4, ADC1_CH3
25	IO06	RTC_GPIO6, GPIO6, TOUCH6, ADC1_CH5
26	IO21	RTC_GPIO21, GPIO21
27	IO20	RTC_GPIO20, GPIO20, U1CTS, ADC2_CH9, CLK_OUT1, USB_D+
28	IO19	RTC_GPIO19, GPIO19, U1RTS, ADC2_CH8, CLK_OUT2, USB_D-
29	IO18	RTC_GPIO18, GPIO18, U1RXD, ADC2_CH7, DAC_2, CLK_OUT3
30	IO17	RTC_GPIO17, GPIO17, U1TXD, ADC2_CH6, DAC_1
31	IO16	RTC_GPIO16, GPIO16, U0CTS, ADC2_CH5, XTAL_32K_N
32	IO15	RTC_GPIO15, GPIO15, U0RTS, ADC2_CH4, XTAL_32K_P
33	IO14	RTC_GPIO14, GPIO14, TOUCH14, ADC2_CH3, FSPIWP, FSPIDQS
34	IO13	RTC_GPIO13, GPIO13, TOUCH13, ADC2_CH2, FSPIQ, FSPIIO7
35	IO12	RTC_GPIO12, GPIO12, TOUCH12, ADC2_CH1, FSPICLK, FSPIIO6
36	EN	Chip Enable pin: High level: on, enables the chip. Low level: off, the chip powers off, low current. Note: Do not leave the EN pin floating.
37	IO11	RTC_GPIO11, GPIO11, TOUCH11, ADC2_CH0, FSPID, FSPIIO5
38	IO10	RTC_GPIO10, GPIO10, TOUCH10, ADC1_CH9, FSPICS0, FSPIIO4
39	IO09	RTC_GPIO9, GPIO9, TOUCH9, ADC1_CH8, FSPIHD
40	IO08	RTC_GPIO8, GPIO8, TOUCH8, ADC1_CH7
41	GND	Ground

3.3 Strapping Pins

ESP32-S2 series has three strapping pins.

- GPIO0 = IO0
- GPIO45 = IO45
- GPIO46 = IO46

Software can read the strapping values of these pins in “GPIO_STRAPPING” register.

During the chip’s system reset(power-on-reset, RTC watchdog reset, brownout reset, analog super watchdog reset, crystal clock glitch detection 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.

IO0, IO45, IO46 are connected to internal pull-up/pull-down by default. If these pins are not connected externally or the connected external circuit is in a high impedance state, the internal weak pull-up/pull-down will determine the default value of the input level of these pins.

To change the value of strapping, users can apply external pull-down/pull-up resistors, or use the GPIO of the host MCU to control the strapping pin level of ESP32-S2 during power-on reset.

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

Refer to Table 2 for a detailed boot-mode configuration of the strapping pins.

Table 2 Strapping Pins

VDD_SPI voltage [1]			
Pin	Default	3.3 V	1.8 V
IO45 [2]	drop down	0	1
Booting Mode [1]			
Pin	**Default**	**SPI Boot**	**Download Boot**
IO0	pull up	1	0
IO46	Drop down	N/A	0
Enabling/Disabling ROM Code Print During Booting [3 4]			
Pin	**Default**	**Print normally**	**No printing after power-on**
IO46	Drop down	See the description in Article 4 for details	See the description in Article 4 for details

Note:

1. The firmware can change the setting of "VDD_SPI voltage" after booting through the configuration register.
2. GPIO 46 = 1 and GPIO0 = 0 cannot be used.
3. Since the operating voltage of the module's flash is 3.3 V by default (VDD_SPI output), the internal IO45 pull-up resistor R1 of the module is not loaded by default. At the same time, please pay attention to ensure that the external circuit will not pull IO45 high when the module is powered on when using IO45.
4. The ROM Code power-on printing defaults to the TXD0 pin, which can be switched to the DAC_1 (IO17) pin under the control of the eFuse bit.
5. The UART_PRINT_CONTROL of eFuse is:

   When it is 0, it will print normally after power-on, and it is not controlled by IO46.

   When 1, IO46 is 0: normal printing when power on; IO46 is 1: no printing when power on.

   At 2 , IO46 is 0: no printing when power on; IO46 is 1: normal printing when power on.

   At 3 , there is no printing after power on, and it is not controlled by IO46.

4 Electrical Characteristics

4.1 Absolute Maximum Ratings

Table 3 Absolute maximum ratings

Symbol	Parameter	Min	Max	Unit
VDD33	Power supply voltage	-0.3	3.6	V
TSTORE	Storage temperature	-40	85	℃

4.2 Recommended Operating Conditions

Table 4 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	Ambient temperature	-40	—	85	℃
Humidity	Humidity condition	—	85	—	%RH

4.3 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 the tables below.

Table 5 Current Consumption Depending on RF Modes

Work mode	Description		Peak (mA)
Active(RF working)	TX	802.11b, 1Mbps, @19.5dBm	310
		802.11g, 54Mbps, @15dBm	220
		802.11n, HT20, MCS7, @13dBm	200
		802.11n, HT40, MCS7, @13dBm	160
	RX	802.11b/g/n, HT20	63
		802.11n, HT40	68

Note:

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 in RX mode are for cases when the peripherals are disabled and the CPU is idle.

Table 6 Current Consumption Depending on Work Modes

Work mode	Description		Typ
Modem-sleep	CPU is working	240 MHz	22 mA
		160 MHz	17 mA
		Normal speed：80 MHz	14 mA
Light-sleep	—		550 µA
Deep-sleep	ULP coprocessor is working		235 µA
	Ultra-low power sensor monitoring mode		22 µA @1% duty
	RTC timer + RTC memory		25 µA
	Only the RTC timer is working		20 µA
close	CHIP_PU pin is pulled low, the chip is in the off state		1 µA

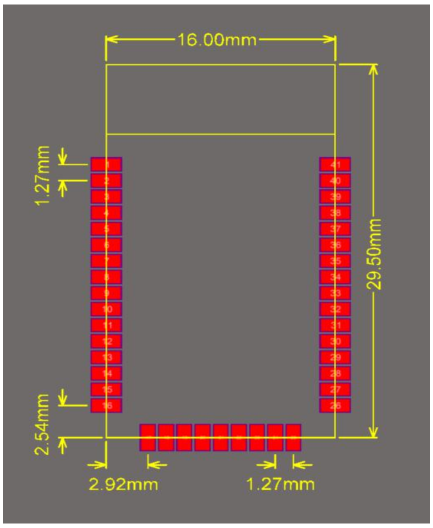
Note:

- When measuring Modem-sleep power consumption data, the CPU is in working state and the cache is in idle state.
- In the scenario where Wi-Fi is turned on, the chip will switch between Active and Modem-sleep modes, and the power consumption will also change between the two modes.
- In Modem-sleep mode, the CPU frequency changes automatically, and the frequency depends on the CPU load and peripherals used.
- In Deep-sleep mode, only when the ULP coprocessor is in working state, GPIO and low-power I2C can be operated.
- When the system is in the ultra-low power sensor monitoring mode, the ULP coprocessor or sensor works periodically. The touch sensor works with a 1% duty cycle, and the system power consumption is typically 22 µA.

5 Application Note

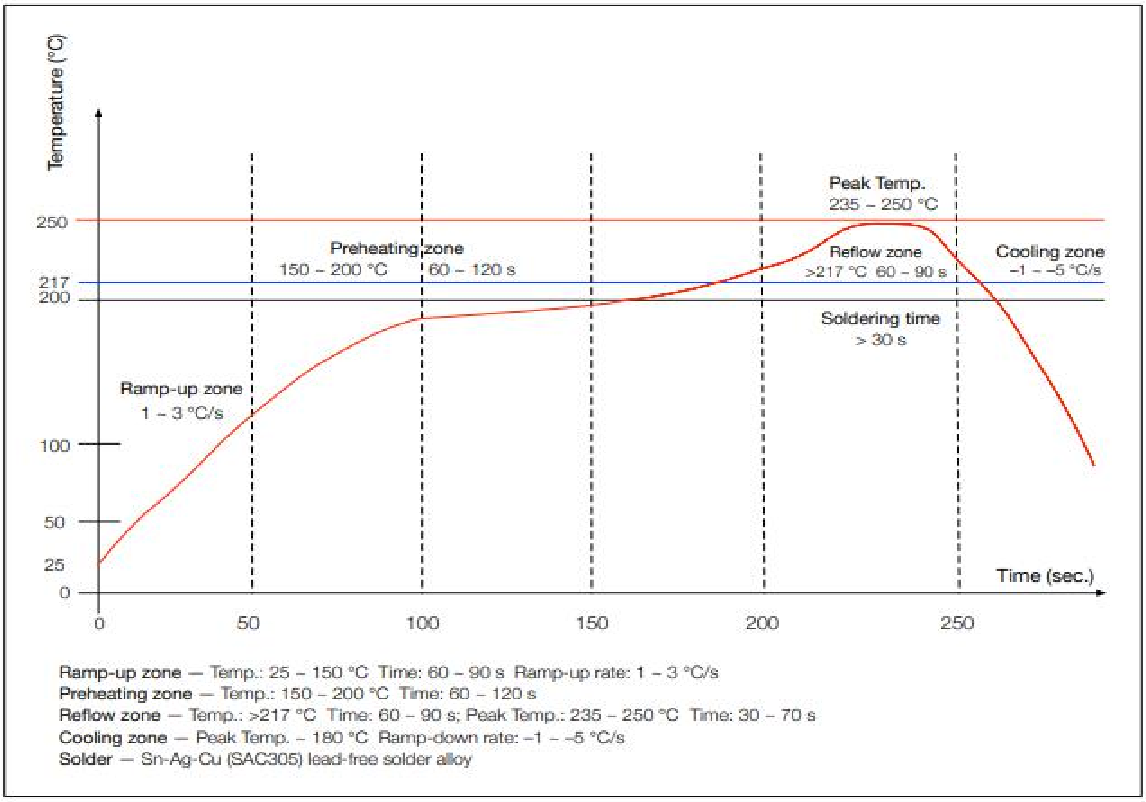
5.1 Module Dimensions

Figure 3 Module Dimensions



5.2 Reflow Profile

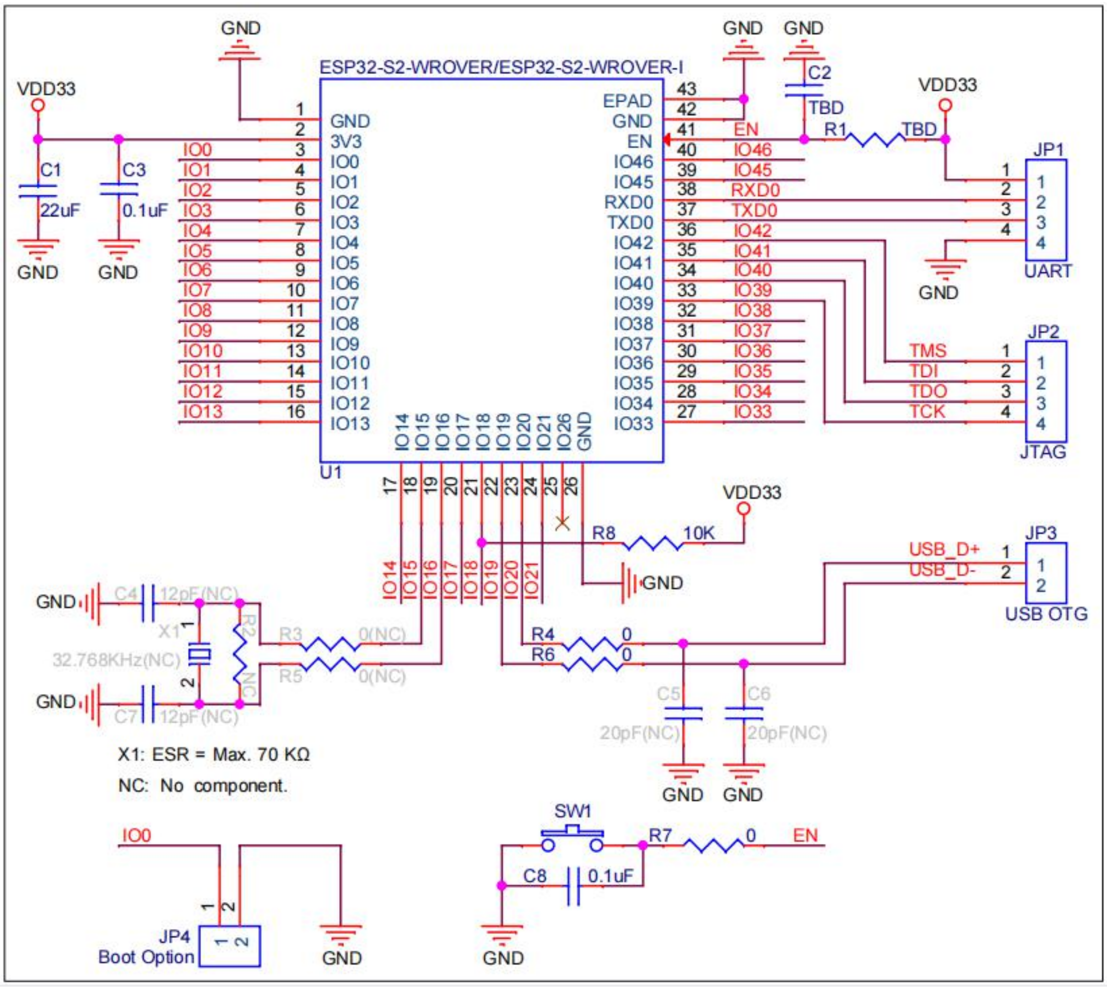
Figure 4 Reflow Profile



5.3 Peripheral Schematic

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 Module Schematics



6 Product Trial

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