

Tuya WRD8P Wi-Fi Module

Version: 2.0.0

Date: 2019-09-18

No.:

1 Product Overview

WRD8P is a low-power embedded Wi-Fi module that Tuya has developed. It consists of a highly integrated RF chip (RDA5981BM) and several peripheral components, with an embedded Wi-Fi network protocol stack and robust library functions. WRD8P is embedded with a low-power Arm Cortex-M4 MCU, 2 MB flash memory, and 384 KB static random-access memory (SRAM), and has extensive peripherals.

WRD8P is an RTOS platform that integrates all function libraries of the Wi-Fi MAC and TCP/IP protocols. You can develop embedded Wi-Fi products as required.

Figure 1-1 shows the WRD8P architecture.

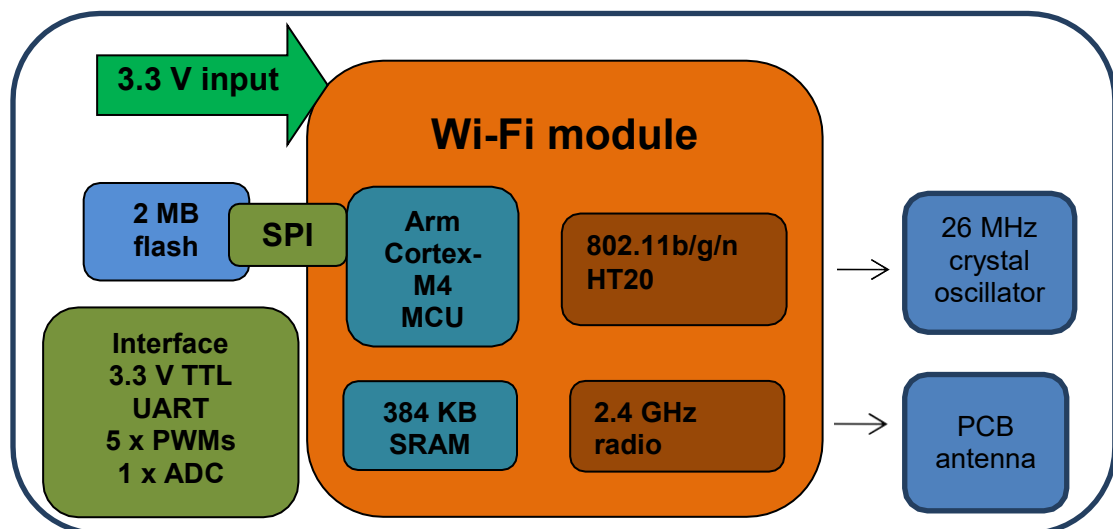


Figure 1-1 WRD8P architecture

1.1 Features

- ✧ Embedded low-power CPU, which can also function as an application processor
 - Dominant frequency: up to 160 MHz
- ✧ Working voltage: 3.3 V to 4.2 V
- ✧ Peripherals: five pulse width modulation (PWM) pins, one universal asynchronous receiver/transmitter (UART), and one analog-to-digital converter (ADC)
- ✧ Wi-Fi connectivity
 - 802.11b/g/n/HT20
 - Channels 1 to 14 at 2.4 GHz
 - WPA, WPA2, WEP, and TKIP security modes
 - Up to +18 dBm output power in 802.11b mode
 - STA, AP, and STA+AP working modes
 - Smart and AP network configuration modes for Android and iOS devices
 - Onboard PCB antenna
 - Working temperature: -40°C to $+105^{\circ}\text{C}$

1.2 Applications

- ✧ Intelligent building
- ✧ Smart household and home appliances
- ✧ Smart socket and light
- ✧ Industrial wireless control
- ✧ Baby monitor
- ✧ Network camera
- ✧ Intelligent bus

Change History

No.	Date	Change Description	Version After Change
1	2019-07-18	This is the first release.	1.0.0
2	2019-09-18	Updated the ADC input voltage and production instructions.	2.0.0

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2 Module Interfaces

2.1 Dimensions and Footprint

WRD8P has a row of pins with a 1.27 mm pin spacing.

The WRD8P dimensions (H x W x D) are 3.5 ± 0.15 mm x 16 ± 0.35 mm x 24.8 ± 0.35 mm. Figure 2-1 shows WRD8P front and rear views. The PCB thickness is 1.2 ± 0.1 mm, and the distance between the solder pad edges is 1.27 ± 0.15 mm.

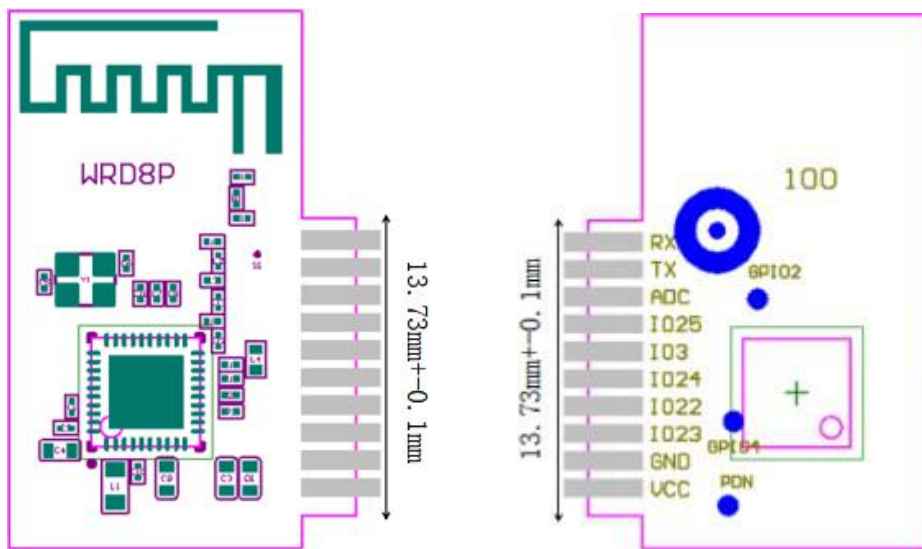


Figure 2-1 WRD8P front and rear views

2.2 Interface Pin Definition

Table 2-1 WRD8P interface pins

Pin No.	Symbol	I/O Type	Function
1	3V3	P	Power supply pin
2	GND	P	Power supply reference ground pin
3	GPIO23	I/O	Standard PWM pin, which is connected to pin 33 on the internal IC
4	GPIO22	I/O	Standard PWM pin, which is connected to pin 34 on the internal IC

Pin No.	Symbol	I/O Type	Function
5	GPIO24	I/O	Standard PWM pin, which is connected to pin 32 on the internal IC
6	GPIO3	I/O	Standard PWM pin, which is connected to pin 23 on the internal IC
7	GPIO25	I/O	Standard PWM pin, which is connected to pin 31 on the internal IC
8	ADC	AI	ADC pin, which is connected to pin 11 on the internal IC (See the following Note 2.)
9	TX	Output	UART_TX, which is connected to pin 16 on the internal IC (See the following Note 3.)
10	RX	Input	UART_RX, which is connected to pin 24 on the internal IC (See the following Note 3.)

Note:


1. **P** indicates power supply pins, **I/O** indicates input/output pins, and **AI** indicates analog input pins.
2. This pin can only function as an ADC input and not a common I/O. If this pin is not used, it must be disconnected.

When this pin is used as the ADC input, the input voltage range is 0 V to 2.0 V. The button test uses the interrupt mode. When the button is being pressed, the maximum voltage is 1.4 V.

3. UART is a user-side serial interface.

2.3 Test Pin Definition

Table 2-2 WRD8P test pins

Pin No.	Symbol	I/O Type	Function
N/A		N/A	Used for the module production test

Note:

Test pins cannot be used.

3 Electrical Parameters

3.1 Absolute Electrical Parameters

Table 3-1 Absolute electrical parameters

Parameter	Description	Minimum Value	Maximum Value	Unit
I_{IN}	Input current	-10	10	mA
V_{IN}	Input voltage	-0.3	$V_{IO} + 0.3$	V
VLNA	LNA input power	N/A	+10	dBm

3.2 Electrical Conditions

Table 3-2 Normal electrical conditions

Parameter	Description	Minimum Value	Typical Value	Maximum Value	Unit
T_a	Working temperature	-40	N/A	105	°C
VCC	Working voltage	3.3	4.0	4.2	V
V_{IL}	I/O low-level input	0	N/A	$V_{CC} \times 0.3$	V
V_{IH}	I/O high-level input	$V_{CC} \times 0.7$	N/A	VCC	V
V_{OL}	I/O low-level output	N/A	N/A	$V_{CC} \times 0.1$	V
V_{OH}	I/O high-level output	$V_{CC} \times 0.8$	N/A	VCC	V

Parameter	Description	Minimum Value	Typical Value	Maximum Value	Unit
I_{max}	I/O drive current	N/A	N/A	12	mA

3.3 WRD8P TX Power Consumption

Table 3-3 Power consumption during constant transmission

Symbol	Parameter			Typical Value	Unit
	Mode	Rate	TX Power		
I_{RF}	802.11b	11 Mbit/s	16 dBm	280	mA
I_{RF}	802.11g	54 Mbit/s	13.5 dBm	250	mA
I_{RF}	802.11n HT20	MCS7	12 dBm	190	mA

3.4 WRD8P RX Power Consumption

Table 3-4 Power consumption during constant receiving

Symbol	Mode	Rate	Typical Value	Unit
I_{RF}	802.11b	11 Mbit/s	80	mA
I_{RF}	802.11g	54 Mbit/s	80	mA
I_{RF}	802.11n	MCS7	80	mA

3.5 Working Current

Table 3-5 WRD8P working current

Working Mode	Working Status ($T_a = 25^\circ\text{C}$)	Average Value	Unit
EZ	The module is in EZ mode.	70	mA

Working Mode	Working Status (Ta = 25°C)	Average Value	Unit
AP	The module is in AP mode.	80	mA
Connected	The module is connected to the network.	70	mA

4 RF Features

4.1 Basic RF Features

Table 4-1 Basic RF features

Parameter	Description
Frequency band	2.412 GHz to 2.4835 GHz
Wi-Fi standard	IEEE 802.11b/g/n20 (channels 1 to 14)
Data transmission rate	802.11b: 1, 2, 5.5, or 11 (Mbit/s) 802.11g: 6, 9, 12, 18, 24, 36, 48, or 54 (Mbit/s) 802.11n: HT20 MCS0 to MCS7
Antenna type	Onboard PCB antenna

4.2 WRD8P TX Power

Table 4-2 Power during constant transmission

Parameter		Minimum Value	Typical Value	Maximum Value	Unit
Average RF output power, 802.11b CCK mode	11 Mbit/s	N/A	16	N/A	dBm
Average RF output power, 802.11g OFDM mode	54 Mbit/s	N/A	13.5	N/A	dBm
Average RF output power, 802.11n OFDM mode	MCS7	N/A	12	N/A	dBm

Parameter		Minimum Value	Typical Value	Maximum Value	Unit
Average RF output power, HT40 mode	MCS7	N/A	12	N/A	dBm
Frequency error		-20	N/A	+20	ppm

4.3 WRD8P RX Sensitivity

Table 4-3 RX sensitivity

Parameter		Minimum Value	Typical Value	Maximum Value	Unit
PER < 8%, 802.11b CCK mode	11 Mbit/s	N/A	-84	N/A	dBm
PER < 10%, 802.11g OFDM mode	54 Mbit/s	N/A	-72	N/A	dBm
PER < 10%, 802.11n OFDM mode	MCS7	N/A	-69	N/A	dBm
PER < 10%, HT40 mode	MCS7	N/A	-68	N/A	dBm

5 Antenna Information

5.1 Antenna Type

WRD8P uses an onboard PCB antenna.

5.2 Antenna Interference Reduction

To ensure optimal Wi-Fi performance when the Wi-Fi module uses an onboard PCB antenna, it is recommended that the antenna be at least 15 mm away from other metal parts.

6.2 Recommended PCB Layout

P1			
1	VCC	UART-RX	10
2	GND	UART-TX	9
3	PWM1	ADC	8
4	PWM2	PWM5	7
5	PWM3	PWM4	6

Figure 6-2 WRD8P pins

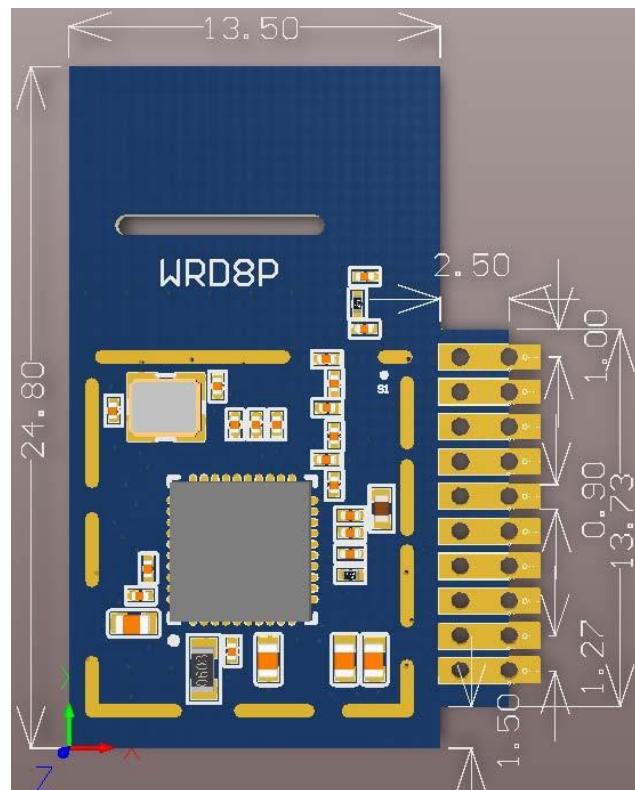


Figure 6-3 Layout of the PCB to which WRD8P applies

6.3 Production Instructions

1. Use an SMT placement machine to mount the stamp hole module that Tuya produces onto the PCB within 24 hours after the module is unpacked and the firmware is

burned. If not, vacuum pack the module again. Bake the module before mounting the module onto the PCB.

- (1) SMT placement equipment
 - i. Reflow soldering machine
 - ii. Automated optical inspection (AOI) equipment
 - iii. Nozzle with a 6 mm to 8 mm diameter
 - (2) Baking equipment
 - i. Cabinet oven
 - ii. Anti-static heat-resistant trays
 - iii. Anti-static heat-resistant gloves
2. Storage conditions for a delivered module are as follows:
- (1) The moisture-proof bag is placed in an environment where the temperature is below 30°C and the relative humidity is lower than 70%.
 - (2) The shelf life of a dry-packaged product is six months from the date when the product is packaged and sealed.
 - (3) The package contains a humidity indicator card (HIC).

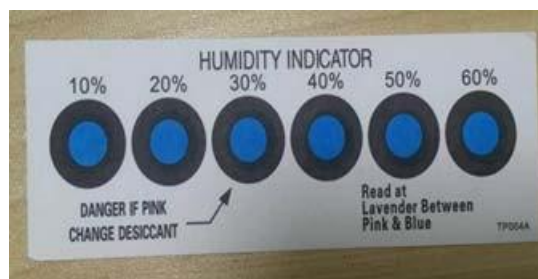


Figure 6-4 HIC for WRD8P

1. Bake a module based on HIC status as follows when you unpack the module package:
 - (1) If the 30%, 40%, and 50% circles are blue, bake the module for 2 consecutive hours.
 - (2) If the 30% circle is pink, bake the module for 4 consecutive hours.
 - (3) If the 30% and 40% circles are pink, bake the module for 6 consecutive hours.
 - (4) If the 30%, 40%, and 50% circles are pink, bake the module for 12 consecutive hours.

2. Baking settings:
 - (1) Baking temperature: $125\pm 5^{\circ}\text{C}$
 - (2) Alarm temperature: 130°C
 - (3) SMT placement ready temperature after natural cooling: $< 36^{\circ}\text{C}$
 - (4) Number of drying times: 1
 - (5) Rebaking condition: The module is not soldered within 12 hours after baking.
3. Do not use SMT to process modules that have been unpacked for over three months. Electroless nickel immersion gold (ENIG) is used for the PCBs. If the solder pads are exposed to the air for over three months, they will be oxidized severely and dry joints or solder skips may occur. Tuya is not liable for such problems and consequences.
4. Before SMT placement, take electrostatic discharge (ESD) protective measures.
5. To reduce the reflow defect rate, draw 10% of the products for visual inspection and AOI before first SMT placement to determine a proper oven temperature and component placement method. Draw 5 to 10 modules every hour from subsequent batches for visual inspection and AOI.

6.4 Recommended Oven Temperature Curve

Perform SMT placement based on the following reflow oven temperature curve. The highest temperature is 245°C .

Based on the IPC/JEDEC standard, perform reflow soldering on a module at most twice.

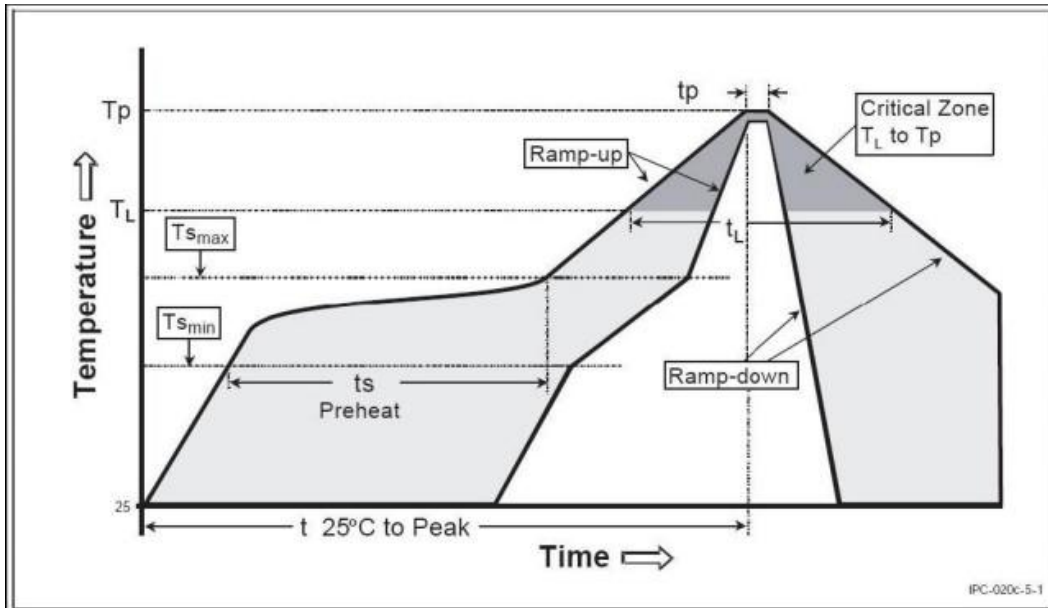


Figure 6-5 Oven temperature curve

6.5 Storage Conditions



CAUTION
This bag contains
MOISTURE-SENSITIVE DEVICES

LEVEL
3

If Blank, see adjacent bar code label

1. Calculated shelf life in sealed bag: 12 months at < 40°C and < 90% relative humidity (RH)
2. Peak package body temperature: 260 °C
If Blank, see adjacent bar code label
3. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must
 - a) Mounted within: 168 hrs. of factory conditions
If Blank, see adjacent bar code label
 - b) Stored at <10% RH
4. Devices require bake, before mounting, if:
 - a) Humidity Indicator Card is > 10% when read at 23 ± 5°C
 - b) 3a or 3b not met.
5. If baking is required, devices may be baked for 48 hrs. at 125 ± 5°C

Note: If device containers cannot be subjected to high temperature or shorter bake times are desired, reference IPC/JEDEC J-STD-033 for bake procedure

Bag Seal Date: _____
If Blank, see adjacent bar code label

Note: Level and body temperature defined by IPC/JEDEC J-STD-020

7 MOQ and Packing Information

MOQ and packing information				
Product Model	MOQ	Packing Method	Number of Modules in Each Reel Pack	Number of Reel Packs in Each Box
WRD8P	3600	Carrier tape and reel packing	900	4

8 Appendix: Statement

Federal Communications Commission (FCC) Declaration of Conformity

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

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.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with 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 equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment 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 equipment and receiver.
- Connect the equipment into 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 equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.

The final end product must be labeled in a visible area with the following: "Contains Transmitter Module 2ANDL-WRD8P"

This radio module must not be installed to co-locate and operating simultaneously with other radios in host system except in accordance with FCC multi-transmitter product procedures. Additional testing and equipment authorization may be required to operating simultaneously with other radio.

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 by the end user.

The host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed. The end user manual shall include all required regulatory information/warning as shown in this manual, including: This product must be installed and operated with a minimum distance of 20 cm between the radiator and user body.

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. 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 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.

ISED Notice

This device complies with Innovation, Science and Economic Development Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

- (1) this device may not cause interference, and
- (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR Innovation, Sciences et Développement économique 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, et
- (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

ISED Radiation Exposure Statement

This device complies with RSS-102 radiation exposure limits set forth for an uncontrolled environment. In order to avoid the possibility of exceeding the ISED radio frequency exposure limits, human proximity to the antenna shall not be less than 20cm (8 inches) during normal operation.

Cet appareil est conforme aux limites d'exposition aux rayonnements de la CNR-102 définies pour un environnement non contrôlé. Afin d'éviter la possibilité de dépasser les limites d'exposition aux fréquences radio de la CNR-102, la proximité humaine à l'antenne ne doit pas être inférieure à 20 cm (8 pouces) pendant le fonctionnement normal.

The Innovation, Science and Economic Development Canada certification label of a module shall be clearly visible at all times when installed in the host device; otherwise, the host device must be labeled to display the Innovation, Science and Economic Development Canada certification number for the module, preceded by the words "Contains transmitter module IC: 23243-WRD8P".