tuya | **Global Intelligent Platform**

Manual

Tuya WRD3L Wi-Fi Module

Version: 2.0.1   **Date: 2019-10-15**   **No.: 0000000001**

1   Product Overview

WRD3L 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. WRD3L is embedded with a low-power Arm Cortex-M4 CPU, 2 MB flash memory, and 448 KB static random-access memory (SRAM), and has extensive peripherals.

WRD3L 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.

1.1 Features

✧ Embedded low-power CPU, which can also function as an application processor

● Dominant frequency: up to 160 MHz

✧ Working voltage: 3.0 V to 3.6 V

✧ Peripherals: nine GPIOs, one universal asynchronous receiver/transmitter (UART), and one analog-to-digital converter (ADC)

✧ Wi-Fi connectivity

● 802.11b/g/n HT20

● 2.4GHz WiFi

● WPA, WPA2, WEP, and TKIP security modes

● Up to +20±3dBm output power

- STA, AP, and STA+AP working modes

- Smart and AP network configuration modes for Android and iOS devices

- Onboard PCB antenna with a gain of 1.0 dBi

- Working temperature: –20°C to +105°C

1.2 Applications

✧ Intelligent building

✧ Smart household and home appliances

✧ Smart socket and light

✧ Industrial wireless control

✧ Baby monitor

✧ Network camera

✧ Intelligent bus

2 Change History

No.	Date	Change Description	Version After Change
1	2019-09-13	This is the first release.	2.0.0
2	2019-10-15	Modified pin numbers and deleted the architecture diagram.	2.0.1

Contents

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Tables

3   Module Interfaces

3.1   Dimensions and Footprint

WRD3L has two rows of pins with a 2 mm pin spacing.

The WRD3L dimensions (H x W x D) are 3.0±0.15 mm x 16±0.35 mm x 24±0.35 mm.

Figure 2-1 shows the WRD3L front and rear views.
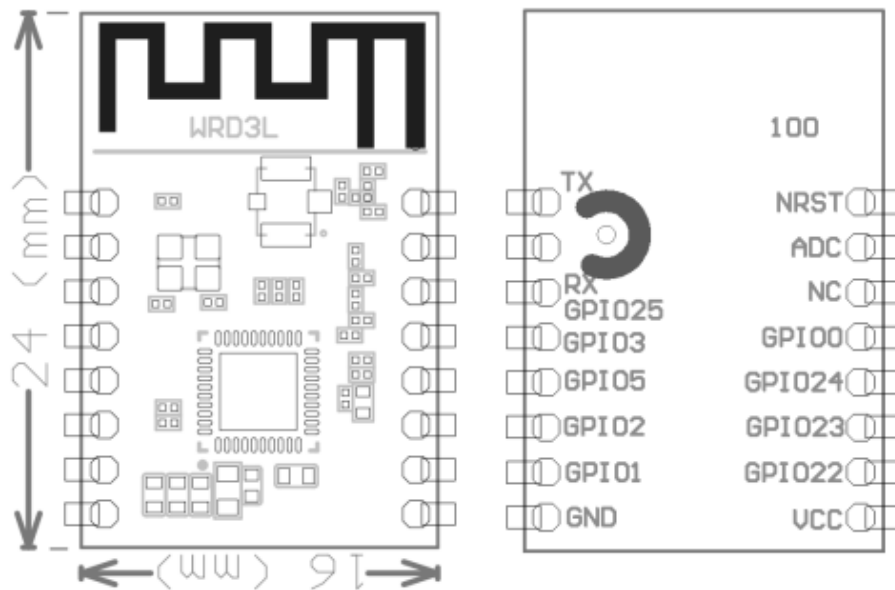
Figure 2-1 WRD3L front and rear views

3.2   Interface Pin Definition

Table 2-1 WRD3L interface pins

Pin No.	Symbol	I/O Type	Function
1	nRST	I/O	Hardware reset pin (active at a low level)
2	ADC	AI	ADC pin (See the following Note 2.)
3	NC	Input	Null pin, no internal connection
4	GPIO0	I/O	GPIO_0, which is connected to GPIO0 (pin 36) on the internal IC

Pin No.	Symbol	I/O Type	Function
5	GPIO24	I/O	GPIO_24, a standard PWM pin, which is connected to GPIO24 (pin 32) on the internal IC
6	GPIO23	I/O	GPIO_23, a standard PWM pin, which is connected to GPIO23 (pin 33) on the internal IC
7	GPIO22	I/O	GPIO_22, a standard PWM pin, which is connected to GPIO22 (pin 34) on the internal IC
8	VCC	P	Power supply pin (3.3 V)
9	GND	P	Power supply reference ground pin
10	GPIO1	Output	GPIO_1, which is connected to GPIO0 (pin 21) on the internal IC
11	GPIO2	Output	UART2_TXD, which is used to display the module internal information and connected to GPIO2 (pin 22) on the internal IC
12	GPIO5	I/O	GPIO_5, which is connected to GPIO5 (pin 14) on the internal IC
13	GPIO3	I/O	GPIO_3, a standard PWM pin, which is connected to GPIO3 (pin 23) on the internal IC
14	GPIO25	I/O	GPIO_25, a standard PWM pin, which is connected to GPIO25 (pin 31) on the internal IC
15	RX	I/O	UART_RX, which is connected to GPIO27 (pin 16) on the internal IC (See the following Note 3.)
16	TX	Output	UART_TX, which is connected to GPIO26 (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. nRST is only a module hardware reset pin and cannot clear the Wi-Fi network configuration.

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 an ADC input, the input voltage range is 0 V to 2.0 V.

3. The UART pins are user-side serial interfaces.

3.3 Test Pin Definition

Table 2-2 WRD3L 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.

4 Electrical Parameters

4.1 Absolute Electrical Parameters

Table 3-1 Absolute electrical parameters

Parameter	Description	Minimum Value	Maximum Value	Unit
Ts	Storage temperature	–40	105	°C
VCC	Power supply voltage	3.0	3.6	V
Static electricity voltage (human body model)	Tamb = 25°C	N/A	2	kV
Static electricity voltage (machine model)	Tamb = 25°C	N/A	0.5	kV

4.2 Electrical Conditions

Table 3-2 Normal electrical conditions

Parameter	Description	Minimum Value	Typical Value	Maximum Value	Unit
Ta	Working temperature	–20	N/A	105	°C
VCC	Working voltage	3.0	3.3	3.6	V
V_{IL}	I/O low-level input	–0.3	N/A	VCC x 0.3	V
V_{IH}	I/O high-level input	VCC x 0.7	N/A	VCC	V
V_{OL}	I/O low-level output	N/A	N/A	VCC x 0.1	V
V_{OH}	I/O high-level output	VCC x 0.8	N/A	VCC	V
I_{max}	I/O drive current	N/A	N/A	10	mA

4.3 WRD3L 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

4.4 Working Current

Table 3-5 WRD3L working current

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

5 RF Features

5.1 Basic RF Features

Table 4-1 Basic RF features

Parameter	Description
Frequency band	2.4GHz
Wi-Fi standard	IEEE 802.11b/g/n20
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

5.2 WRD3L 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	1 Mbit/s	N/A	17	N/A	dBm
Average RF output power, 802.11g	54 Mbit/s	N/A	14	N/A	dBm

Parameter		Minimum Value	Typical Value	Maximum Value	Unit
OFDM mode					
Average RF output power, 802.11n OFDM mode	MCS7	N/A	13	N/A	dBm
Frequency error		−20	N/A	+20	ppm

5.3 WRD3L RX Sensitivity

Table 4-3 RX sensitivity

Parameter		Minimum Value	Typical Value	Maximum Value	Unit
PER < 8%, 802.11b CCK mode	1 Mbit/s	N/A	−90	N/A	dBm
PER < 10%, 802.11g OFDM mode	54 Mbit/s	N/A	−73	N/A	dBm
PER < 10%, 802.11n OFDM mode	MCS7	N/A	−70	N/A	dBm

6 Antenna Information

## 6.1 Antenna Type

WRD3L uses an onboard PCB antenna.

6.2 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.

To prevent adverse impact on the antenna radiation performance, avoid copper or traces along the antenna area on the PCB.

Ensure that there are no substrate media above or below the antenna and that copper is

at a certain distance away from the antenna to maximize the antenna radiation performance.
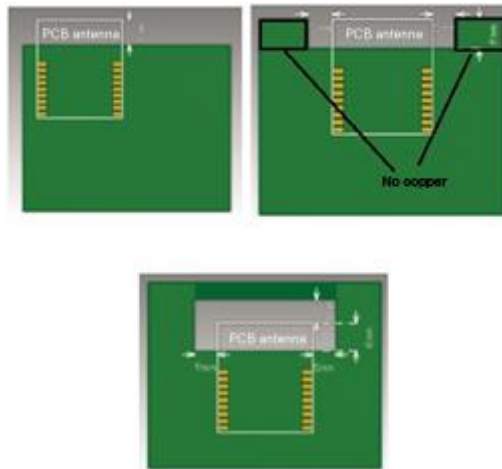
6.3 Antenna Connector Specifications

WRD3L does not use an antenna connector.

7   Packaging Information and Production Instructions

7.1 Mechanical Dimensions
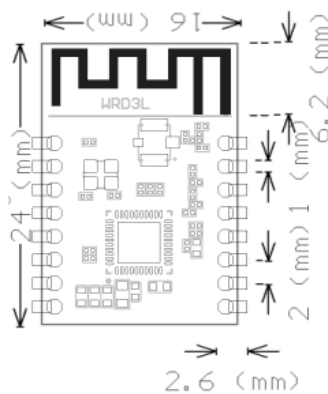

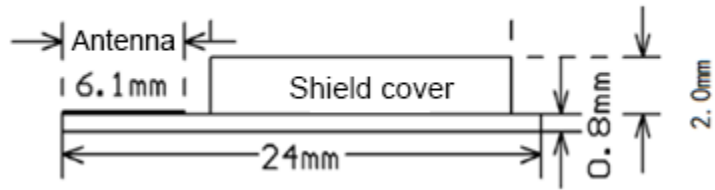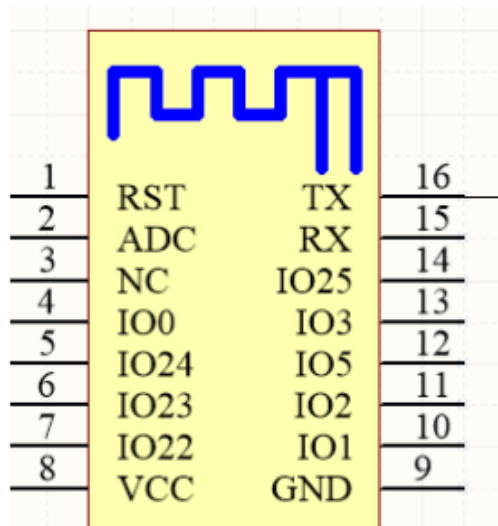**Figure 6-1 WRD3L mechanical dimensions**

Figure 6-2 Side view

7.2 Recommended Pin figure
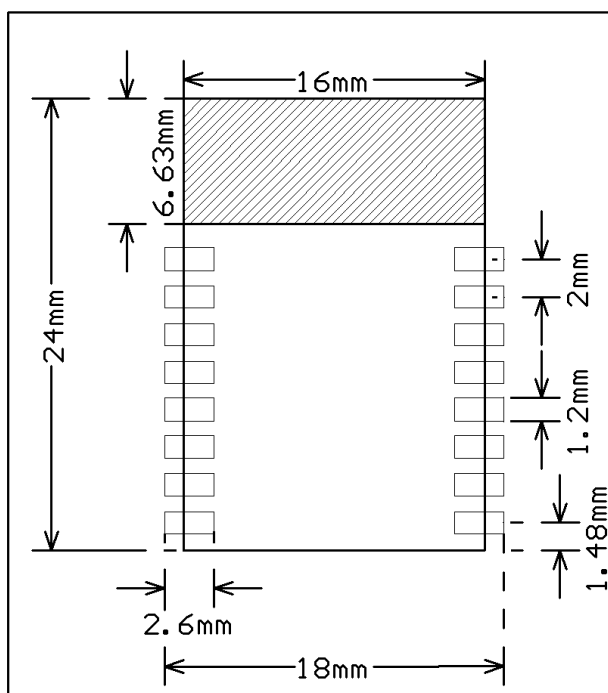

Figure 6-3 WRD3L pins

Figure 6-4 Layout of the PCB to which WRD3L applies

7.3 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 it 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).
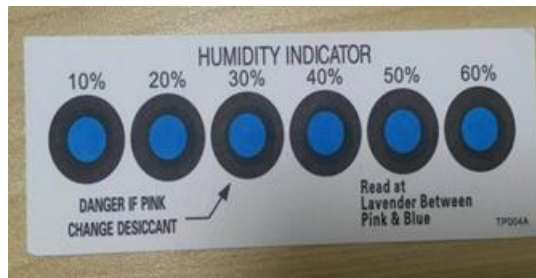

Figure 6-5 HIC for WRD3L

3. 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.

4. Baking settings:

(1) Baking temperature: 125±5°C

(2) Alarm temperature: 130°C

(3) SMT placement ready temperature after natural cooling: < 36°C

(4) Number of drying times: 1

(5) Rebaking condition: The module is not soldered within 12 hours after baking.

5. 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.

6. Before SMT placement, take electrostatic discharge (ESD) protective measures.

7. 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.

7.4 Recommended Oven Temperature Curve

1. 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.
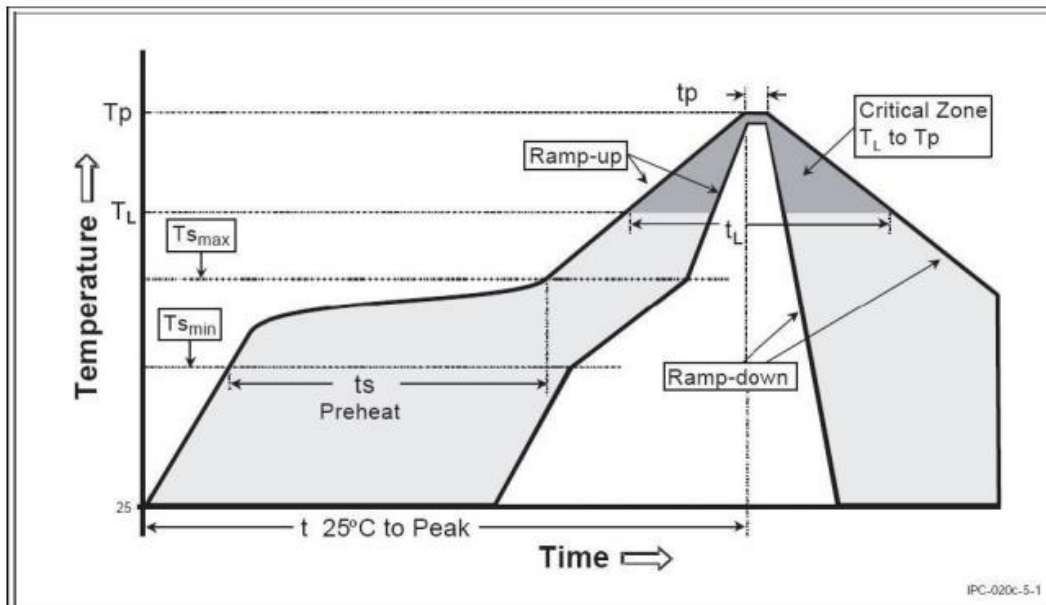
7.5 Storage Conditions

8   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
WRD3L		Carrier tape and reel packing		

9   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.

This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.

15.105 Information to the user.

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

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.

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

Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

The availability of some specific channels and/or operational frequency bands is country dependent and firmware programmed at the factory to match the intended destination.

The firmware setting is not accessible by the end user.

The final end product must be labeled in a visible area with the following:

"Contains Transmitter Module 2ANDL-WRD3L"

This radio module must not be installed to co-locate and operating simultaneously with other radios in host system, additional testing and equipment authorization may be required to operating simultaneously with other radio.

Declaration of Conformity European notice

C E

Hereby, Hangzhou Tuya Information Technology Co., Ltd. declares that this Wi-Fi module product is in compliance with essential requirements and other relevant provisions of Directive 2014/53/EC. A copy of the Declaration of conformity can be found at https://www.tuya.com.

EN 300 328 V2.1.1

EN 301 489-1 V2.1.1; EN 301 489-17 V3.1.1

EN 62311:2008

EN 60950-1:2006+A11:2009+A1:2010+A12:2011+A2:2013