

1. Product Overview

WRD2L 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. WRD2L 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.

WRD2L 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 32-bit CPU, which can also function as an application processor
 - Dominant frequency: 160 MHz
- ✧ Working voltage: 3.0 V to 3.6 V
- ✧ Peripherals: five GPIOs and one universal asynchronous receiver/transmitter (UART)
- ✧ Wi-Fi connectivity
 - 802.11b/g/n
 - 2.4 GHz WiFi
 - WPA and WPA2 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 2.0 dBi

- 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 | 2019-09-20 | This is the first release. | 1.0.0 |

Contents

| | |
|---|----|
| 1. Product Overview..... | 1 |
| 1.1 Features..... | 1 |
| 1.2 Applications..... | 2 |
| 2 Module Interfaces..... | 6 |
| 2.1 Dimensions and Footprint..... | 6 |
| 2.2 Interface Pin Definition..... | 6 |
| 2.3 Test Pin Definition..... | 7 |
| 3. Electrical Parameters..... | 8 |
| 3.1 Absolute Electrical Parameters..... | 8 |
| 3.2 Electrical Conditions..... | 8 |
| 3.3 RF Current Consumption..... | 9 |
| 3.4 Working Current..... | 9 |
| 4 RF Features..... | 10 |
| 4.1 Basic RF Features..... | 10 |
| 4.2 TX Performance..... | 10 |
| 4.3 RX Performance..... | 11 |
| 5 Antenna Information..... | 11 |
| 5.1 Antenna Type..... | 11 |
| 5.2 Antenna Interference Reduction..... | 11 |
| 6. Packaging Information and Production Instructions..... | 12 |
| 6.1 Mechanical Dimensions..... | 12 |
| 6.2 Recommended PCB Layout..... | 13 |
| 6.3 Production Instructions..... | 14 |
| 6.4 Recommended Oven Temperature Curve..... | 16 |
| 6.5 Storage Conditions..... | 17 |
| 7. MOQ and Packing Information..... | 17 |
| 8 Appendix: Statement..... | 18 |

Tables

| | |
|---|----|
| Table 2-1 WRD2L interface pins..... | 6 |
| Table 2-2 WRD2L test pins..... | 7 |
| Table 3-1 Absolute electrical parameters..... | 8 |
| Table 3-2 Normal electrical conditions..... | 8 |
| Table 3-3 Current consumption during constant transmission and receiving..... | 9 |
| Table 3-4 WRD2L working current..... | 9 |
| Table 4-1 Basic RF features..... | 10 |
| Table 4-2 Performance during constant transmission..... | 10 |
| Table 4-3 RX sensitivity..... | 11 |

Figures

| | |
|--|-----------|
| Figure 1-1 WRD2L architecture..... | 错误！未定义书签。 |
| Figure 2-1 WRD2L front and rear views..... | 6 |
| Figure 6-2 Side view..... | 12 |
| Figure 6-3 WRD2L pins..... | 13 |
| Figure 6-4 WRD2L pin header dimensions..... | 13 |
| Figure 6-5 Layout of the PCB to which WRD2L applies..... | 14 |
| Figure 6-6 HIC for WRD2L..... | 15 |
| Figure 6-7 Oven temperature curve..... | 16 |

2 Module Interfaces

2.1 Dimensions and Footprint

WRD2L has two rows of pins with a 2 ± 0.1 mm pin spacing.

The WRD2L dimensions (H x W x D) are 2.8 ± 0.15 mm x 17.3 ± 0.35 mm x 15 ± 0.35 mm.

Figure 2-1 shows the WRD2L front and rear views.

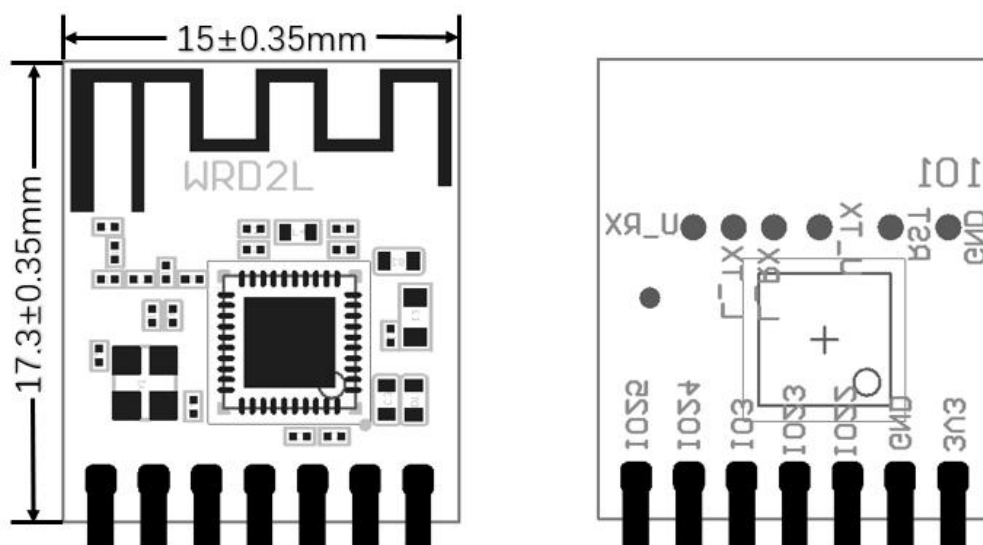


Figure 2-1 WRD2L front and rear views

2.2 Interface Pin Definition

Table 2-1 WRD2L interface pins

| Pin No. | Symbol | I/O Type | Function |
|---------|--------|----------|--|
| 1 | GPIO25 | P | Hardware PWM pin, which is connected to GPIO25 (pin 31) on the internal IC |
| 2 | GPIO24 | I/O | Hardware PWM pin, which is connected to GPIO24 (pin 32) on the internal IC |
| 3 | GPIO3 | I/O | Hardware PWM pin, which is connected to GPIO3 (pin 23) on the internal IC |

| Pin No. | Symbol | I/O Type | Function |
|---------|--------|----------|--|
| 4 | GPIO23 | I/O | Hardware PWM pin, which is connected to GPIO23 (pin 33) on the internal IC |
| 5 | GPIO22 | I/O | Hardware PWM pin, which is connected to GPIO22 (pin 34) on the internal IC |
| 6 | GND | P | Power supply reference ground pin |
| 7 | 3V3 | P | Power supply pin (3.3 V) |

Note:

P indicates power supply pins, and **I/O** indicates input/output pins.

2.3 Test Pin Definition

Table 2-2 WRD2L test pins

| Pin No. | Symbol | I/O Type | Function |
|---------|--------|----------|---|
| N/A | GND | P | Power supply reference ground pin |
| N/A | RST | Input | Hardware reset pin (It is at a high level by default and is active at a low level.) |
| N/A | U_TX | I/O | UART_TX (user-side serial interface) |
| N/A | U_RX | I/O | UART_RX (user-side serial interface) |
| N/A | L_TX | I/O | Log TX pin |
| N/A | L_RX | I/O | Log RX pin |

Note:

Test pins are not recommended.

3. Electrical Parameters

3.1 Absolute Electrical Parameters

Table 3-1 Absolute electrical parameters

| Parameter | Description | Minimum Value | Maximum Value | Unit |
|---|----------------------|---------------|---------------|------|
| Ts | Storage temperature | −40 | 105 | °C |
| VBAT | 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 |

3.2 Electrical Conditions

Table 3-2 Normal electrical conditions

| Parameter | Description | Minimum Value | Typical Value | Maximum Value | Unit |
|-----------------|----------------------|---------------|---------------|---------------|------|
| Ta | Working temperature | −40 | N/A | 105 | °C |
| VBAT | Power supply voltage | 3.0 | 3.3 | 3.6 | V |
| V _{IL} | I/O low-level input | −0.3 | N/A | VCC x 0.25 | V |
| V _{IH} | I/O high-level input | VCC x 0.75 | N/A | VCC | V |
| V _{OL} | I/O low-level output | N/A | N/A | VCC x 0.1 | V |

| Parameter | Description | Minimum Value | Typical Value | Maximum Value | Unit |
|------------------|-----------------------|---------------|---------------|---------------|------|
| 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 | 12 | mA |

3.3 RF Current Consumption

Table 3-3 Current consumption during constant transmission and receiving

| Working Status | Parameter | | | Typical Value | Maximum Value | Unit |
|----------------|-----------|-----------|------------------------|---------------|---------------|------|
| | Mode | Rate | TX Power/ Receiving | | | |
| TX | 802.11b | 11 Mbit/s | 17±3 dBm | 200 | 260 | mA |
| | 802.11g | 54 Mbit/s | 20±3 dBm | 170 | 215 | mA |
| | 802.11n | MCS7 | 20±3 dBm | 166 | 200 | mA |
| RX | 802.11b | 11 Mbit/s | Constant receiving | 65 | 80 | mA |
| | 802.11g | 54 Mbit/s | Constant receiving | 65 | 80 | mA |
| | 802.11n | MCS7 | Constant receiving | 65 | 80 | mA |

3.4 Working Current

Table 3-4 WRD2L working current

| Working Mode | Working Status (Ta = 25°C) | Average Value | Maximum Value | Unit |
|--------------|---|---------------|---------------|------|
| EZ | The module is in EZ mode, and the Wi-Fi indicator blinks quickly. | 66 | 261 | mA |
| AP | The module is in AP mode, and the Wi-Fi indicator blinks slowly. | 68 | 261 | mA |

| Working Mode | Working Status (Ta = 25°C) | Average Value | Maximum Value | Unit |
|--------------|---|---------------|---------------|------|
| Connected | The module is connected to the network, and the Wi-Fi indicator is steady on. | 68 | 264 | mA |
| Disconnected | The module is disconnected from the network, and the Wi-Fi indicator is steady off. | 14.5 | 18 | mA |

4 RF Features

4.1 Basic RF Features

Table 4-1 Basic RF features

| Parameter | Description |
|------------------------|---|
| Frequency band | 2.4GHz |
| Wi-Fi standard | IEEE 802.11b/g/n |
| 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 | PCB antenna with a gain of 2.0 dBi |

4.2 TX Performance

Table 4-2 Performance during constant transmission

| Parameter | | Minimum Value | Typical Value | Maximum Value | Unit |
|---|-----------|---------------|---------------|---------------|------|
| Average RF output power, 802.11b CCK mode | 11 Mbit/s | N/A | 17 | N/A | dBm |

| Parameter | | Minimum Value | Typical Value | Maximum Value | Unit |
|--|-----------|---------------|---------------|---------------|------|
| 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 |
| Frequency error | | -10 | N/A | +10 | ppm |

4.3 RX Performance

Table 4-3 RX sensitivity

| Parameter | | Minimum Value | Typical Value | Maximum Value | Unit |
|------------------------------|-----------|---------------|---------------|---------------|------|
| PER < 8%, 802.11b CCK mode | 11 Mbit/s | N/A | -83 | 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 | -70 | N/A | dBm |

5 Antenna Information

5.1 Antenna Type

WRD2L 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.

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

For details about the onboard PCB antenna area on WRD2L, see Figure 6-1.

6. Packaging Information and Production Instructions

6.1 Mechanical Dimensions

The PCB dimensions (H x W x D) are 2.8 ± 0.15 mm x 17.3 ± 0.35 mm x 15 ± 0.35 mm.

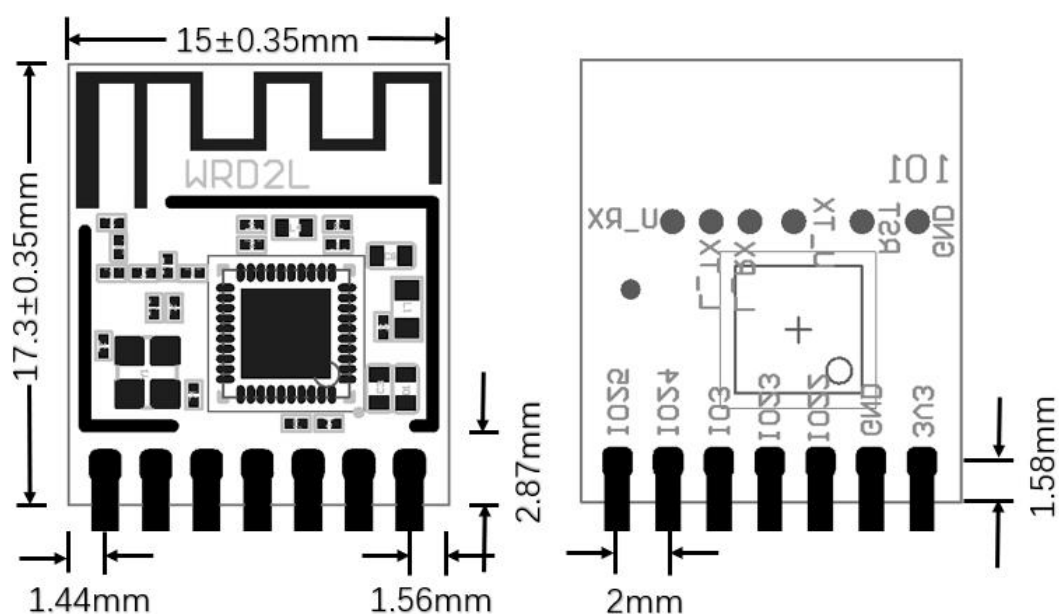


Figure 6-1 WRD2L PCB mechanical dimensions

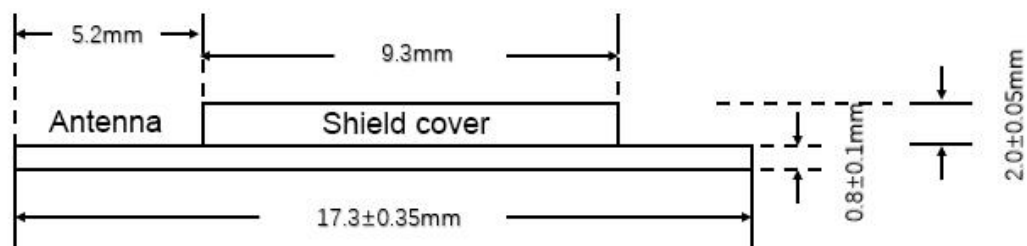


Figure 6-2 Side view

6.2 Recommended Pin figure

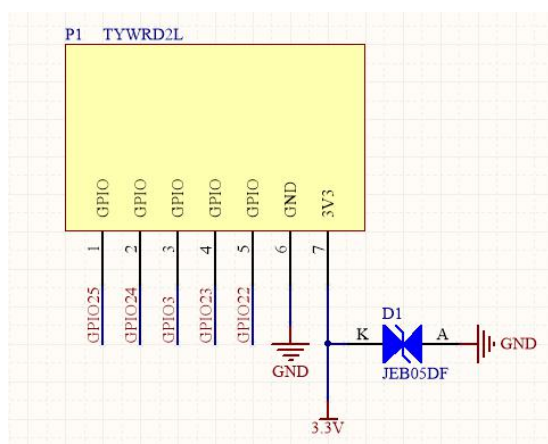


Figure 6-3 WRD2L pins

WRD2L can be mounted onto a PCB by using an SMT placement machine or connected to the PCB through a pin header. Figure 6-4 shows the pin header dimensions.

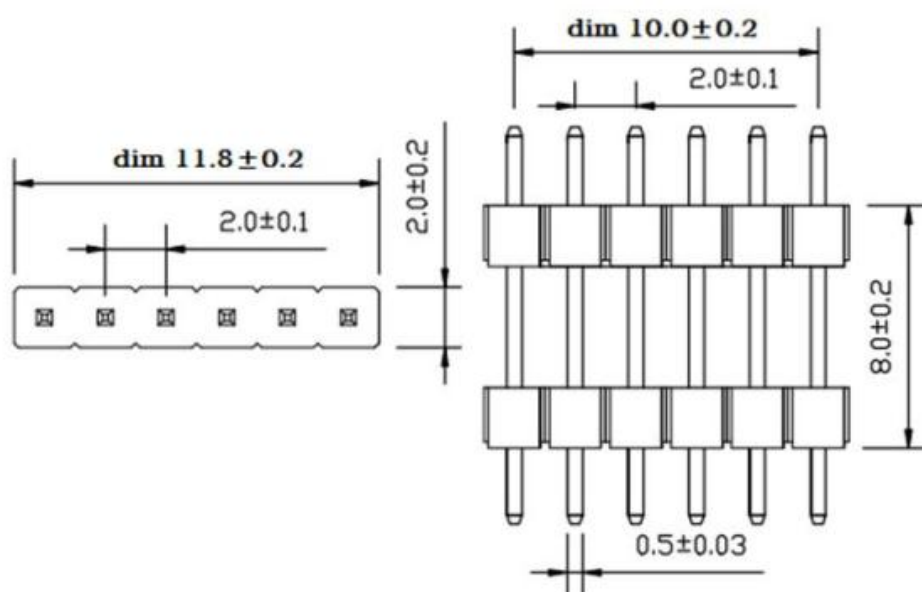


Figure 6-4 WRD2L pin header dimensions

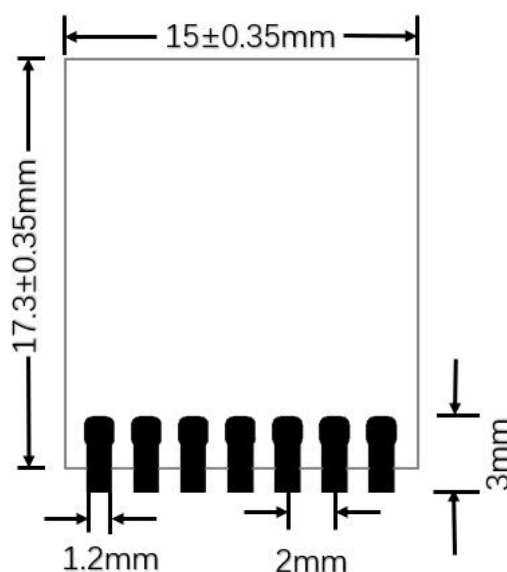


Figure 6-5 Layout of the PCB to which WRD2L applies

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).

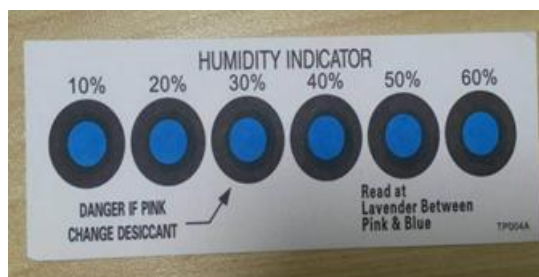


Figure 6-6 HIC for WRD2L

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: $125 \pm 5^{\circ}\text{C}$
 - (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.
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.

6.4 Recommended Oven Temperature Curve

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

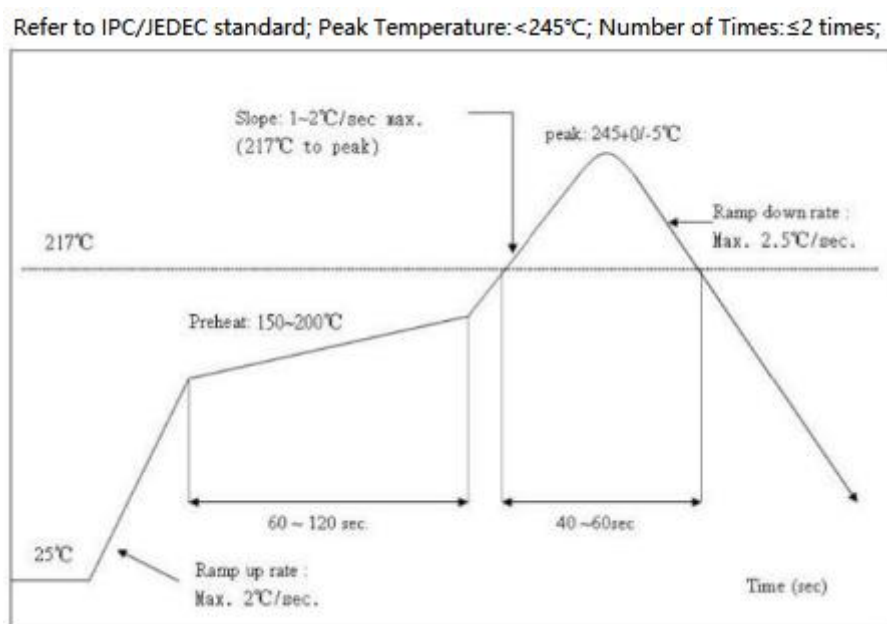


Figure 6-7 Oven temperature curve

6.5 Storage Conditions

| | | | |
|--|--|--|---|
|  | CAUTION This bag contains MOISTURE-SENSITIVE DEVICES | | LEVEL <div style="border: 1px solid black; padding: 5px; display: inline-block;"> 3 </div> |
| | 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: <u>260</u> °C <small>If Blank, see adjacent bar code label</small> | | | |
| 3. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must | | | |
| a) Mounted within: <u>168</u> hrs. of factory conditions <small>If Blank, see adjacent bar code label</small> | | | |
| ≤ 30°C/60%RH, OR | | | |
| 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: _____ <small>If Blank, see adjacent bar code label</small> | | | |
| 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 |
| WRD2L | 4000 | Carrier tape and reel packing | 1000 | 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.

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-WRD2L"

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



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