

## 1. Product Overview

WBR3 is a low-power embedded Wi-Fi and Bluetooth module that Tuya has developed. It consists of a highly integrated RF chip (RTL8720CF) with an embedded Wi-Fi network protocol stack and robust library functions. WBR3 also contains a low-power KM4 multipoint control unit (MCU), WLAN MAC, 1T1R WLAN, 256 KB static random-access memory (SRAM), and 2 MB flash memory, and has extensive peripherals.

WBR3 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 WBR3 architecture.

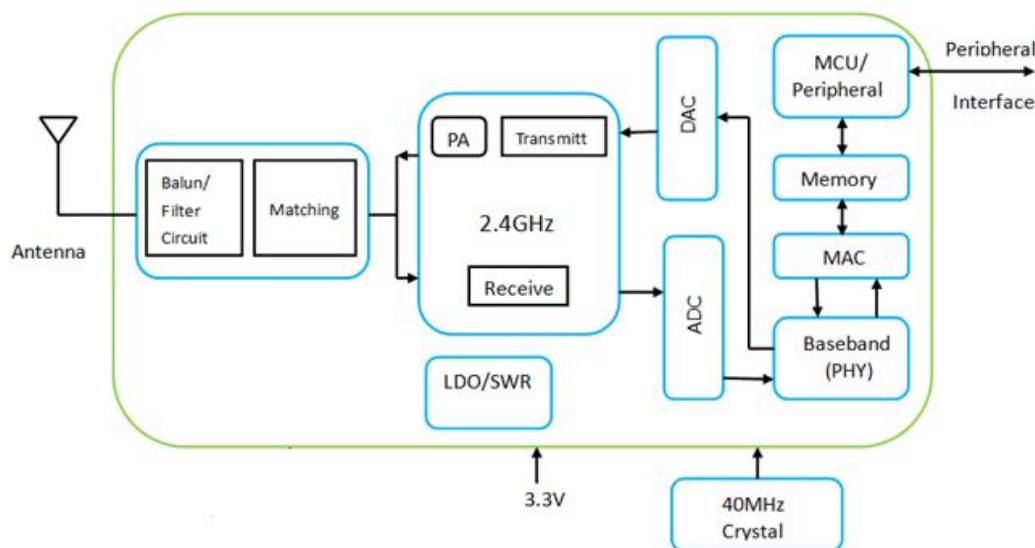


Figure 1-1 WBR3 architecture

## 1.1 Features

- ✧ Embedded low-power KM4 MCU, which can also function as an application processor
  - Clock rate: 100 MHz
- ✧ Working voltage: 3.0 V to 3.6 V
- ✧ Peripherals: nine GPIOs, one universal asynchronous receiver/transmitter (UART), and one Log\_TX pin
- ✧ Wi-Fi connectivity
  - 802.11b/g/n20
  - Channels 1 to 14 at 2.4 GHz
  - Compatible with Bluetooth low energy (BLE) 4.2 (Up to +9dBm EIRP output power)
  - WPA and WPA2 security modes
  - Up to +20 dBm EIRP output power in 802.11b mode
  - Smart network configuration for Android and iOS devices
  - Onboard PCB antenna
  - Certified by CE, FCC, and SRRC
  - Working temperature: -20°C to +85°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   | 2019-10-21 | This is the first release. | 2.0.0                |

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## 2 Module Interfaces

### 2.1 Dimensions and Footprint

WBR3 has two rows of 16 pins (2 x 8) with a 2 mm pin spacing.

The WBR3 dimensions (H x W x D) are 2.9±0.15 mm x 16±0.35 mm x 24±0.35 mm.

Figure 2-1 shows the WBR3 front and rear views.

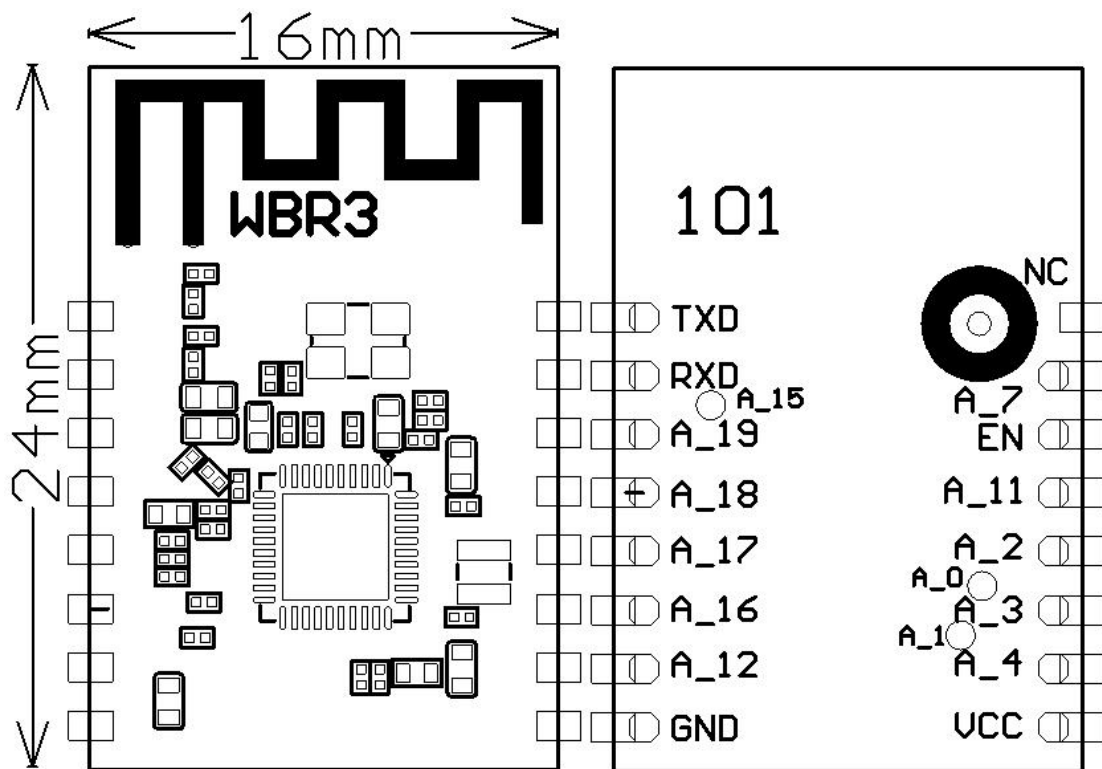


Figure 2-1 WBR3 front and rear views

### 2.2 Interface Pin Definition

Table 2-1 WBR3 interface pins

| Pin No. | Symbol | I/O Type | Function   |
|---------|--------|----------|--|
| 1       | NC     | N/A      | Disconnected to be compatible with other modules |
| 2       | A_7    | I/O      | GPIOA_7, hardware PWM pin, which is              |

| Pin No. | Symbol | I/O Type | Function  |
|---------|--------|----------|---|
|         |        |          | connected to pin 21 on the internal IC  |
| 3       | EN     | I/O      | Enable pin, which is active at a high level (The pin has been pulled up and is externally controllable.)                  |
| 4       | A_11   | I/O      | GPIOA_11, hardware PWM pin, which is connected to pin 25 on the internal IC   |
| 5       | A_2    | I/O      | GPIOA_2, hardware PWM pin, which is connected to pin 18 on the internal IC  |
| 6       | A_3    | I/O      | GPIOA_3, hardware PWM pin, which is connected to pin 19 on the internal IC  |
| 7       | A_4    | I/O      | GPIOA_4, hardware PWM pin, which is connected to pin 20 on the internal IC  |
| 8       | VCC    | P        | Power supply pin (3.3 V)  |
| 9       | GND    | P        | Power supply reference ground pin   |
| 10      | A_12   | I/O      | GPIOA_12, hardware PWM pin, which is connected to pin 26 on the internal IC   |
| 11      | A_16   | I/O      | GPIOA_16, UART_Log_TXD, which is used for printing the module internal information and can be configured as a common GPIO |
| 12      | A_17   | I/O      | GPIOA_17, hardware PWM pin, which is connected to pin 38 on the internal IC   |
| 13      | A_18   | I/O      | GPIOA_18, hardware PWM pin, which is connected to pin 39 on the internal IC   |
| 14      | A_19   | I/O      | GPIOA_19, hardware PWM pin, which is connected to pin 40 on the internal IC   |
| 15      | RXD    | I/O      | GPIOA_13, UART0_RXD (user-side serial interface)  |
| 16      | TXD    | I/O      | GPIOA_14, UART0_TXD (user-side serial interface)  |

Note:

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

## 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   |
| VDD   | Power supply voltage | -0.3          | 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  | -20           | N/A           | 85            | °C   |
| VDD             | Working voltage      | 3.0           | N/A           | 3.6           | V    |
| V <sub>IL</sub> | I/O low-level input  | N/A           | N/A           | 0.8           | V    |
| V <sub>IH</sub> | I/O high-level input | 2.0           | N/A           | N/A           | V    |
| V <sub>OL</sub> | I/O low-level output | N/A           | N/A           | 0.4           | V    |
| V <sub>OH</sub> | I/O high-level       | 2.4           | N/A           | N/A           | V    |



| Parameter        | Description           | Minimum Value | Typical Value | Maximum Value | Unit |
|------------------|-----------------------|---------------|---------------|---------------|------|
|                  | output                |               |               |               |      |
| I <sub>max</sub> | I/O drive current     | N/A           | N/A           | 16            | mA   |
| C <sub>pad</sub> | Input pin capacitance | N/A           | 2             | N/A           | pF   |

### 3.3 RF Current Consumption

**Table 3-3 Power consumption during constant transmission**

| Symbol          | Mode         | Power    | Typical Value | Peak Value | Unit |
|-----------------|--------------|----------|---------------|------------|------|
| I <sub>RF</sub> | 802.11b      | 17 dBm   | 217           | 268        | mA   |
| I <sub>RF</sub> | 11 Mbit/s    | 18 dBm   | 231           | 283        | mA   |
| I <sub>RF</sub> | 802.11g      | 15 dBm   | 159           | 188        | mA   |
| I <sub>RF</sub> | 54 Mbit/s    | 17.5 dBm | 177           | 213        | mA   |
| I <sub>RF</sub> | 802.11n BW20 | 13 dBm   | 145           | 167        | mA   |
| I <sub>RF</sub> | MCS7         | 16.5 dBm | 165           | 193        | mA   |

**Table 3-4 Power consumption during constant receiving**

| Symbol          | Mode                 | Typical Value | Peak Value | Unit |
|-----------------|----------------------|---------------|------------|------|
| I <sub>RF</sub> | 802.11b<br>11 Mbit/s | 63            | 65         | mA   |
| I <sub>RF</sub> | 802.11g<br>54 Mbit/s | 65            | 67         | mA   |
| I <sub>RF</sub> | 802.11n<br>HT20 MCS7 | 65            | 67         | mA   |

### 3.4 Working Current

**Table 3-5 WBR3 working current**

| Working Mode            | Working Status (Ta = 25°C)  | Typical Value | Peak Value | Unit |
|-------------------------|---|---------------|------------|------|
| EZ                      | The module is in EZ mode, and the Wi-Fi indicator blinks quickly.                   | 75            | 324        | mA   |
| Connected and idle      | The module is connected to the network, and the Wi-Fi indicator is steady on.       | 64            | 314        | mA   |
| Connected and operating | The module is connected to the network, and the Wi-Fi indicator is steady on.       | 66            | 305        | mA   |
| Disconnected            | The module is disconnected from the network, and the Wi-Fi indicator is steady off. | 66            | 309        | mA   |

## 4 RF Features

### 4.1 Basic RF Features

**Table 4-1 Basic RF features**

| Parameter              | Description   |
|------------------------|---|
| Frequency range        | Bluetooth:2.400 GHz to 2.4835 GHz<br>Wi-Fi:2.412 GHz to 2.484 GHz   |
| Wi-Fi standard         | IEEE 802.11b/g/n (channels 1 to 14,Ch1-11 for US/CA,Ch1-13 for EU/CN)   |
| Data transmission rate | 802.11b: 1, 2, 5.5, or 11 (Mbit/s)<br>802.11g: 6, 9, 12, 18, 24, 36, 48, or 54 (Mbit/s)<br>802.11n: HT20 MCS0 to MCS7 |
| Antenna type           | PCB antenna   |

## 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   | 1 Mbit/s  | N/A           | 17.5          | N/A           | dBm  |
| Average RF output power, 802.11g OFDM mode  | 54 Mbit/s | N/A           | 14.5          | N/A           | dBm  |
| Average RF output power, 802.11n OFDM mode  | MCS7      | N/A           | 13.5          | N/A           | dBm  |
| Frequency error                             |           | -20           | N/A           | +20           | ppm  |
| EVM under 802.11b CCK, 11 Mbit/s, 17.5 dBm  |           |               |               | -10           | dB   |
| EVM under 802.11g OFDM, 54 Mbit/s, 14.5 dBm |           |               |               | -29           | dB   |
| EVM under 802.11n OFDM, MCS7, 13.5 dBm      |           |               |               | -30           | dB   |

## 4.3 RX Performance

**Table 4-3 RX sensitivity**

| Parameter                    |           | Minimum Value | Typical Value | Maximum Value | Unit |
|------------------------------|-----------|---------------|---------------|---------------|------|
| PER < 8%, 802.11b CCK mode   | 1 Mbit/s  | N/A           | -91           | N/A           | dBm  |
| PER < 10%, 802.11g OFDM mode | 54 Mbit/s | N/A           | -75           | N/A           | dBm  |
| PER < 10%, 802.11n OFDM mode | MCS7      | N/A           | -72           | N/A           | dBm  |

## 5 Antenna Information

### 5.1 Antenna Type

WBR3 uses an onboard PCB antenna with a gain of 2.5 dBi.

### 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 Packaging Information and Production Instructions

### 6.1 Mechanical Dimensions

The PCB dimensions (H x W x D) are  $0.8\pm 0.1$  mm x  $16\pm 0.35$  mm x  $24\pm 0.35$  mm. Figure 6-1 shows the WBR3 mechanical dimensions.

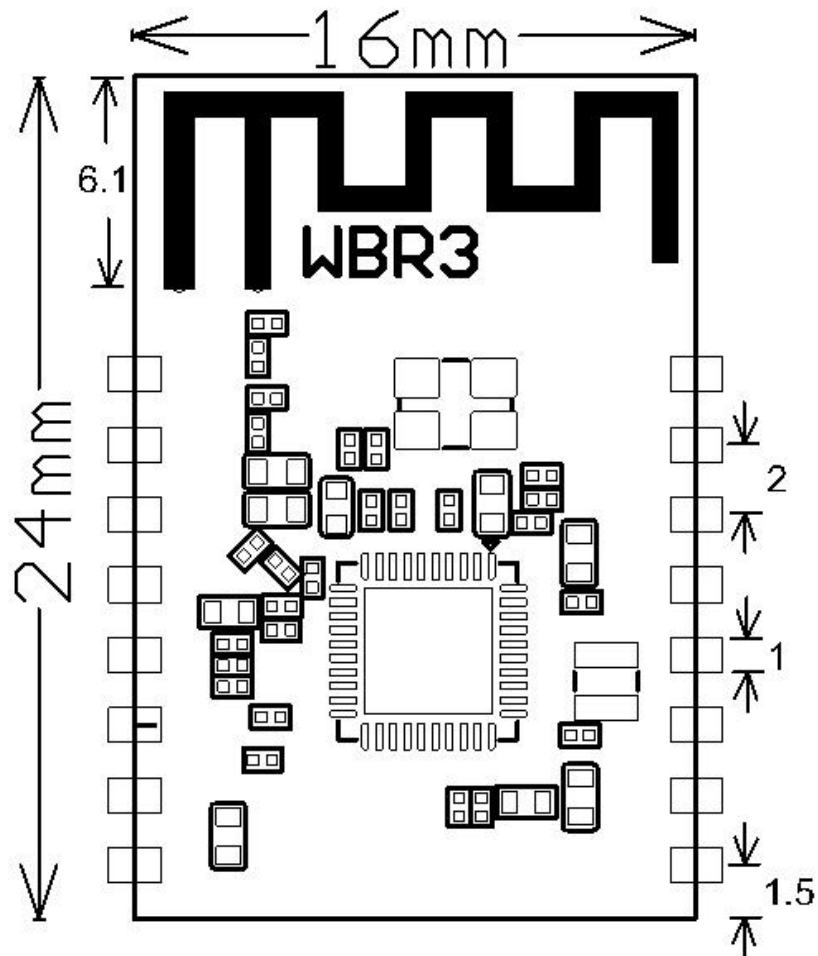


Figure 6-1 WBR3 mechanical dimensions

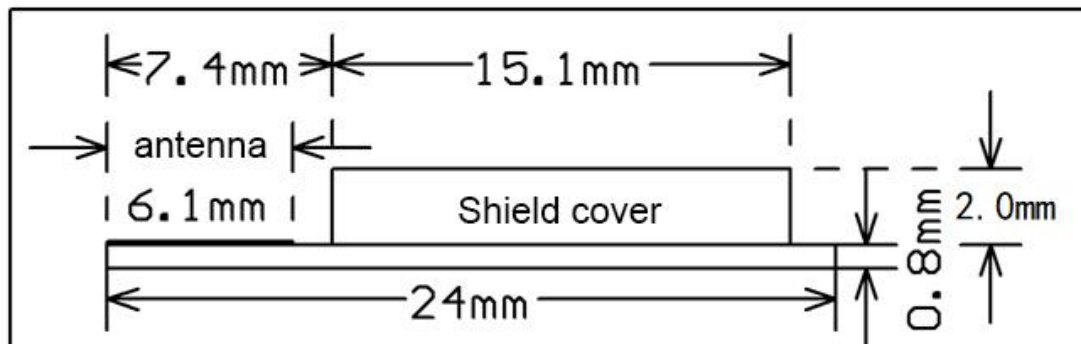


Figure 6-2 Side view

Note:

The default dimensional tolerance is  $\pm 0.35$  mm. If a customer has other requirements, clearly specify them in the datasheet after communication.

## 6.2 Recommended PCB Layout

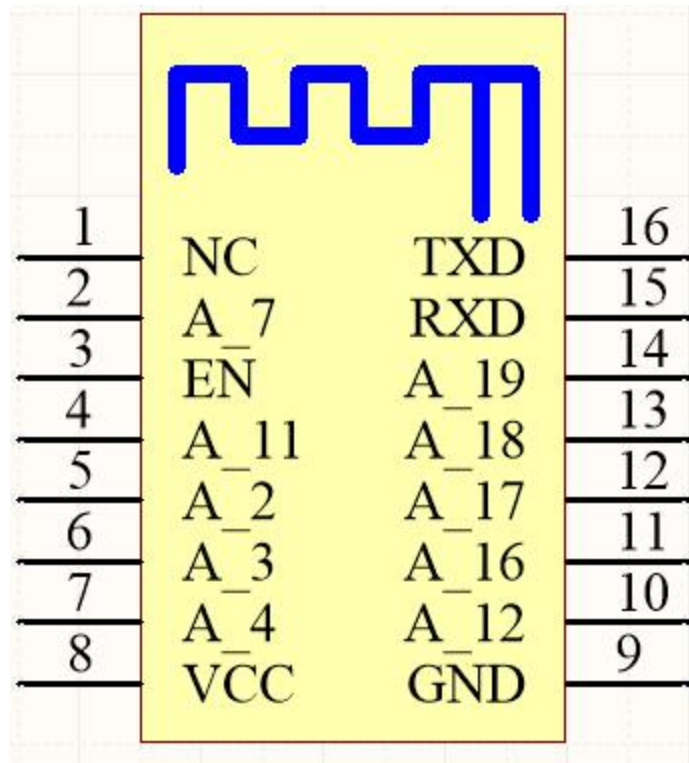


Figure 6-3 WBR3 pins

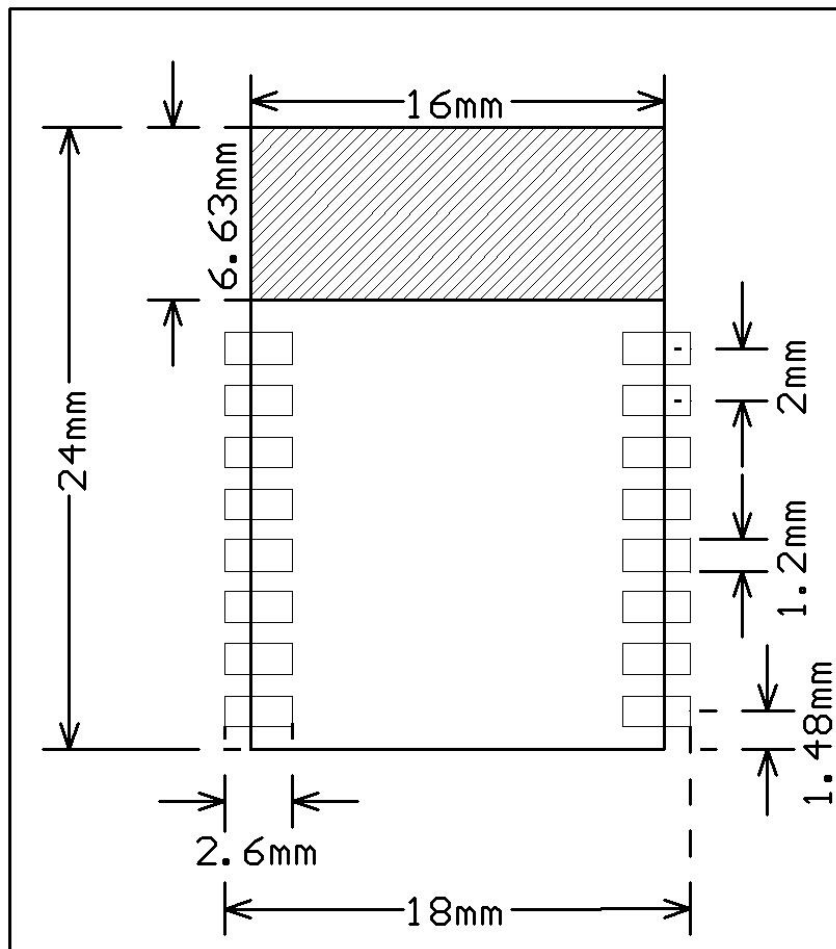
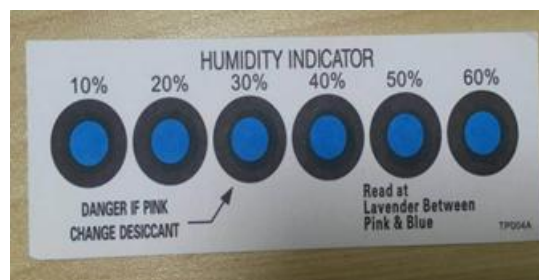


Figure 6-4 Layout of the PCB to which WBR3 applies

### 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 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 WBR3**

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.

### 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.

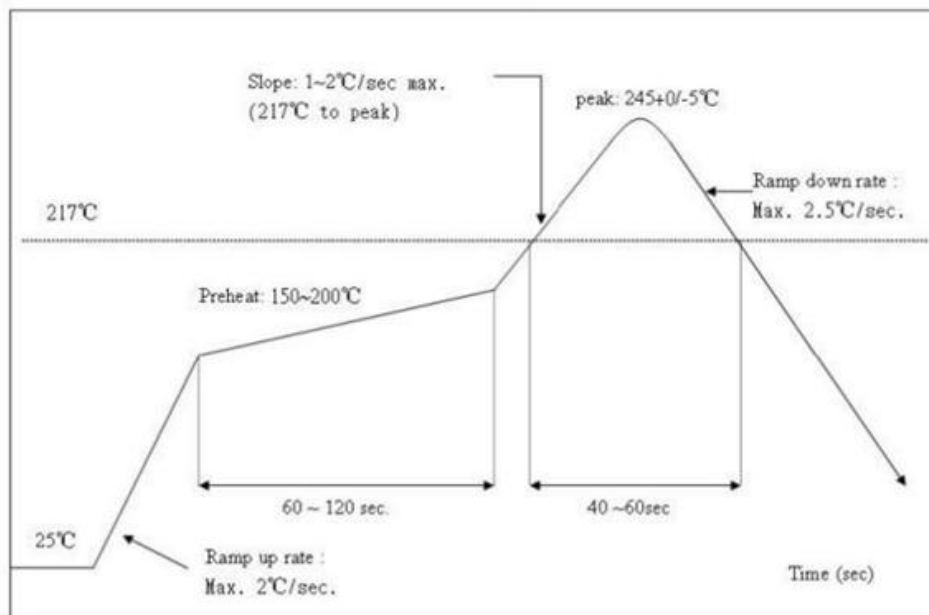


Figure 6-6 Oven temperature curve

## 6.5 Storage Conditions

|   |   |                                  |
|---|---|----------------------------------|
|    | <p><b>CAUTION</b><br/>This bag contains<br/><b>MOISTURE-SENSITIVE DEVICES</b></p> | <p><b>LEVEL</b><br/><b>3</b></p> |
|   | <p>If Blank, see adjacent bar code label</p>                                      |                                  |
| <p>1. Calculated shelf life in sealed bag: 12 months at &lt; 40°C and &lt; 90% relative humidity (RH)</p>   |   |                                  |
| <p>2. Peak package body temperature: <u>260</u> °C<br/><small>If Blank, see adjacent bar code label</small></p>   |   |                                  |
| <p>3. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must</p>   |   |                                  |
| <p>a) Mounted within: <u>168</u> hrs. of factory conditions<br/><small>If Blank, see adjacent bar code label</small></p>                                      |   |                                  |
| <p>≤ 30°C/60%RH, OR</p>   |   |                                  |
| <p>b) Stored at &lt;10% RH</p>  |   |                                  |
| <p>4. Devices require bake, before mounting, if:</p>  |   |                                  |
| <p>a) Humidity Indicator Card is &gt; 10% when read at 23 ± 5°C</p>   |   |                                  |
| <p>b) 3a or 3b not met.</p>   |   |                                  |
| <p>5. If baking is required, devices may be baked for 48 hrs. at 125 ± 5°C</p>  |   |                                  |
| <p>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</p> |   |                                  |
| <p>Bag Seal Date: _____<br/><small>If Blank, see adjacent bar code label</small></p>  |   |                                  |
| <p>Note: Level and body temperature defined by IPC/JEDEC J-STD-020</p>  |   |                                  |

## 7 MOQ and Packing Information

## 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 rolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.

### Important Note

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.

This device have got a FCC ID: 2ANDL-WBR3.The final end product must be labeled in a visible area with the following: “Contains Transmitter Module FCC ID:2ANDL-WBR3”

This device is intended only for OEM integrators under the following conditions:

- 1) The antenna must be installed such that 20cm is maintained between the antenna and users, and
- 2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

**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 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.