tuya | Global Intelligent Platform

Product Manual

Tuya WBR1 Wi-Fi and Bluetooth

Version: 1.0.0 **Date: 2019-10-21** **No.: 0000000001**

1. Product Overview

WBR1 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. WBR1 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.

WBR1 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 WBR1 architecture.

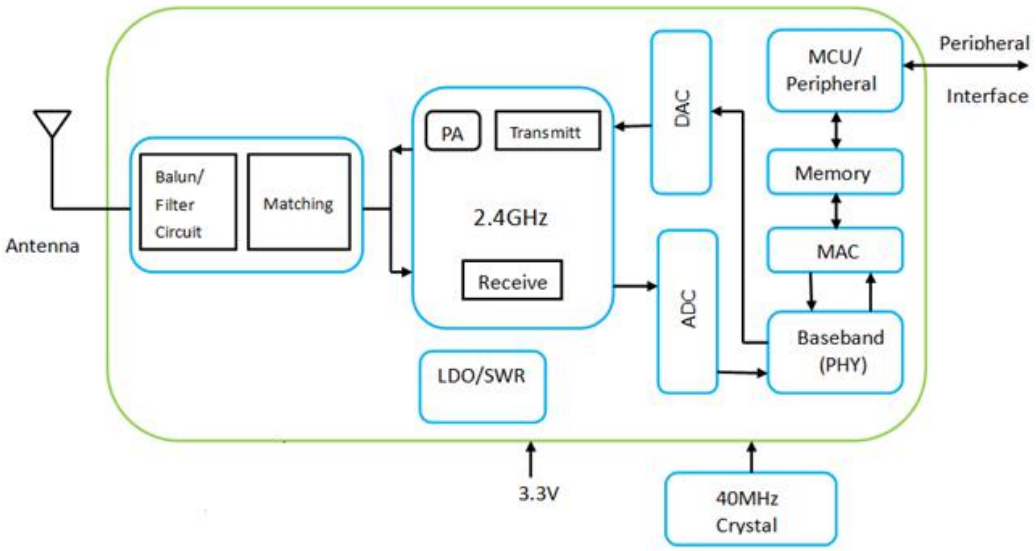

Figure 1-1 WBR1 architecture

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: seven GPIOs and two universal asynchronous receivers/transmitters (UARTs)
- 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 EIPR output power)
  - WPA and WPA2 security modes
  - Up to +20 dBm EIPR 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.	1.0.0

Contents

Tables

Figures

2 Module Interfaces

2.1 Dimensions and Footprint

WBR1 has two rows of 16 pins (2 x 8) with a 2 mm pin spacing.

The WBR1 dimensions (H x W x D) are 2.9±0.15 mm x 18±0.35 mm x 23.5±0.35 mm. Figure 2-1 shows the WBR1 front and rear views.

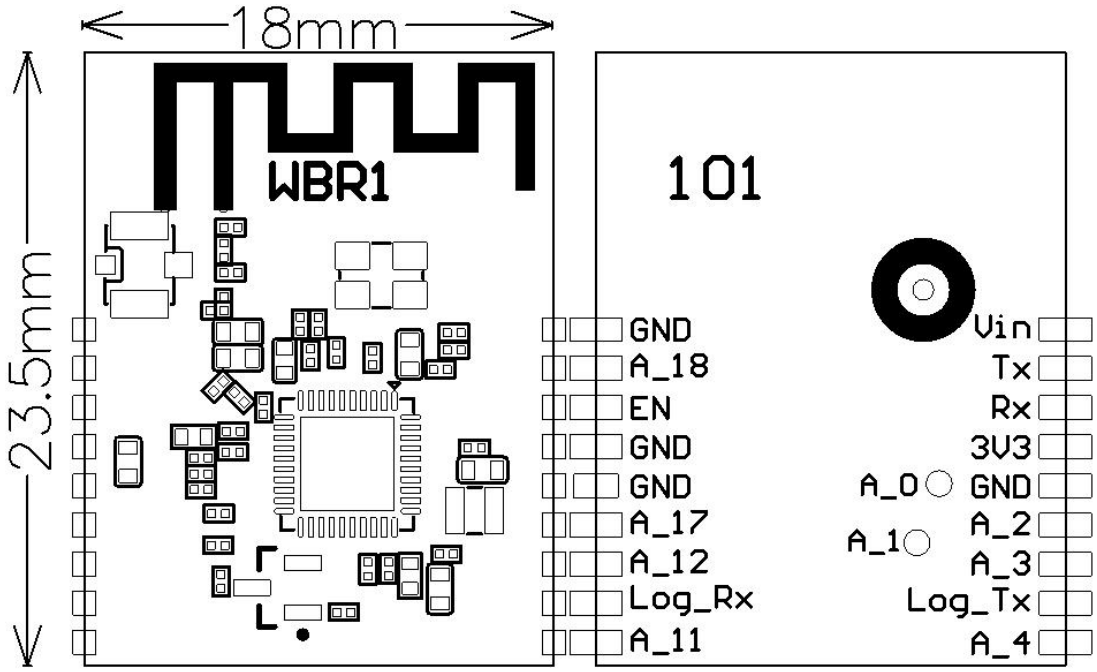

Figure 2-1 WBR1 front and rear views

2.2 Interface Pin Definition

Table 2-1 WBR1 interface pins

Pin No.	Symbol	I/O Type	Function
1	Vin	P	UART_TX power conversion pin (5 V or 3.3 V)
2	TX	I/O	GPIOA_14, UART_TX (user-side serial interface)
3	RX	I/O	GPIOA_13, UART_RX (user-side serial interface)

Pin No.	Symbol	I/O Type	Function
4	3V3	P	Power supply pin (3.3 V)
5	GND	P	Power supply reference ground pin
6	A_2	I/O	GPIOA_2, hardware PWM pin, which is connected to pin 18 on the internal IC
7	A_3	I/O	GPIOA_3, hardware PWM pin, which is connected to pin 19 on the internal IC
8	Log_TX	P	GPIOA_16, UART_Log_TXD, which is used for printing the module internal information and can be configured as a common GPIO
9	A_4	I/O	GPIOA_4, hardware PWM pin, which is connected to pin 20 on the internal IC
10	A_11	I/O	GPIOA_11, hardware PWM pin, which is connected to pin 25 on the internal IC
11	Log_RX	I/O	GPIOA_15, UART_Log_RXD, which is used for printing the module internal information and can be configured as a common GPIO
12	A_12	I/O	GPIOA_12, hardware PWM pin, which is connected to pin 26 on the internal IC
13	A_17	I/O	GPIOA_17, hardware PWM pin, which is connected to pin 38 on the internal IC
14	GND	P	Power supply reference ground pin
15	GND	P	Power supply reference ground pin
16	EN	I/O	Enable pin, which is active at a high level (The pin has been pulled up and is externally controllable.)
17	A_18	I/O	GPIOA_18, hardware PWM pin, which is connected to pin 39 on the internal IC
18	GND	P	Power supply reference ground pin

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_{IL}	I/O low-level input	N/A	N/A	0.8	V
V_{IH}	I/O high-level input	2.0	N/A	N/A	V
V_{OL}	I/O low-level output	N/A	N/A	0.4	V
V_{OH}	I/O high-level output	2.4	N/A	N/A	V
Imax	I/O drive current	N/A	N/A	16	mA
Cpad	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_{RF}	802.11b 11 Mbit/s	17 dBm	217	268	mA
I_{RF}		18 dBm	231	283	mA
I_{RF}	802.11g 54 Mbit/s	15 dBm	159	188	mA
I_{RF}		17.5 dBm	177	213	mA
I_{RF}	802.11n BW20 MCS7	13 dBm	145	167	mA
I_{RF}		16.5 dBm	165	193	mA

Table 3-4 Power consumption during constant receiving

Symbol	Mode	Typical Value	Peak Value	Unit
I_{RF}	802.11b 11 Mbit/s	63	65	mA
I_{RF}	802.11g 54 Mbit/s	65	67	mA
I_{RF}	802.11n HT20 MCS7	65	67	mA

3.4 Working Current

Table 3-5 WBR1 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

Working Mode	Working Status (Ta = 25°C)	Typical Value	Peak Value	Unit
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 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) 802.11g: 6, 9, 12, 18, 24, 36, 48, or 54 (Mbit/s) 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

WBR1 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±0.1 mm x 18±0.35 mm x 23.5±0.35 mm. Figure 6-1 shows the WBR1 mechanical dimensions.

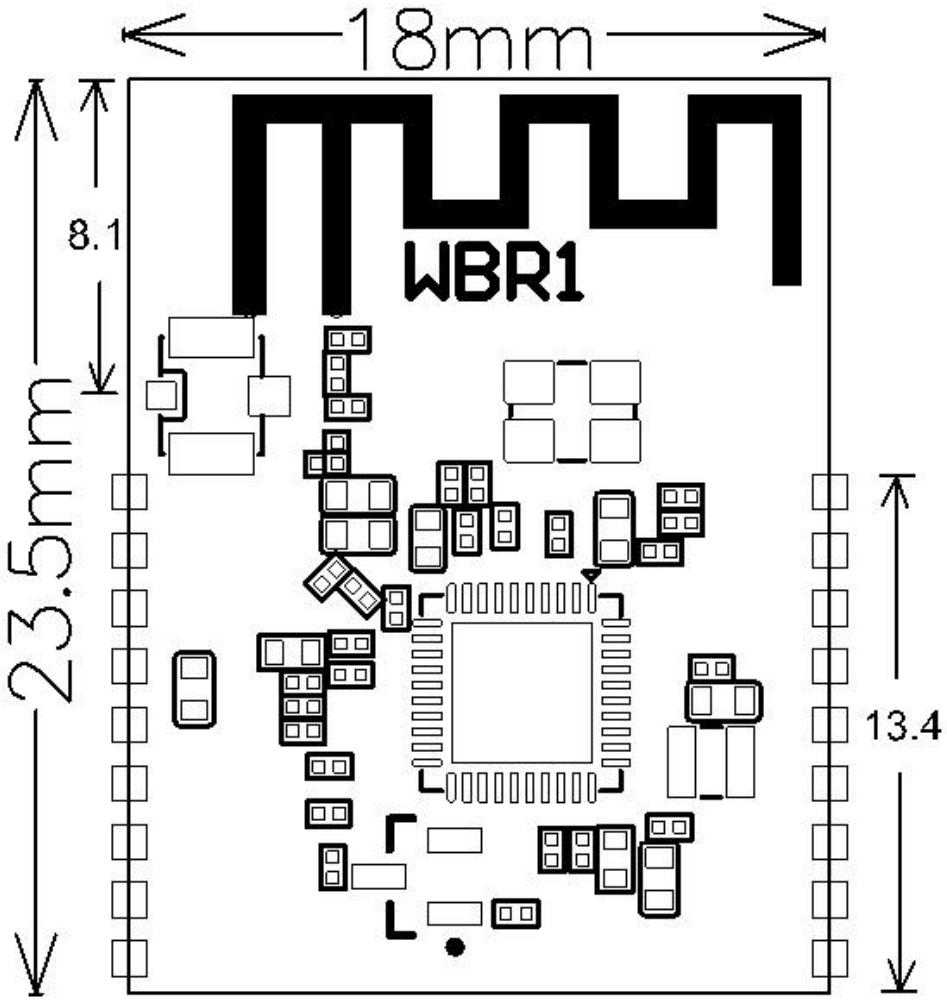

Figure 6-1 WBR1 mechanical dimensions

Figure 6-2 Side view

Note:

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

6.2 Recommended PCB Layout

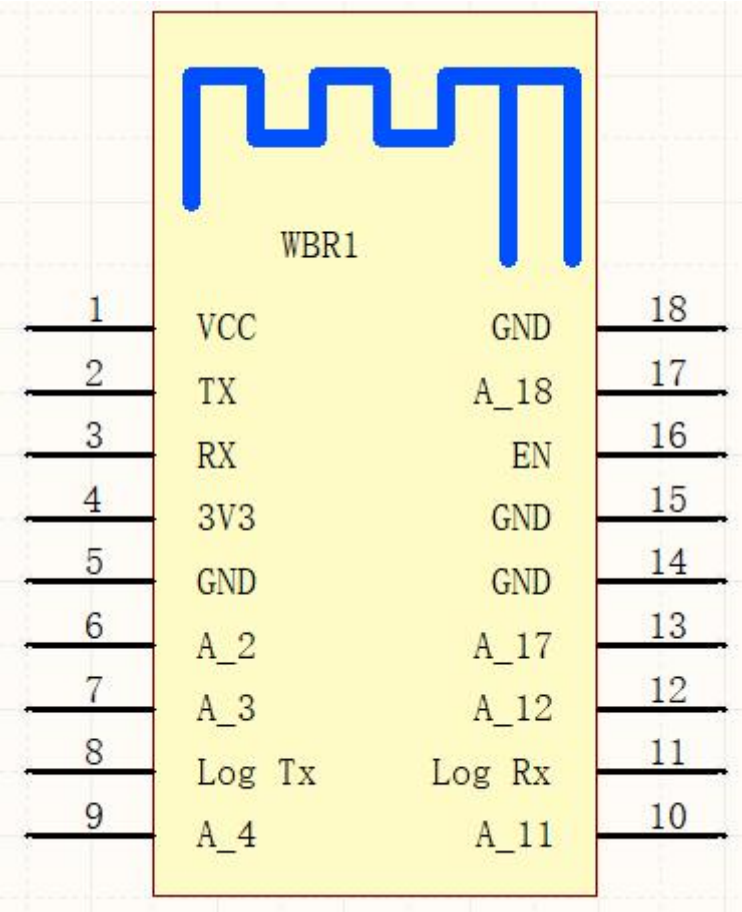

Figure 6-3 WBR1 pins

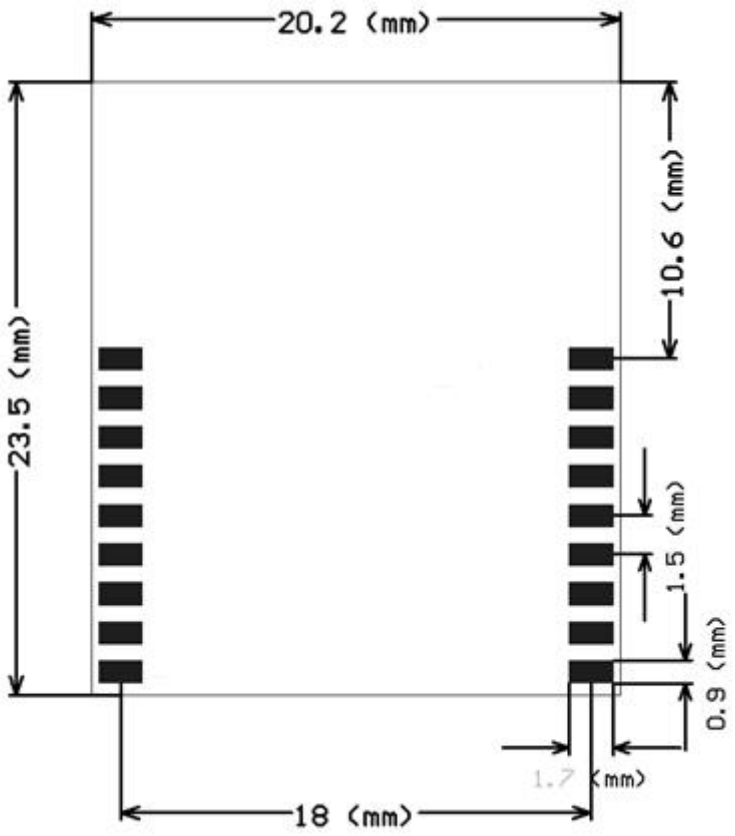

Figure 6-4 Layout of the PCB to which WBR1 applies

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).

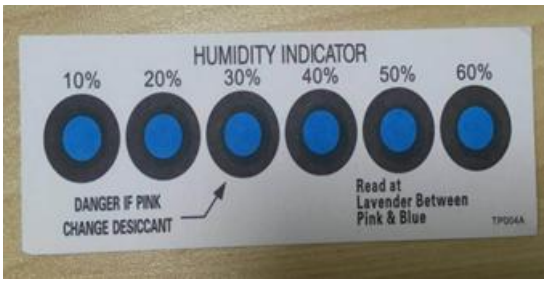

Figure 6-5 HIC for WBR1

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.

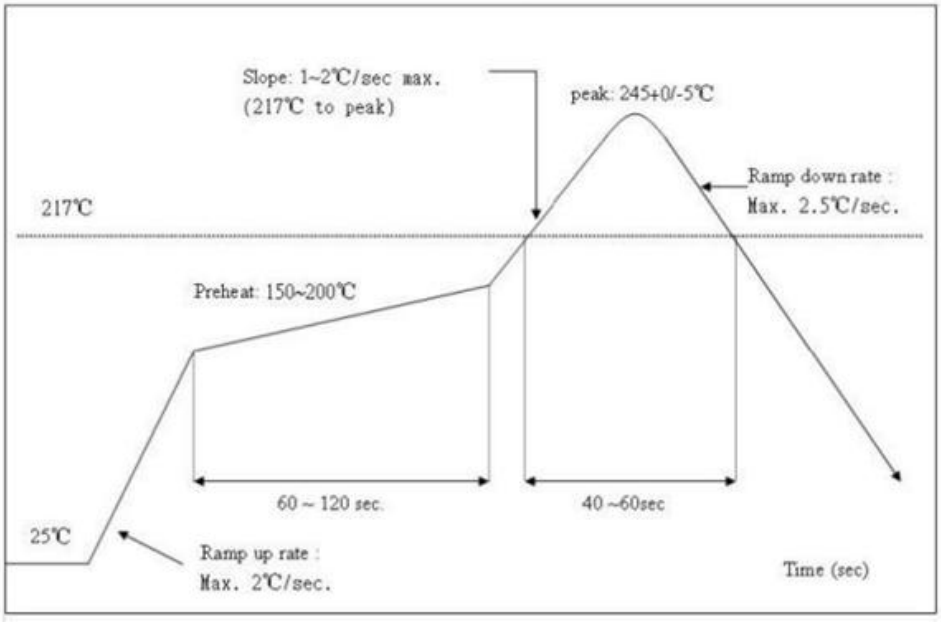

Figure 6-6 Oven temperature curve

6.5 Storage Conditions

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
      ≤ 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: _____
If Blank, see adjacent bar code label

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

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 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-WBR1.The final end product must be labeled in a visible area with the following: “Contains Transmitter Module FCC ID:2ANDL-WBR1”

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.