

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.

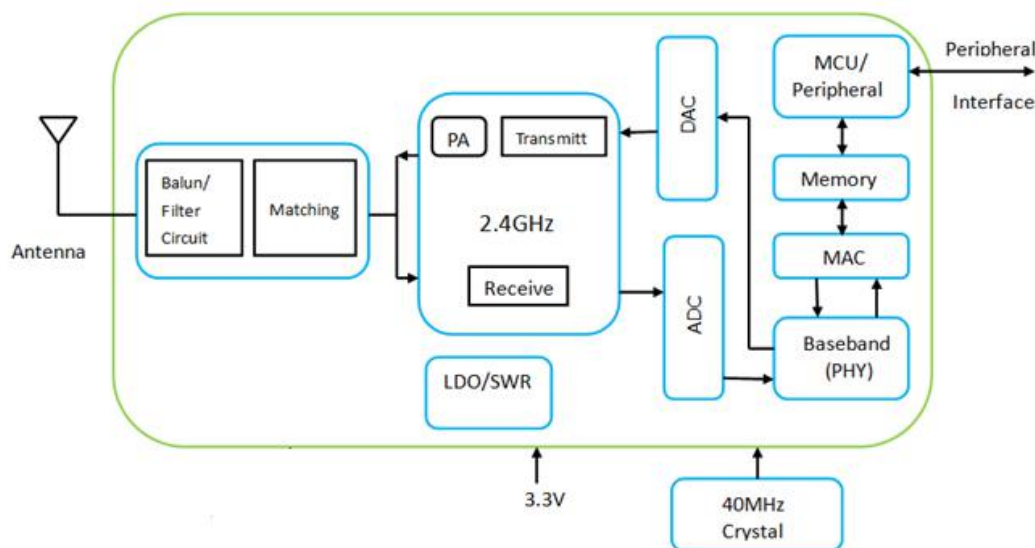


Figure 1-1 WBR1 architecture

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 11at 2.4 GHz
 - Compatible with Bluetooth low energy (BLE) 4.2
 - WPA and WPA2 security modes
 - 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

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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.

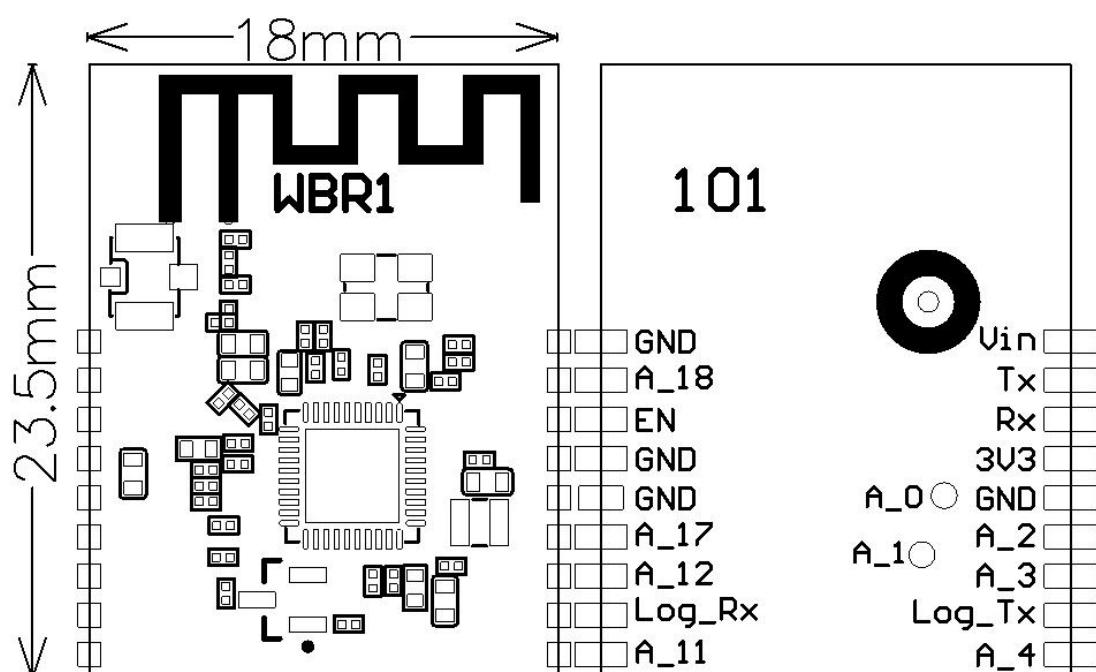


Figure 2-1 WBR1 front and rear views

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
I _{max}	I/O drive current	N/A	N/A	16	mA
C _{pad}	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	17 dBm	217	268	mA
I _{RF}	11 Mbit/s	18 dBm	231	283	mA
I _{RF}	802.11g	15 dBm	159	188	mA
I _{RF}	54 Mbit/s	17.5 dBm	177	213	mA
I _{RF}	802.11n BW20	13 dBm	145	167	mA
I _{RF}	MCS7	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:2.402GHz to 2.480 GHz Wi-Fi:2.412 GHz to 2.462GHz
Wi-Fi standard	IEEE 802.11b/g/n (channels 1 to 11,Ch1-11 for US/CA)
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.

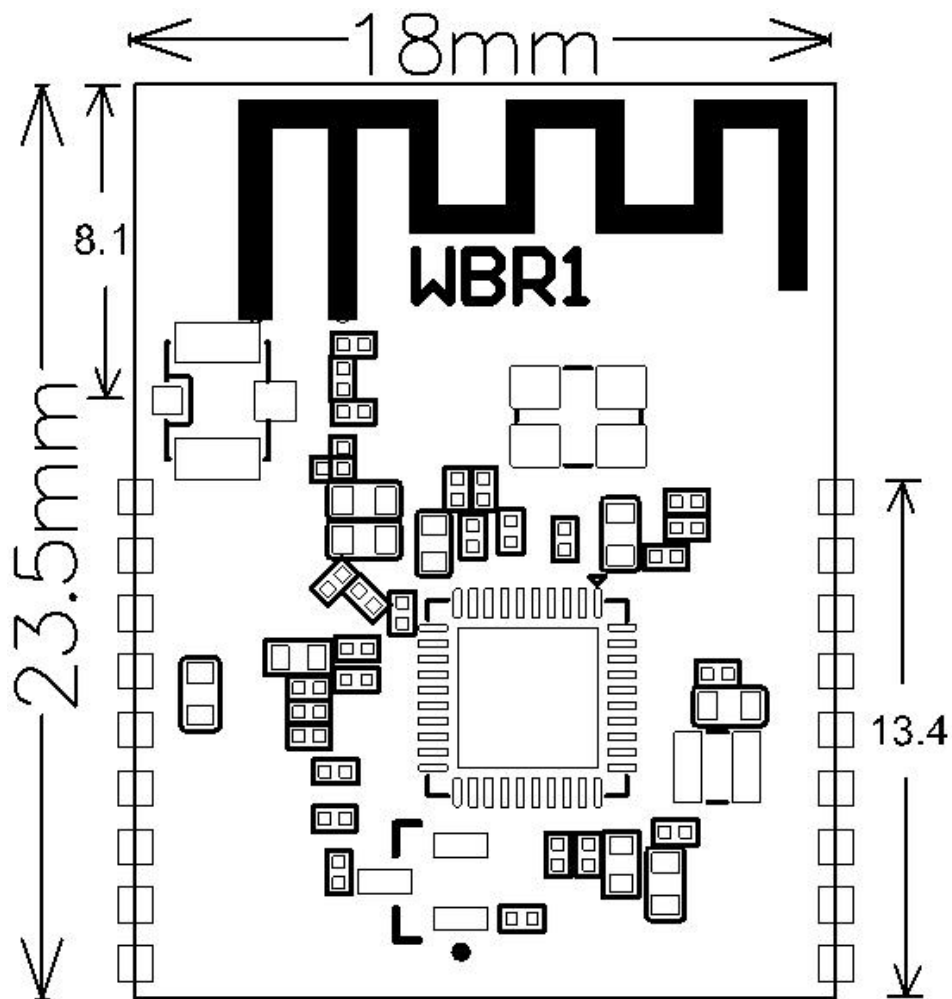


Figure 6-1 WBR1 mechanical dimensions



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

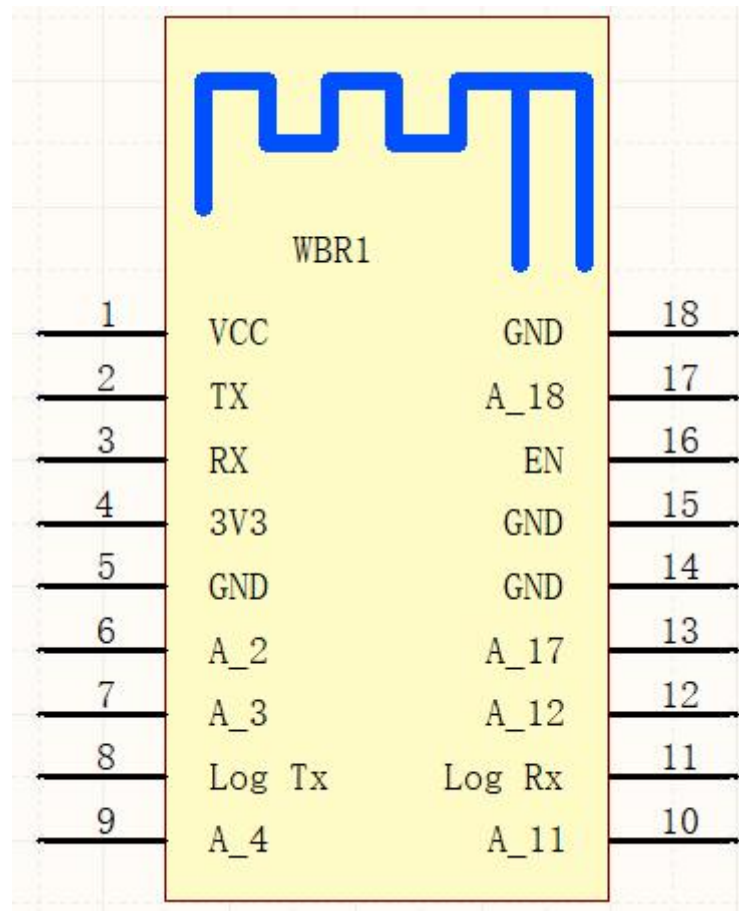


Figure 6-3 WBR1 pins

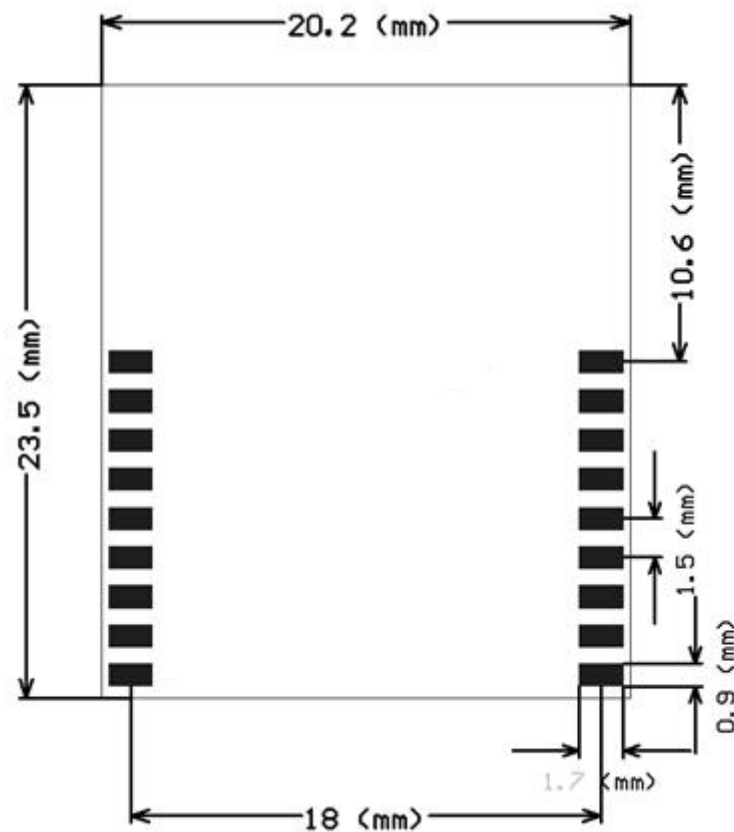


Figure 6-4 Layout of the PCB to which WBR1 applies

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).

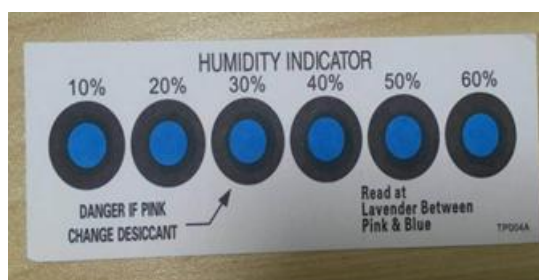


Figure 6-5 HIC for WBR1

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.

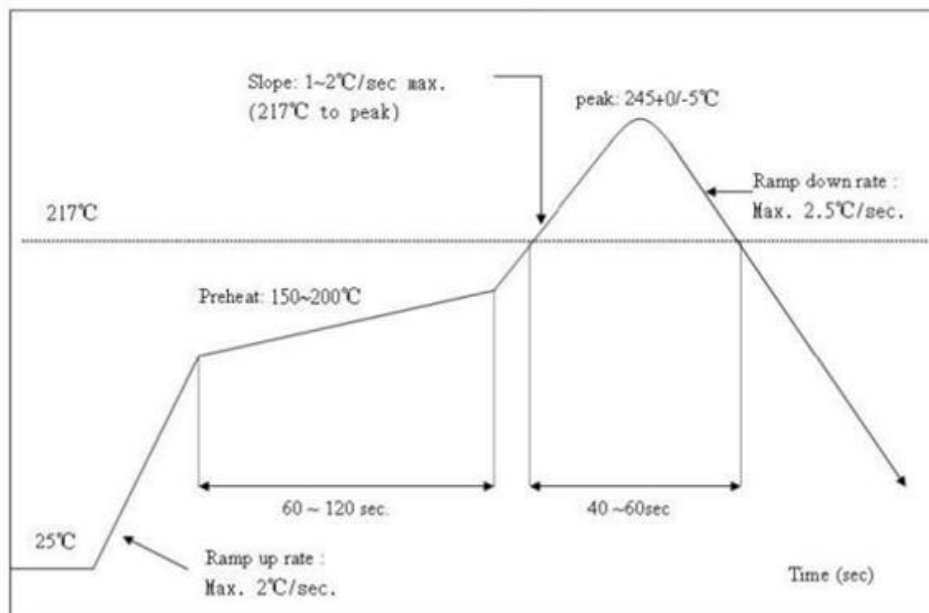


Figure 6-6 Oven temperature curve

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: <u>260</u> °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: <u>168</u> 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.

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01

2.2 List of applicable FCC rules

FCC Part 15 Subpart C 15.247 & 15.209

2.3 Specific operational use conditions

The module is a module with BLE and WIFI function.

Operation Frequency:

BT:2402-2480MHz

WIFI:IEEE 802.11b: 2412MHz-2462MHz

IEEE 802.11g: 2412MHz-2462MHz

IEEE 802.11n HT20: 2412MHz-2462MHz

Number of Channel:

BT:40CH

WIFI:802.11b/g/n20 11CH

Modulation:

BT:GFSK

WIFI:IEEE 802.11b: DSSS (CCK, QPSK, BPSK)

IEEE 802.11g: OFDM (64QAM, 16QAM, QPSK, BPSK)

IEEE 802.11n HT20: OFDM (64QAM, 16QAM, QPSK, BPSK)

Type: PCB Antenna

Gain: 2.5 dBi Max.

The module can be used for mobile or portable applications with a maximum 2.5dBi antenna. The host manufacturer installing this module into their product must ensure that the final composite product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operation. The host manufacturer has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

2.4 Limited module procedures

Not applicable. The module is a Single module and complies with the requirement of FCC Part 15.212.

2.5 Trace antenna designs

Not applicable. The module has its own antenna, and doesn't need a host's printed board microstrip trace antenna etc.

2.6 RF exposure considerations

The module must be installed in the host equipment such that at least 20cm is maintained between the antenna and users' body; and if RF exposure statement or module layout is changed, then the host product manufacturer required to take responsibility of the module through a change in FCC ID or new application. The FCC ID of the module cannot be used on the final product. In these circumstances, the host manufacturer will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

2.7 Antennas

Antenna Specification are as follows:

Type: PCB Antenna

Gain: 2.5 dBi

This device is intended only for host manufacturers under the following conditions:

The transmitter module may not be co-located with any other transmitter or antenna;

The module shall be only used with the internal antenna(s) that has been originally tested and certified with this module. The antenna must be either permanently attached or employ a 'unique' antenna coupler.

As long as the conditions above are met, further transmitter test will not be required. However, the host manufacturer is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

2.8 Label and compliance information

Host product manufacturers need to provide a physical or e-label stating "Contains FCC ID: 2A3L8-ZW118" with their finished product.

2.9 Information on test modes and additional testing requirements

Operation Frequency:

BT:2402-2480MHz

WIFI:IEEE 802.11b: 2412MHz-2462MHz

IEEE 802.11g: 2412MHz-2462MHz

IEEE 802.11n HT20: 2412MHz-2462MHz

Number of Channel:

BT:40CH

WIFI:802.11b/g/n20 11CH

Modulation:

BT:GFSK

WIFI:IEEE 802.11b: DSSS (CCK, QPSK, BPSK)

IEEE 802.11g: OFDM (64QAM, 16QAM, QPSK, BPSK)

IEEE 802.11n HT20: OFDM (64QAM, 16QAM, QPSK, BPSK)

Host manufacturer must perform test of radiated & conducted emission and spurious emission, etc according to the actual test modes for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

Only when all the test results of test modes comply with FCC requirements, then the end product can be sold legally.

2.10 Additional testing, Part 15 Subpart B disclaimer

The modular transmitter is **only** FCC authorized for FCC Part 15 Subpart C 15.247 & 15.209 and that 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. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

Federal Communication Commission Statement (FCC, U.S.)

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 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 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.

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.

IMPORTANT NOTES

Co-location warning:

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

OEM integration instructions:

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

The transmitter module may not be co-located with any other transmitter or antenna. The module shall be only used with the external antenna(s) that has been originally tested and certified with this module.

As long as the 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 (for example, digital device emissions, PC peripheral requirements, etc.).

Validity of using the module certification:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID of the module cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End product labeling:

The final end product must be labeled in a visible area with the following: "Contains Transmitter Module [FCC ID: 2A3L8-ZW118](#)".

Information that must be placed in the end user manual:

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

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.

Warning: changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment

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.