tuya | **Global Intelligent Platform**

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<tr><td>**Product Manual**</td><td>**Tuya WBR1D Wi-Fi Module**</td></tr>
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Version: 1.0.0   **Date: 2019-10-10**   **No.: 0000000001**

1 Product Overview

WBR1D is a low-power embedded Wi-Fi and Bluetooth module that Tuya has developed. It consists of a highly integrated RF chip (RTL8720DN) and several peripheral components, with an embedded Wi-Fi network protocol stack, Bluetooth network protocol, and robust library functions. WBR1D is embedded with a low-power 32-bit CPU, 512 KB static random-access memory (SRAM), and 4 MB flash memory, and has extensive peripherals.

WBR1D 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

   ● Clock rates: 80 MHz and 160 MHz

✧ Working voltage: 2.8 V to 3.6 V

✧ Peripherals: six GPIOs, two universal asynchronous receivers/transmitters (UARTs), and one analog-to-digital converter (ADC)

✧ Wi-Fi connectivity

   ● 802.11a/b/g/n 1x1, 2.4 GHz and 5 GHz capable

   ● Channels 1 to 14 at 2.4 GHz and channels 36 to 177 at 5 GHz

   ● WPA and WPA2 security modes

   ● 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 dBi at 2.4 GHz and 2.6 dBi at 5 GHz

- Working temperature: –20°C to +85°C

◇ Bluetooth connectivity
  - Support Bluetooth （V5.0）
  - Onboard PCB antenna with a gain of 2 dBi
  - 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	2019-10-10	This is the first release.	1.0.0

Contents

Tables

Figures

2 WBR1D Label

3 Module Interfaces

3.1 Dimensions and Footprint

WBR1D has two rows of pins with a 2 mm pin spacing.

The WBR1D dimensions (H x W x D) are 3.5 mm x 18 mm x 23.5 mm. Figure 3-1 shows the WBR1D front and rear views.
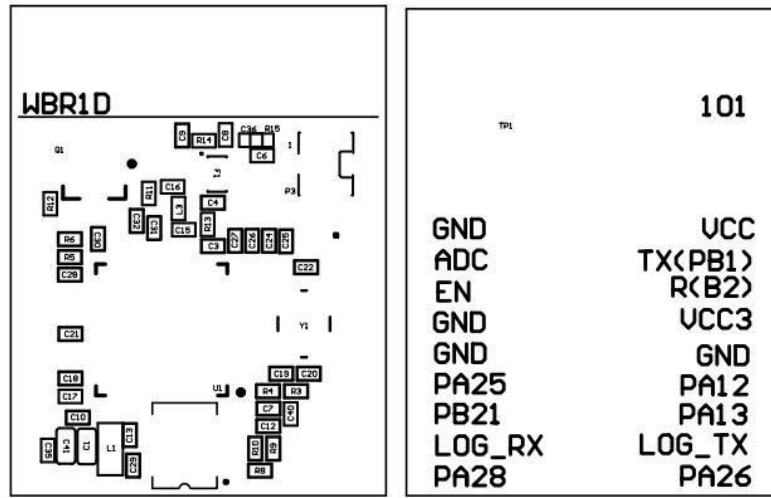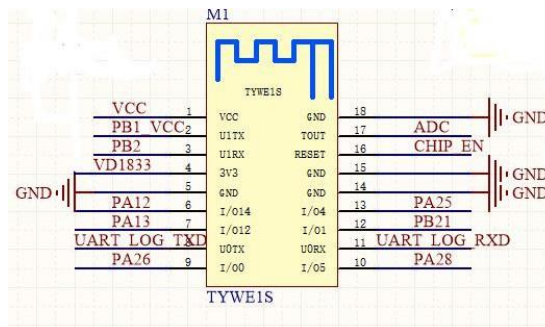

Figure 3-1 WBR1D front and rear views

Note:

The default dimensional tolerance is ±0.3 mm, and the tolerance for some measurements is ±0.1 mm. The PCB thickness is 1.0±0.1 mm.

3.2 Interface Pin Definition

Table 3-1 WBR1D interface pins

Pin No.	Symbol	I/O Type	Function
1	VCC	P	UART1 power supply pin
2	U1TX	I/O	UART1_TXD (user-side serial interface)
3	U1RX	I/O	UART1_RXD (user-side serial interface)
4	3V3	P	Power supply pin (3.3 V)
5	GND	P	Power supply reference ground pin
6	IO14	I/O	GPIO_14
7	IO12	I/O	GPIO_12
8	U0TX	I/O	UART0_TXD (used to display the module internal information)
9	IO0	I/O	GPIO_0
10	IO5	I/O	GPIO_5
11	U0RX	I/O	UART0_RXD (used to display the module internal information)
12	IO1	I/O	GPIO_1
13	IO4	I/O	GPIO_4
14	GND	P	Power supply reference ground pin
15	GND	P	Power supply reference ground pin
16	RESET	I/O	External reset pin
17	TOUT	AI	ADC pin
18	GND	P	Power supply reference ground pin

Note:

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

RESET is only a hardware reset pin and cannot clear the Wi-Fi network configuration.

3.3 Test Pin Definition

Table 3-2 WBR1D test pins

Pin No.	Symbol	I/O Type	Function
N/A	TEST	Input	Used for the module production test

Note:

Test pins are not recommended.

4 Electrical Parameters

4.1 Absolute Electrical Parameters

Table 4-1 Absolute electrical parameters

Parameter	Description	Minimum Value	Maximum Value	Unit
Ts	Storage temperature	−20	85	°C
VCC	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

4.2 Electrical Conditions

Table 4-2 Normal electrical conditions

Parameter	Description	Minimum Value	Typical Value	Maximum Value	Unit
Ta	Working temperature	−20	N/A	85	°C
VCC	Power supply voltage	2.8	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
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

4.3 RF Current Consumption

Table 4-3 Power consumption during constant transmission

Working Status	Mode	TX Power
TX at 2.4 GHz	802.11b	+17.56 dBm
	802.11g	+18.35 dBm
	802.11n HT20	+17.43 dBm
	802.11n HT40	+16.52 dBm
	BLE	+8.66dBm
TX at 5GHz	802.11a	5150MHz-5250MHz：+16.52dBm 5250MHz-5350MHz：+16.83dBm 5470MHz-5725MHz：+15.92dBm 5725MHz-5850MHz：+11.89dBm
	802.11n HT20	5150MHz-5250MHz：+15.87dBm 5250MHz-5350MHz：+15.65dBm 5470MHz-5725MHz：+15.77dBm 5725MHz-5850MHz：+11.65dBm
	802.11n HT40	5150MHz-5250MHz：+14.33dBm 5250MHz-5350MHz：+14.91dBm 5470MHz-5725MHz：+13.92dBm 5725MHz-5850MHz：+11.51dBm

Table 4-4 Power consumption during constant receiving

Working Status	Mode	Rate	Typical Value	Unit
2.4 GHz	802.11b	11 Mbit/s	70	mA
	802.11g	54 Mbit/s	72	mA
	802.11n HT20	MCS7	70	mA
	802.11n HT40	MCS7	73	mA
5 GHz	802.11a	54 Mbit/s	71	mA
	802.11n HT20	MCS7	72	mA
	802.11n HT40	MCS7	76	mA

4.4 Working Current

Table 4-5 WBR1D 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.			mA
AP	The module is in AP mode, and the Wi-Fi indicator blinks slowly.			mA
Connected	The module is connected to the network, and the Wi-Fi indicator is steady on.			mA
Disconnected	The module is disconnected from the network, and the Wi-Fi indicator is steady off.			mA

5   RF Features

5.1   Basic RF Features

Table 5-1 Basic RF features

Parameter	Description
Frequency band	BT:2.400GHz to 2.4835GHz WIFI:2.412 GHz to 2.484 GHz; 5.15 GHz to 5.85 GHz
standard	IEEE 802.11a/b/g/n (channels 1 to 14 and 36 to 177, channels 1 to 11 for US, channels 1 to 13 for EU) Bluetooth LE 5.0
Data transmission rate	802.11b: 1, 2, 5.5, or 11 (Mbit/s) 802.11a/g: 6, 9, 12, 18, 24, 36, 48, or 54 (Mbit/s) 802.11n: HT20 MCS0 to MCS7 802.11n: HT40 MCS0 to MCS7 Bluetooth：1Mbps, 2Mbps
Antenna type	PCB antenna with a gain of 2 dBi at 2.4 GHz and 2.6 dBi at 5 GHz

5.2   TX Performance

Table 5-2 Performance during constant transmission at 2.4 GHz

Parameter		Minimum Value	Typical Value	Maximum Value	Unit
Average RF output power, 802.11b CCK mode	11 Mbit/s	N/A	17.56	N/A	dBm
Average RF output power, 802.11g OFDM mode	54 Mbit/s	N/A	18.35	N/A	dBm
Average RF output power, 802.11n HT20 mode	MCS7	N/A	17.43	N/A	dBm
Average RF output power, 802.11n HT40 mode	MCS7	N/A	16.52	N/A	dBm
Frequency error		−10	N/A	+10	ppm
EVM under 802.11b CCK, 11 Mbit/s			−16.5		dB

Parameter	Minimum Value	Typical Value	Maximum Value	Unit
EVM under 802.11g OFDM, 54 Mbit/s		−33.1		dB
EVM under 802.11n OFDM, MCS7		−32.2		dB

Table 5-3 Performance during constant transmission at 5 GHz

Parameter		Minimum Value	Typical Value	Maximum Value	Unit
Average RF output power, 802.11a OFDM mode	54 Mbit/s	N/A	16.83	N/A	dBm
Average RF output power, 802.11n HT20 mode	MCS7	N/A	15.87	N/A	dBm
Average RF output power, 802.11n HT40 mode	MCS7	N/A	14.91	N/A	dBm
Frequency error		−10	N/A	+10	ppm
EVM under 802.11b CCK, 11 Mbit/s			−16.5		dB
EVM under 802.11g OFDM, 54 Mbit/s			−33.1		dB
EVM under 802.11n OFDM, MCS7			−32.2		dB

5.3 RX Performance

Table 5-4 RX sensitivity

| Parameter		Minimum Value	Typical Value	Maximum Value	Unit
PER < 8%, 802.11b CCK mode	11 Mbit/s	N/A	−91	N/A	dBm
PER < 10%, 802.11a/g OFDM mode	54 Mbit/s	N/A	−75	N/A	dBm
PER < 10%, 802.11n OFDM mode	HT20 MCS7	N/A	−72	N/A	dBm

6　Antenna Information

6.1　Antenna Type

WBR1D 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.
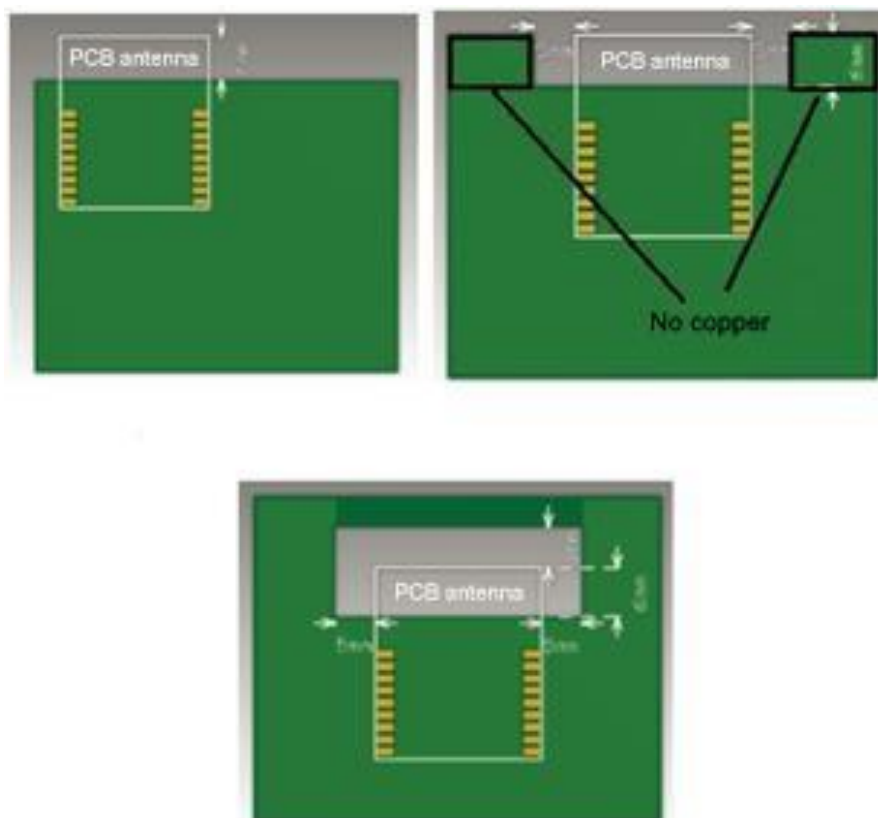
Figure 6-1 Antenna clearance part

For details about the onboard PCB antenna area on WBR1D, see Figure 7-1.

6.3 Antenna Connector Specifications

WBR1D does not use an antenna connector.

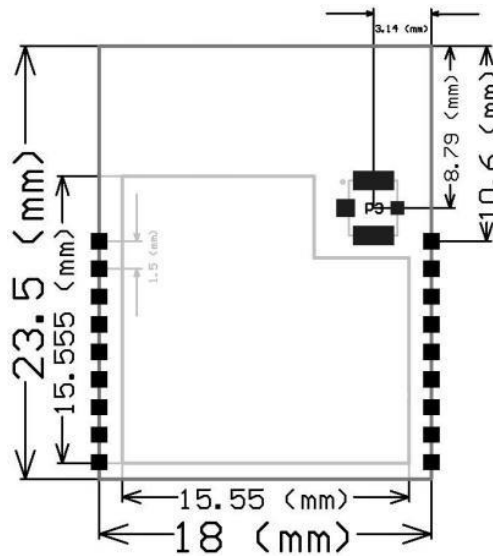# 7   Packaging Information and Production Instructions

7.1 Mechanical Dimensions

Figure 7-1 WBR1D mechanical dimensions

Figure 7-2 Side view

Note:

The default dimensional tolerance is ±0.3 mm. If a customer has other requirements, clearly specify them in the datasheet after communication.
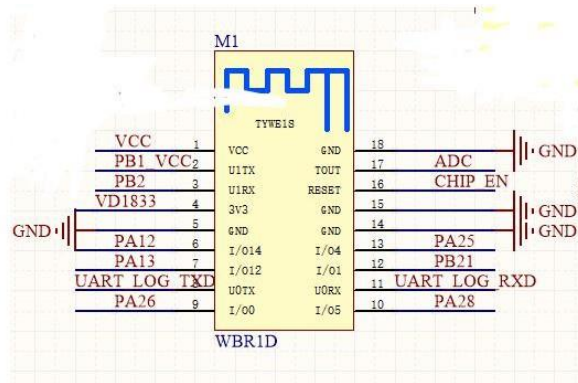
7.2 Recommended PCB Layout
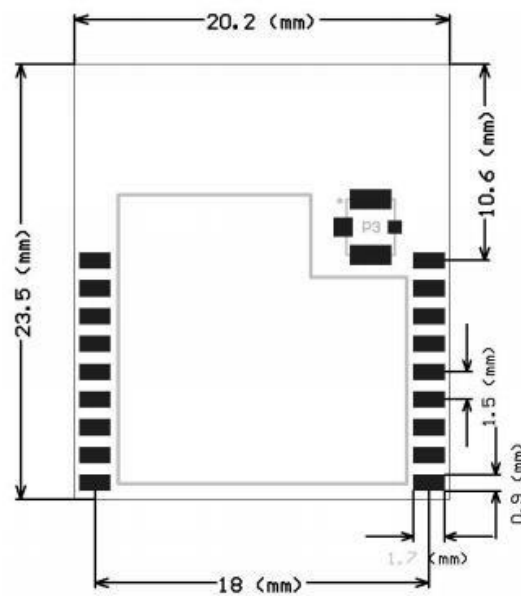

Figure 7-3 WBR1D pins

Figure 7-4 Layout of the PCB to which WBR1D 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.

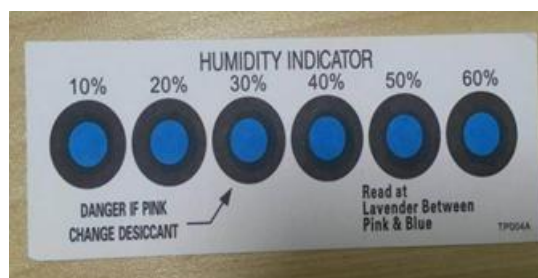   (3) The package contains a humidity indicator card (HIC).

Figure 7-5 HIC for WBR1D

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

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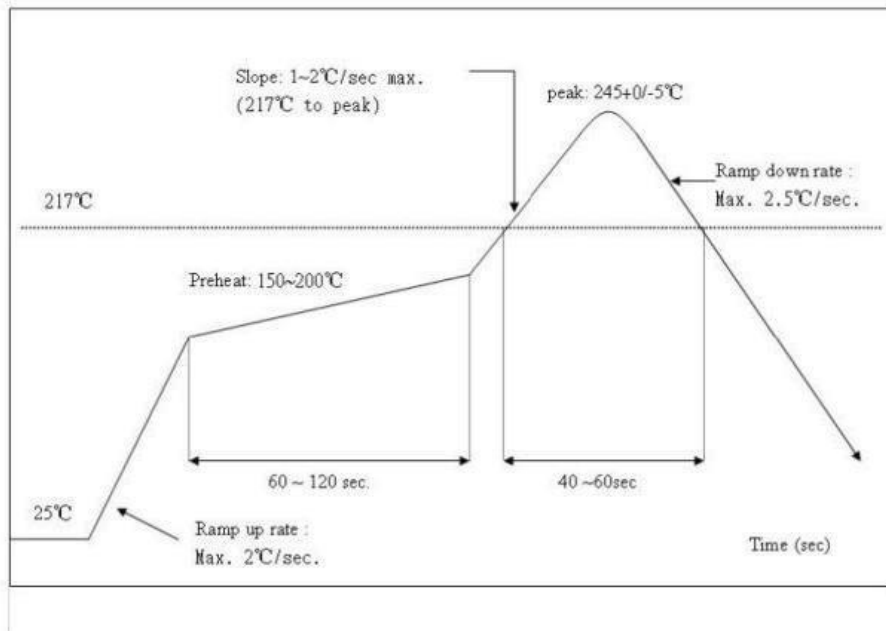

Figure 7-6 Oven temperature curve

7.5 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

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.

This device have got a FCC ID：2ANDL-WBR1D.The final end product must be labeled in a visible area with the following: "Contains Transmitter Module FCC ID: 2ANDL-WBR1D"

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.

The device could be used with a separation distance of 20cm to the human body.

The device is restricted to indoor use only when operating in the 5150 to 5350 MHz frequency range.

	AT	BE	BG	HR	CY	CZ	DK
	EE	FI	FR	DE	EL	HU	IE
	IT	LV	LT	LU	MT	NL	PL
	PT	RO	SK	SI	ES	SE	UK