

1. Product Overview

WB3S is a low-power embedded Wi-Fi module that Tuya has developed. It consists of a highly integrated RF chip (BK7231T) and several peripheral components, with an embedded Wi-Fi network protocol stack and robust library functions. WB3S also contains a low-power Arm Cortex-M4 microcontroller unit (MCU), 1T1R WLAN module, 256 KB static random-access memory (SRAM), 2 MB flash memory, and extensive peripherals.

WB3S 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 rate: 120 MHz
- ✧ Working voltage: 3.0 V to 3.6 V
- ✧ Peripherals: nine GPIOs, one universal asynchronous receiver/transmitter (UART), and one analog-to-digital converter (ADC)
- ✧ Wi-Fi connectivity
 - 802.11b/g/n
 - Channels 1 to 14 at 2.4 GHz
 - WPA and WPA2 security modes
 - Up to +20 dBm output power in 802.11b mode
 - EZ net pairing mode for Android and iOS devices
 - Onboard PCB antenna with a gain of 1.5 dBi

- Working temperature: -20°C to $+85^{\circ}\text{C}$
- ✧ BT
 - Support Bluetooth (V4.0)
 - Maximum output power + 7dBm
 - Onboard PCB antenna with a gain of 1.5 dBi

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 | 2019-11-22 | This is the first release. | 1.0.0 |

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2 Module Interfaces

2.1 Dimensions and Footprint

WB3S has two rows of pins with a 2 mm pin spacing.

The WB3S dimensions (H x W x D) are 3.5 mm x 16 mm x 24 mm. Figure 2-1 shows the WB3S front and rear views.

Note:

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

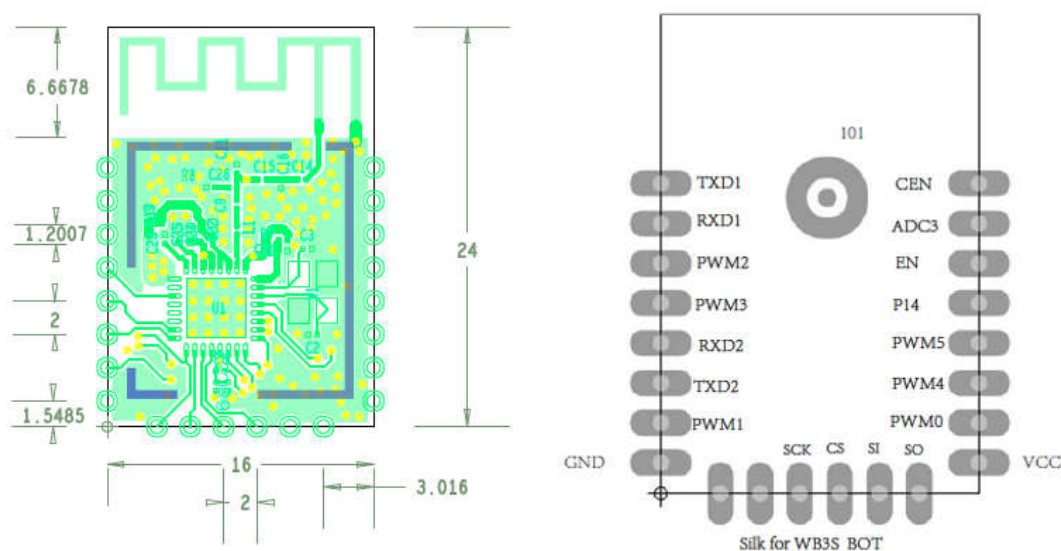


Figure 2-1 WB3S front and rear views

2.2 Interface Pin Definition

Table 2-1 WB3S interface pins

| Pin No. | Symbol | I/O Type | Function |
|---------|--------|----------|--|
| 1 | CEN | I/O | Chip enabling pin, which is active at a low level and is connected to the CEN pin on the internal IC |
| 2 | ADC3 | AI | ADC pin, which is connected to the P23 pin on the internal IC |

| Pin No. | Symbol | I/O Type | Function |
|---------|--------|----------|---|
| 3 | EN | Input | Enabling pin, which is internally pulled up and compatible with other module design |
| 4 | P14 | I/O | Common GPIO, which is connected to the P14 pin on the internal IC |
| 5 | PWM5 | I/O | GPIO_P_26, which is connected to the P26 pin on the internal IC |
| 6 | PWM4 | I/O | GPIO_P_24, common GPIO, which is connected to the P24 pin on the internal IC |
| 7 | PWM0 | I/O | GPIO_P_6, which is connected to the P6 pin on the internal IC |
| 8 | VCC | P | Power supply pin (3.3 V) |
| 9 | GND | P | Power supply reference ground pin |
| 10 | PWM1 | I/O | GPIO_P_7, which is connected to the P7 pin on the internal IC |
| 11 | TXD2 | I/O | UART2_TXD, which is used for displaying the module internal information and is connected to the P0 pin on the internal IC |
| 12 | RXD2 | I/O | UART0_RXD, which is used to display the module internal information and connected to the P1 pin on the internal IC |
| 13 | PWM3 | I/O | GPIO_P_9, common GPIO, which is connected to the P9 pin on the internal IC |
| 14 | PWM2 | I/O | GPIO_P_8, which is connected to the P8 pin on the internal IC |
| 15 | RXD1 | I/O | UART1_RXD, which is used as a user-side serial interface pin and is connected to the P10 pin on the internal IC |
| 16 | TXD1 | I/O | UART1_TXD, which is used as a user-side serial interface pin and is connected to the P11 pin on the internal IC |

Note:

1. **P** indicates power supply pins, **I/O** indicates input/output pins, and **AI** indicates analog input pins.
2. CEN is only a hardware reset pin and cannot clear the Wi-Fi network configuration.
3. UART1 is a user-side serial interface pin, which generates information when the module is powered on and starts.

2.3 Test Pin Definition

Table 2-2 WB3S test pins

| Pin No. | Symbol | I/O Type | Function |
|---------|--------|----------|--|
| N/A | SO | I/O | Data output pin when data is downloaded from the flash memory, which is used for module production and firmware burning and is connected to the P23 or ADC3 pin on the internal IC |
| N/A | SI | I/O | Data input pin when data is downloaded from the flash memory, which is used for module production and firmware burning and is connected to the P22 pin on the internal IC |
| N/A | CS | I/O | Chip selection pin when data is downloaded from the flash memory, which is used for module production and firmware burning and is connected to the P21 pin on the internal IC |
| N/A | SCK | I/O | Clock pin when data is downloaded from the flash memory, which is used for module production and firmware burning and is connected to the P20 pin on the internal IC |

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 | 150 | °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 |

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 |
| VCC | Power supply voltage | 3.0 | 3.3 | 3.6 | V |
| VIL | I/O low-level input | −0.3 | N/A | VCC x 0.25 | V |
| VIH | I/O high-level input | VCC x 0.75 | N/A | 3.6 | V |
| VOL | I/O low-level output | N/A | N/A | VCC x 0.1 | V |
| VOH | I/O high-level | VCC x 0.8 | N/A | VCC | V |

| Parameter | Description | Minimum Value | Typical Value | Maximum Value | Unit |
|------------------|-------------------|---------------|---------------|---------------|------|
| | output | | | | |
| I _{max} | I/O drive current | N/A | 6 | 15 | mA |

3.3 RF Current Consumption

Table 3-3 Power consumption during constant transmission and receiving

| Working Status | Parameter | | | Typical Value | Unit |
|----------------|--------------|-----------|--------------------|---------------|------|
| | Mode | Rate | TX Power/Receiving | | |
| TX | 802.11b | 11 Mbit/s | +16 dBm | 222 | mA |
| | 802.11g | 54 Mbit/s | +14 dBm | 195 | mA |
| | 802.11n | MCS7 | +12 dBm | 185 | mA |
| | 802.11n HT40 | MCS7 | +12 dBm | 190 | mA |
| RX | 802.11b | 11 Mbit/s | Constant receiving | 98 | mA |
| | 802.11g | 54 Mbit/s | Constant receiving | 98 | mA |
| | 802.11n | MCS7 | Constant receiving | 98 | mA |
| | 802.11n HT40 | MCS7 | Constant receiving | 116 | mA |

3.4 Working Current

Table 3-4 WB3S 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. | 100 | 170 | mA |
| Connected and idle | The module is connected to the network, and the Wi-Fi indicator is steady on. | 50 | 125 | mA |
| Connected | The module is connected to the network, | 40 | 180 | mA |

| Working Mode | Working Status (Ta = 25°C) | Typical Value | Peak Value* | Unit |
|---------------|---|---------------|-------------|------|
| and operating | and the Wi-Fi indicator is steady on. | | | |
| Disconnected | The module is disconnected from the network, and the Wi-Fi indicator is steady off. | 60 | 110 | mA |

4 RF Features

4.1 Basic RF Features

Table 4-1 Basic RF features

| Parameter | Description |
|------------------------|---|
| Frequency band | BT: 2.400 GHz to 2.4835 GHz WIFI: 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) |
| BT standard | BT 4.0 |
| 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 802.11n: HT40 MCS0 to MCS7 |
| Antenna type | Onboard PCB antenna with a gain of 1.5 dBi |

4.2 TX Performance

Table 4-2 Performance during constant transmission

| Parameter | | Minimum Value | Typical Value | Maximum Value | Unit |
|--------------------------|-----------|---------------|---------------|---------------|------|
| Average RF output power, | 11 Mbit/s | N/A | 16 | N/A | dBm |

| Parameter | | Minimum Value | Typical Value | Maximum Value | Unit |
|--|-----------|---------------|---------------|---------------|------|
| 802.11b CCK mode | | | | | |
| Average RF output power, 802.11g OFDM mode | 54 Mbit/s | N/A | 14 | N/A | dBm |
| Average RF output power, 802.11n OFDM mode | MCS7 | N/A | 13 | N/A | dBm |
| Frequency error | | -2 | N/A | +2 | ppm |
| EVM under 802.11b CCK, 11 Mbit/s, 17 dBm | | | -23 | | dB |
| EVM under 802.11g OFDM, 54 Mbit/s, 11 dBm | | -26 | -27 | -29 | dB |
| EVM under 802.11n OFDM, MCS7, 10 dBm | | -26 | -27 | -29 | 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 | -92 | 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 | -68 | N/A | dBm |
| PER < 10%, BT 1M | | | -95 | | |

5 Antenna Information

5.1 Antenna Type

WB3S 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. Deploy the antenna based on the antenna placement solutions, as shown in Figure 5-1.

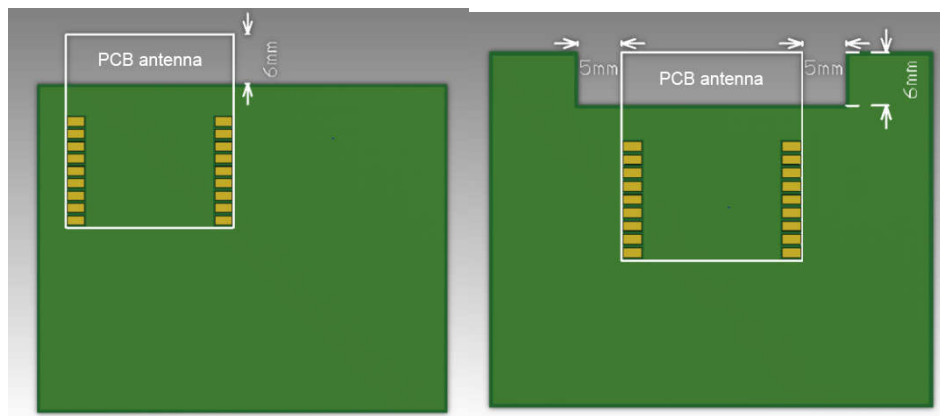


Figure 5-1 Antenna clearance part

5.3 Antenna Connector Specifications

WB3S does not use an antenna connector.

6 Packaging Information and Production Instructions

6.1 Mechanical Dimensions

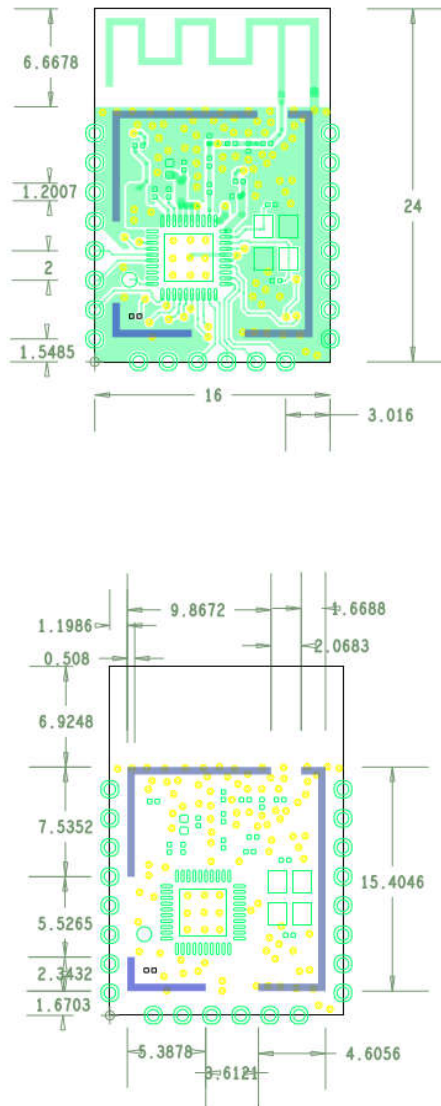


Figure 6-1 WB3S mechanical dimensions

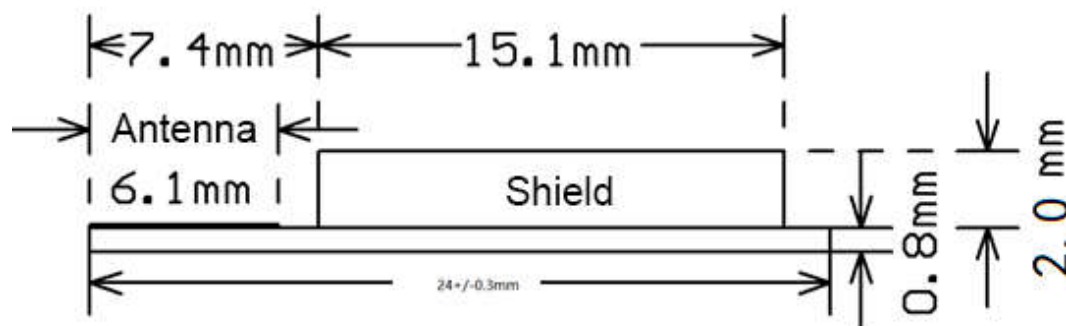


Figure 6-2 Side view

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

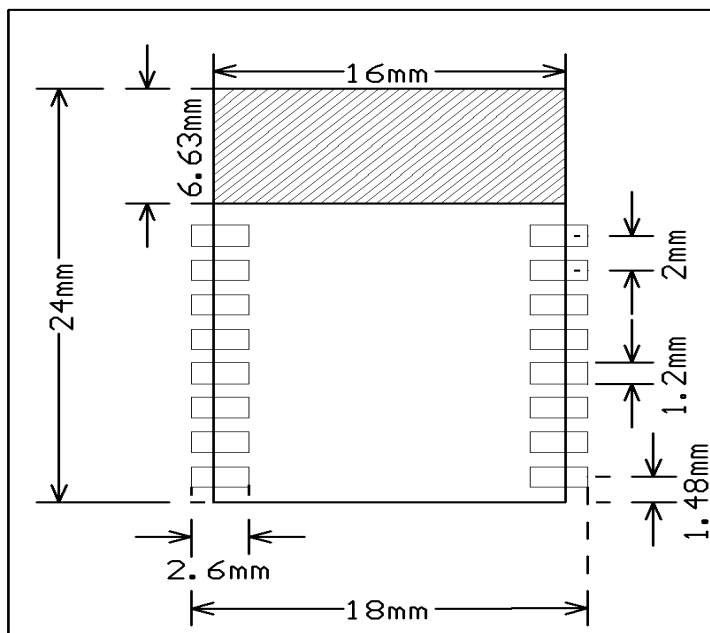


Figure 6-3 Layout of the PCB to which WB3S applies

Note:

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

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 85%.
 - (2) The shelf life of a dry-packaged product is 12 months from the date when the product is packaged and sealed.
 - (3) The package contains a humidity indicator card (HIC).



Figure 6-4 HIC for WB3S

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: $125\pm5^{\circ}\text{C}$
 - (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.

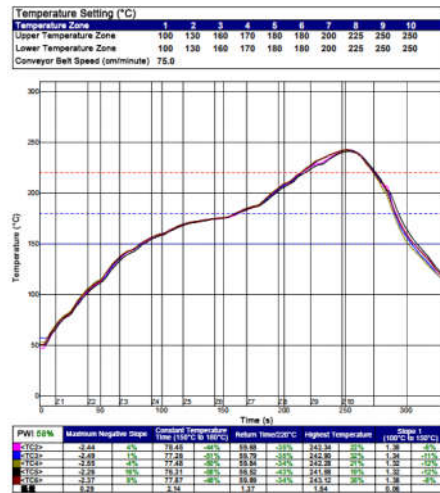


Figure 6-5 Oven temperature curve

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 | | |

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-WB3S. The final end product must be labeled in a visible area with the following: "Contains Transmitter Module FCC ID:2ANDL-WB3S"

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.