tuya | **Global Intelligent Platform**

Product Manual

Tuya WB1S Wi-Fi Module

Version: 1.0.0   **Date: 2019-11-20**   **No.: 0000000001**

1   Product Overview

WB1S 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. WB1S also contains a low-power Arm Cortex-M4 MCU, 1T1R WLAN module, 256 KB static random-access memory (SRAM), and 2 MB flash memory, and has extensive peripherals.

WB1S 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 +18 dBm output power in 802.11b mode

  ● Smart network configuration for Android and iOS devices

  ● Onboard PCB antenna with a gain of 0.5 dBi

  ● Working temperature: –20°C to +85°C

- ✧ BT
  - Support Bluetooth (V4.0)
  - Maximum output power + 9dBm EIRP
  - Onboard PCB antenna with a gain of 0.5 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	2019-11-20	This is the first release.	1.0.0

Contents

Figures

Tables

2 Module Interfaces

2.1 Dimensions and Footprint

WB1S has two rows of pins with a 2 mm pin spacing.

The WB1S dimensions (H x W x D) are 3.0 mm x 16 mm x 24 mm. Figure 2-1 shows the WB1S front and rear views.

Note: The default dimensional tolerance is ±0.3 mm. If a customer has other requirements, clearly specify them in the datasheet after communication.
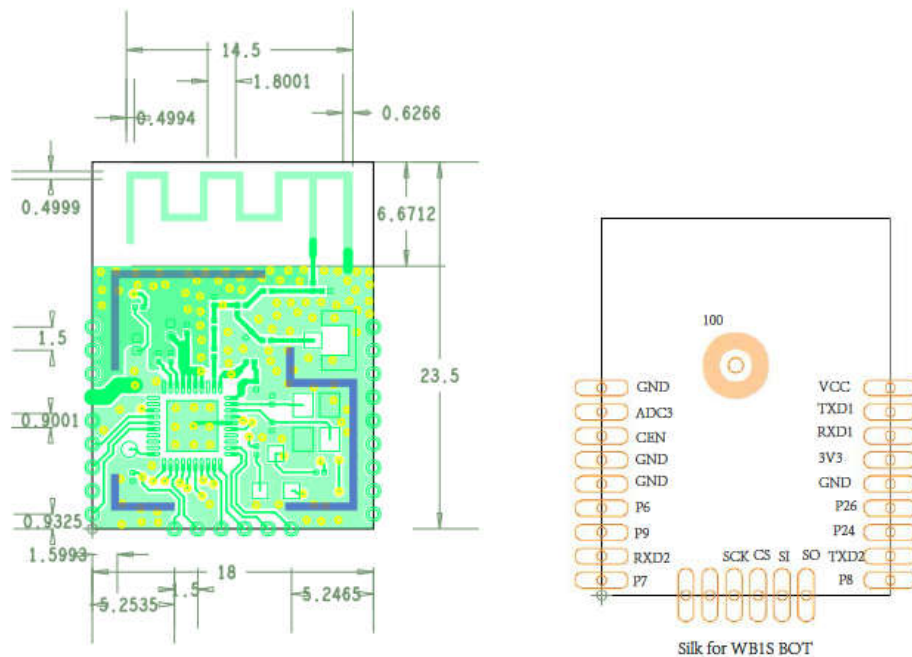
Figure 2-1 WB1S front and rear views

2.2 Interface Pin Definition

Table 2-1 WB1S interface pins

Pin No.	Symbol	I/O Type	Function
1	VCC	P	Power supply pin (3.3 V)

Pin No.	Symbol	I/O Type	Function
2	TXD1	I/O	UART1_TXD, which is used as a user-side serial interface pin and connected to the P11 pin on the internal IC
3	RXD1	I/O	UART1_RXD, which is used as a user-side serial interface pin and connected to the P10 pin on the internal IC
4	3V3	P	Power supply pin (3.3 V)
5	GND	P	Power supply reference ground pin
6	P26	I/O	Common I/O pin, which can be used as a hardware PWM pin and is connected to the P26 pin on the internal IC
7	P24	I/O	Common I/O pin, which can be used as a hardware PWM pin and is connected to the P24 pin on the internal IC
8	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
9	P8	I/O	Common I/O pin, which can be used as a hardware PWM pin and is connected to the P8 pin on the internal IC
10	P7	I/O	Common I/O pin, which can be used as a hardware PWM pin and is connected to the P7 pin on the internal IC
11	RXD2	I/O	UART0_RXD, which is used for displaying the module internal information and is connected to the P1 pin on the internal IC
12	P9	I/O	Common I/O pin, which can be used as a hardware PWM pin and is connected to the P9 pin on the internal IC
13	P6	I/O	Common I/O pin, which can be used as a hardware PWM pin and is connected to the P6 pin on the internal IC
14	GND	P	Power supply reference ground pin

Pin No.	Symbol	I/O Type	Function
15	GND	P	Power supply reference ground pin
16	CEN	I/O	Chip enabling pin, which is active at a low level and is connected to the CEN pin on the internal IC
17	ADC3	AI	ADC pin, which is connected to the P23 pin on the internal IC
18	GND	P	Power supply reference ground pin

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.

2.3 Test Pin Definition

Table 2-2 WB1S 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

Pin No.	Symbol	I/O Type	Function
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

Parameter	Description	Minimum Value	Typical Value	Maximum Value	Unit
VCC	Power supply voltage	3.0	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	3.6	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	6	15	mA

3.3 RF Current Consumption

Table 3-3 Current 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	+13 dBm	185	mA
	802.11n HT40	MCS7	+13 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 WB1S 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	150	mA
Connected and idle	The module is connected to the network, and the Wi-Fi indicator is steady on.	50	125	mA
Connected and operating	The module is connected to the network, and the Wi-Fi indicator is steady on.	40	180	mA
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 0.5 dBi

4.2 TX Performance

Table 4-2 Performance during constant transmission

Parameter		Minimum Value	Typical Value	Maximum Value	Unit
Average RF output power, 802.11b CCK mode	11 Mbit/s	N/A	16	N/A	dBm
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, 16 dBm			–18		dB
EVM under 802.11g OFDM, 54 Mbit/s, 14 dBm		–30	–29	–25	dB
EVM under 802.11n OFDM, MCS7, 13 dBm		–31	–28	–27	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

5   Antenna Information

5.1 Antenna Type

WB1S 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 shown in the following figures.
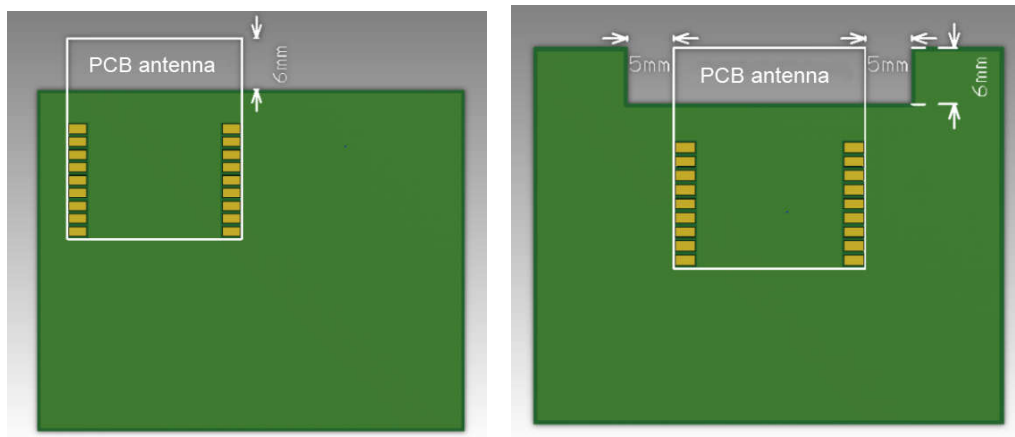
Figure 5-1 Antenna clearance part

5.3 Antenna Connector Specifications

WB1S does not use an antenna connector.

6   Packaging Information and Production Instructions
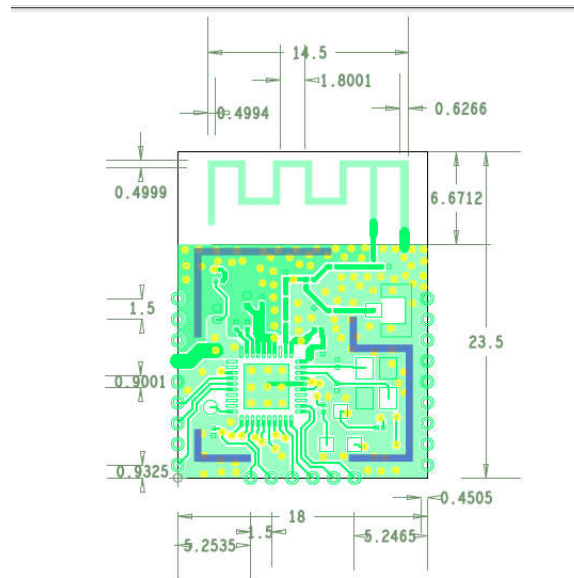
6.1   Mechanical Dimensions

Figure 6-1 WB1S mechanical dimensions

Figure 6-2 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.
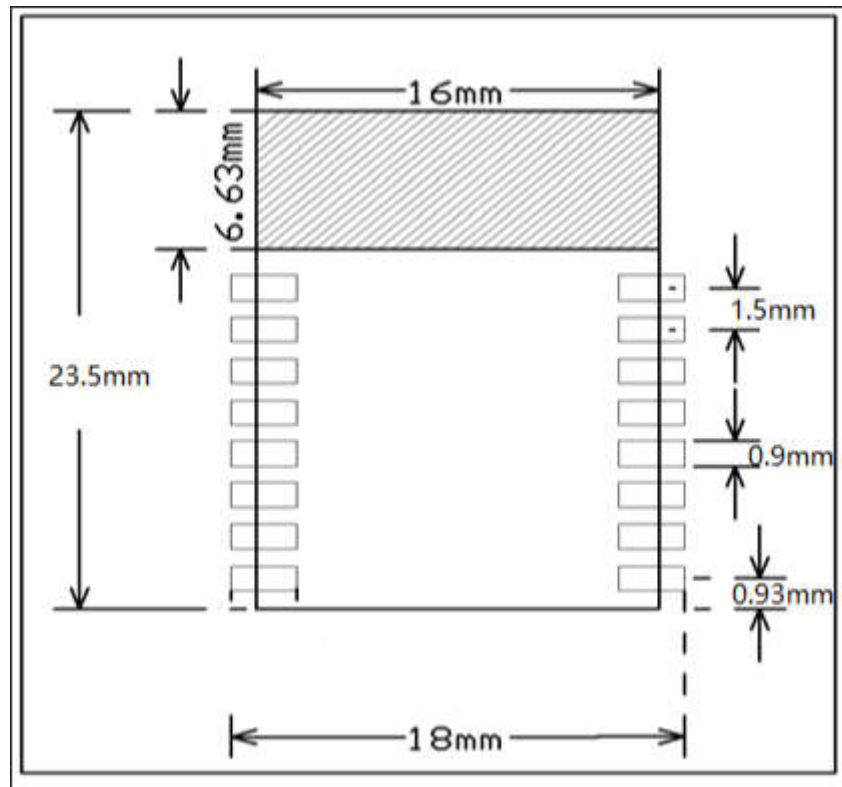
6.2 Recommended PCB Layout

Figure 6-3 Layout of the PCB to which WB1S applies

Note: The default dimensional tolerance is ±0.3 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.
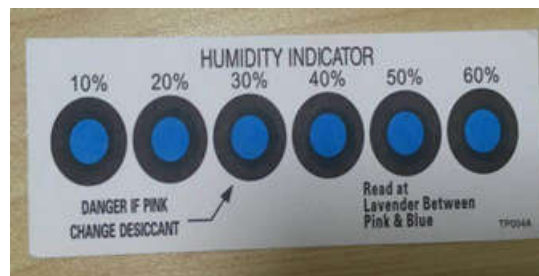
(3) The package contains a humidity indicator card (HIC).

Figure 6-4 HIC for WB1S

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

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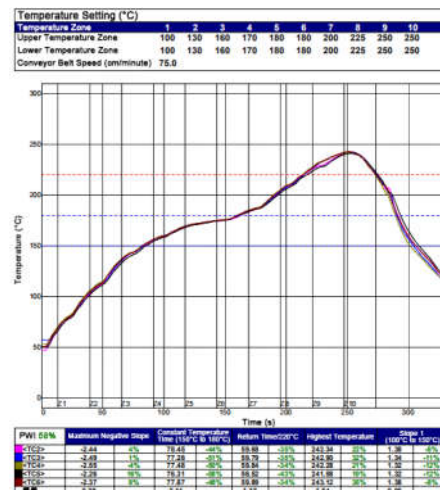

Figure 6-5 Oven temperature curve

6.5 Storage Conditions

CAUTION
This bag contains
MOISTURE-SENSITIVE DEVICES

LEVEL 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 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-WB1S.The final end product must be labeled in a visible area with the following: "Contains Transmitter Module FCC ID:2ANDL-WB1S"

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.