

## 1 Product Overview

XR3 is a low-power embedded Wi-Fi module that Tuya has developed. It consists of a highly integrated RF chip (XR809) and several peripheral components, with an embedded Wi-Fi network protocol stack and robust library functions. XR3 is embedded with an Arm Cortex-M4F CPU, 2 MB flash read-only memory (ROM), and 384 KB static random-access memory (SRAM), and has extensive peripherals.

XR3 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

- ✧ Clock rate: 160 MHz
- ✧ Working voltage: 2.7 V to 5.5 V
- ✧ Peripherals: two universal asynchronous receivers/transmitters (UARTs)
- ✧ Wi-Fi connectivity
  - 802.11b/g/n
  - Channels 1 to 14 at 2.4 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
  - 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	2019-10-14	This is the first release.	2.0.0
2	2020-01-13	Change Electrical parameters	2.0.1
3	2020-03-19	Update RF parameters	2.0.2

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## 2 Module Interfaces

### 2.1 Dimensions and Footprint

XR3 has three rows of 22 pins with a 2 mm pin spacing.

The XR3 dimensions (H x W x D) are 3.3±0.15 mm x 16±0.3 mm x 24±0.3 mm. The PCB thickness is 0.8±0.1 mm. The shield cover height is 2.5±0.05 mm. Figure 1-1 shows the XR3 front and rear views.

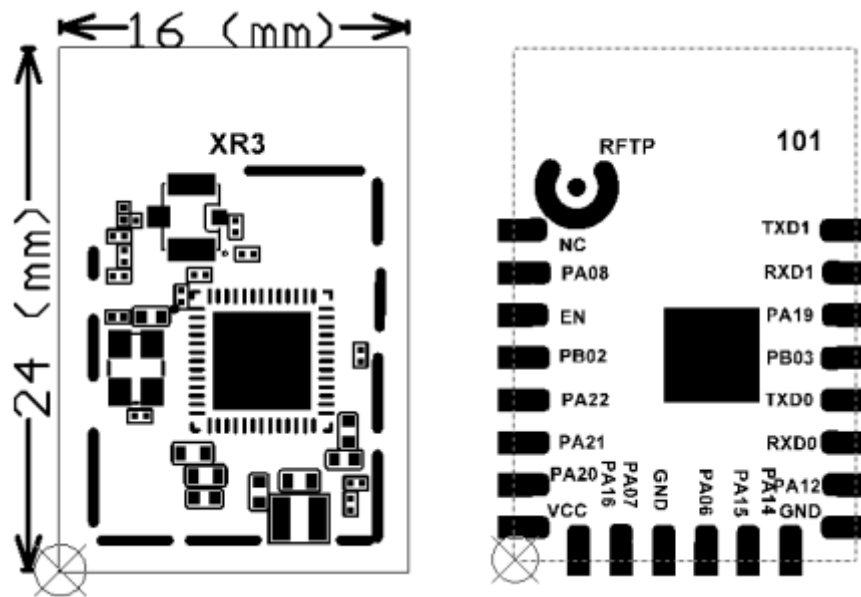


Figure 1-1 XR3 front and rear views

### 2.2 Interface Pin Definition

Table 2-1 XR3 interface pins

Pin No.	Symbol	I/O Type	Function
1	NC	N/A	N/A
2	ADC	AI	ADC pin (See the following Note 2.)
3	EN	I/O	Enable/Reset pin (This pin is active at a high level, and is at a high level by default.)
4	PB02	I/O	PB02

Pin No.	Symbol	I/O Type	Function
5	PA22	I/O	PA22
6	PA21	I/O	PA21
7	PA20	I/O	PA20
8	VCC	P	Power input pin (3.3 V)
9	PA16	I/O	PA16
10	PA07	I/O	PA07
11	GND	P	Power supply reference ground pin
12	PA06	I/O	PA06
13	PA15	I/O	PA15
14	PA14	I/O	PA14
15	GND	P	Power supply reference ground pin
16	PA12	I/O	PA12
17	RXD0	I/O	Can be used as a debugging serial interface pin, connect with UART-RX
18	TXD0	I/O	Can be used as a debugging serial interface pin, connect with UART-TX
19	PB03	I/O	PB03 (PB03 and PB02 cannot be pulled down simultaneously.)
20	PA19	I/O	PA19
21	RXD	I/O	User UART_RX, connect with UART-TX
22	TXD	I/O	User UART_TX, connect with UART-RX

**Note:**

1. **P** indicates power supply pins, **I/O** indicates input/output pins, and **AI** indicates analog input pins.
2. This Pin2 can be used as an ADC input. If this pin is not used, it must be disconnected. When this pin is used as an ADC input, the input voltage range is 0 V to 2.5 V.
3. During firmware burning, both PB02 and PB03 need to be connected to a low level. When the module works properly, PB02 and PB03 cannot be connected to a low level

simultaneously.



### 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	125	°C
VCC	Power supply voltage	-0.3	5.8	V
Static electricity voltage (human body model)	Tamb = 25°C	N/A	4	kV
Static electricity voltage (machine model)	Tamb = 25°C	N/A	0.8	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	2.7	3.3	5.5	V
V <sub>IL</sub>	I/O low-level input	-0.3	N/A	1.32	V
V <sub>IH</sub>	I/O high-level input	2.06	N/A	3.6	V
V <sub>OL</sub>	I/O low-level output	-0.3	N/A	0.4	V
V <sub>OH</sub>	I/O high-level output	2.9	N/A	3.3	V
I <sub>max</sub>	I/O drive current	-40	N/A	40	mA
R <sub>pu</sub>	IO input pull-up resistance	40	-	110	KΩ
R <sub>pd</sub>	IO input pull-down resistance	40	-	110	KΩ

### 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	+14 dBm	155	mA
	802.11g	54 Mbit/s	+13.5 dBm	136	mA
	802.11n	MCS0	+13 dBm	144	mA
	802.11n	MCS7	+13 dBm	140	mA
RX	802.11b	11 Mbit/s	Constant receiving	34	mA
	802.11g	54 Mbit/s	Constant receiving	34	mA
	802.11n	MCS7	Constant receiving	34	mA

### 3.4 Working Current

Table 3-4 XR3 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.	50	179	mA
AP	The module is in AP mode, and the Wi-Fi indicator blinks slowly.	87	184	mA
Connected	The module is connected to the network, and the Wi-Fi indicator is steady on.	36	130	mA
Disconnected	The module is disconnected from the network, and the Wi-Fi indicator is steady off.	40	186	mA

## 4 RF Features

### 4.1 Basic RF Features

Table 4-1 Basic RF features

Parameter	Description
Frequency band	2.412 GHz to 2.4835 GHz
Wi-Fi standard	IEEE 802.11b/g/n (channels 1 to 14)
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 with a gain of 1.5 dBi (default)

### 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	14	N/A	dBm
Average RF output power, 802.11g OFDM mode	54 Mbit/s	N/A	13.5	N/A	dBm
Average RF output power, 802.11n OFDM mode	MCS7	N/A	13	N/A	dBm
Frequency error		-15	N/A	+15	ppm
EVM under 802.11b CCK, 11 Mbit/s, 17.5 dBm			-15		dB
EVM under 802.11g OFDM, 54 Mbit/s, 15.0 dBm			-29		dB
EVM under 802.11n OFDM, MCS7, 14.0 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	-89	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

XR3 supports an onboard PCB antenna or external antenna. By default, XR3 uses an onboard PCB antenna.

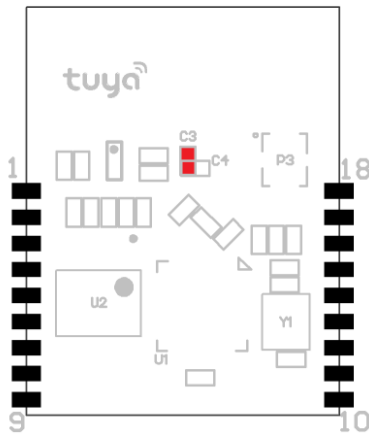


Figure 5-1 Resistor connection with the module that uses an onboard antenna

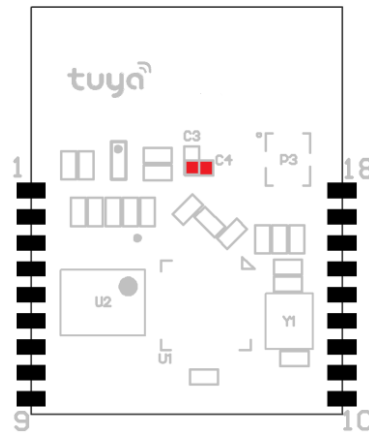
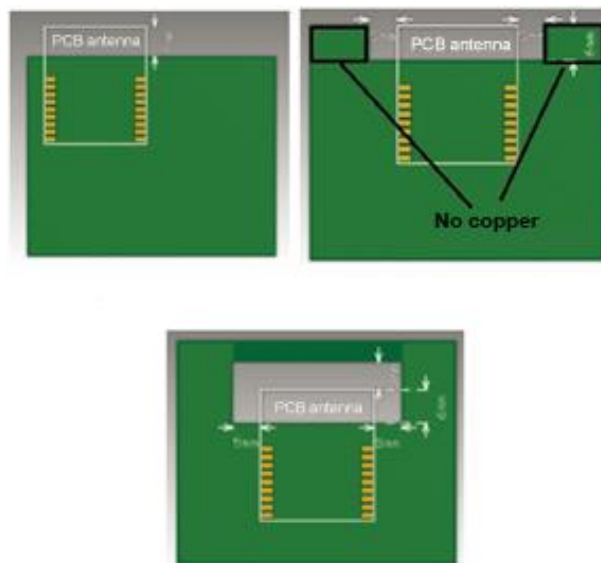


Figure 5-2 Resistor connection with the module that uses an external antenna

## 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. 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 5-3 Antenna clearance part**

For details about the onboard PCB antenna area on XR3, see Figure 6-1.

## 6 Packaging Information and Production Instructions

### 6.1 Mechanical Dimensions

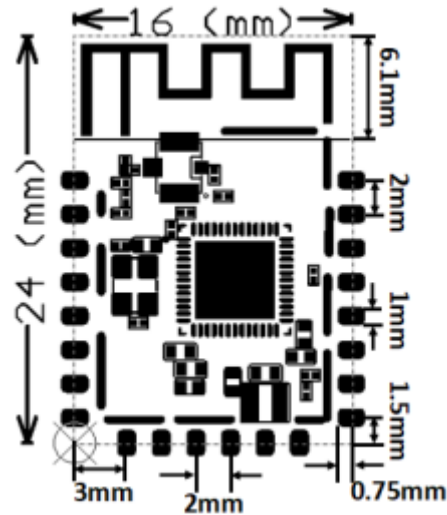


Figure 6-1 XR3 mechanical dimensions

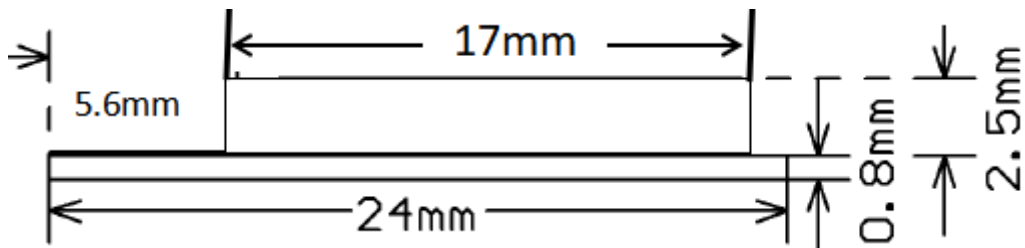


Figure 6-2 Side view

## 6.2 Recommended PCB Layout

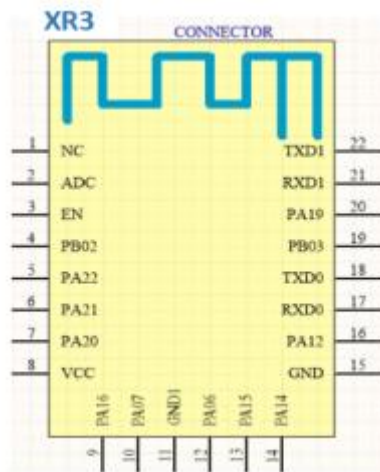


Figure 6-3 XR3 pins

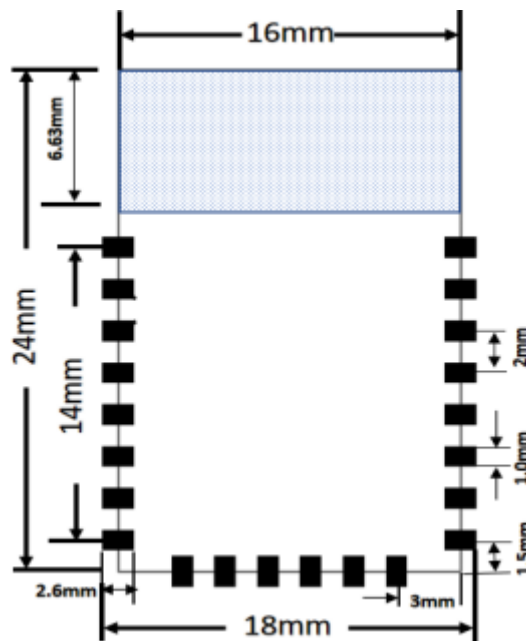


Figure 6-4 Layout of the PCB to which XR3 applies

## 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).

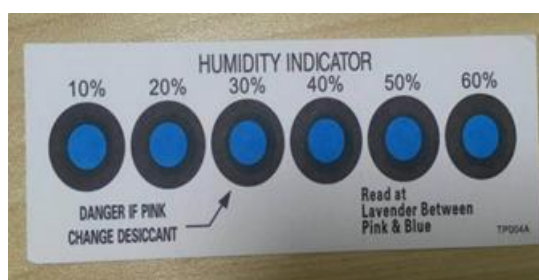


Figure 6-5 HIC for XR3



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:  $125\pm 5^{\circ}\text{C}$
  - (2) Alarm temperature:  $130^{\circ}\text{C}$
  - (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  $245^{\circ}\text{C}$ .

Based on the IPC/JEDEC standard, perform reflow soldering on a module at most twice.

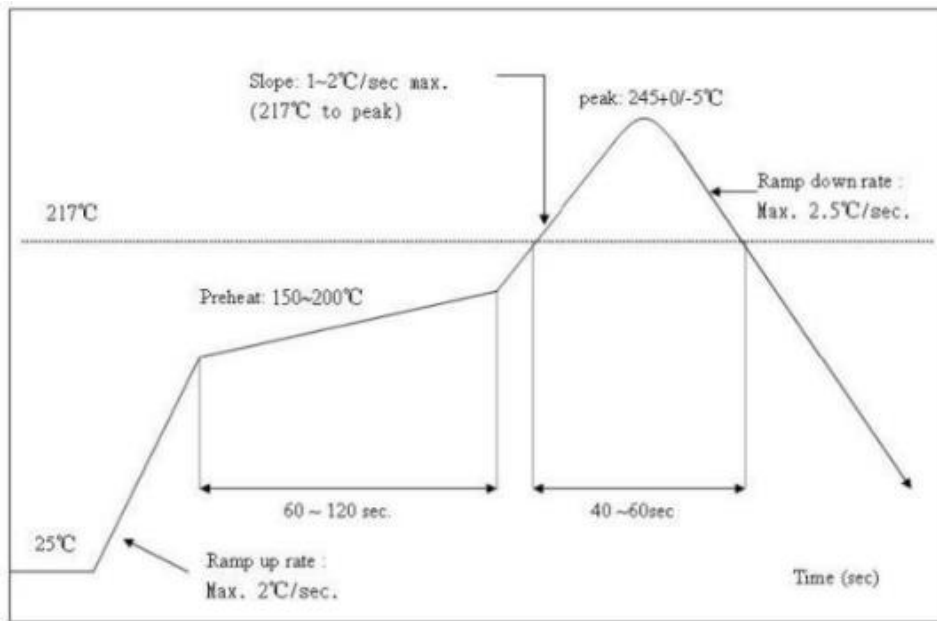


Figure 6-6 Oven temperature curve

## 6.5 Storage Conditions

	<p><b>CAUTION</b> This bag contains <b>MOISTURE-SENSITIVE DEVICES</b></p>	<p><b>LEVEL</b> <b>3</b></p>
	<p><i>if Blank, see adjacent bar code label</i></p>	
<p>1. Calculated shelf life in sealed bag: 12 months at &lt; 40°C and &lt; 90% relative humidity (RH)</p>		
<p>2. Peak package body temperature: _____ 260 _____ °C <i>if Blank, see adjacent bar code label</i></p>		
<p>3. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must</p>		
<p>a) Mounted within: _____ 168 _____ hrs. of factory conditions <i>if Blank, see adjacent bar code label</i></p>		
<p>≤ 30°C/60%RH, OR</p>		
<p>b) Stored at &lt;10% RH</p>		
<p>4. Devices require bake, before mounting, if:</p>		
<p>a) Humidity Indicator Card is &gt; 10% when read at 23 ± 5°C</p>		
<p>b) 3a or 3b not met.</p>		
<p>5. If baking is required, devices may be baked for 48 hrs. at 125 ± 5°C</p>		
<p>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</p>		
<p>Bag Seal Date: _____ <i>if Blank, see adjacent bar code label</i></p>		
<p>Note: Level and body temperature defined by IPC/JEDEC J-STD-020</p>		

## 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-XR3.The final end product must be labeled in a visible area with the following: “Contains Transmitter Module FCC ID:2ANDL-XR3”

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.