WR3E Module Datasheet

Hardware Product Development > Network Modules > Wi-Fi Module >

WR Series Module

Version: 20201215

Contents

WR3E is a low-power embedded Wi-Fi module that Tuya has developed. It consists of a highly integrated RF chip (RTL8710BN) and an external flash chip, with an embedded Wi-Fi network protocol stack and rich library functions.

1 Product overview

With the maximum CPU clock rate of 125 MHz, WR3E also contains a low-power ARM CM4F, a WLAN MAC, a 1T1R WLAN module, 256-KB static random-access memory (SRAM), 2-MB flash memory, and rich peripherals.

WR3E is an RTOS platform that integrates all function libraries of the Wi-Fi MAC and TCP/IP. 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
- The clock rate: 125 MHz
- Working voltage: 3.0 to 3.6 V
- Peripherals: 7 general-purpose input/output (GPIO), 2 universal asynchronous receiver/transmitters (UART), and 1 analog to digital converter (ADC)
- Wi-Fi connectivity

    - 802.11 B/G/N20/N40
    - Channels 1 to 14@2.4 GHz

    - Support WPA/WPA2 security mode
    - Up to + 20dBm output power in 802.11b mode
    - Support SmartConfig functions for Android and iOS devices
    - Onboard PCB antenna with a gain of 2.5 dBi
    - Passed CE, FCC, and SRRC certifications
    - Working temperature: -20℃ to 85℃

1.2 Applications

- Intelligent building
- Smart household and home appliances
- Medical health care
- Industrial wireless control
- Baby monitor
- Network camera
- Intelligent bus

1.3 Change history

Update date	Updated content	Version after update
01/28/2019	This is the first release.	1.0.0
06/22/2019	Updated the tolerance of the module	1.0.1
09/21/2019	Updated the instructions on the production process	1.0.2
04/13/2020	Updated the data of power consumption	1.0.3

2 Module interfaces

2.1 Dimensions and package

WR3E has two rows of pins with a 2.0 mm pin spacing. Each row has 8 pins. The WR3E dimensions are 16±0.35 mm (W)×24±0.35 mm (L)× 3.4±0.15 mm (H). The thickness of the PCB is 0.8 ± 0.1 mm. The shield case is 2.5±0.05 mm.
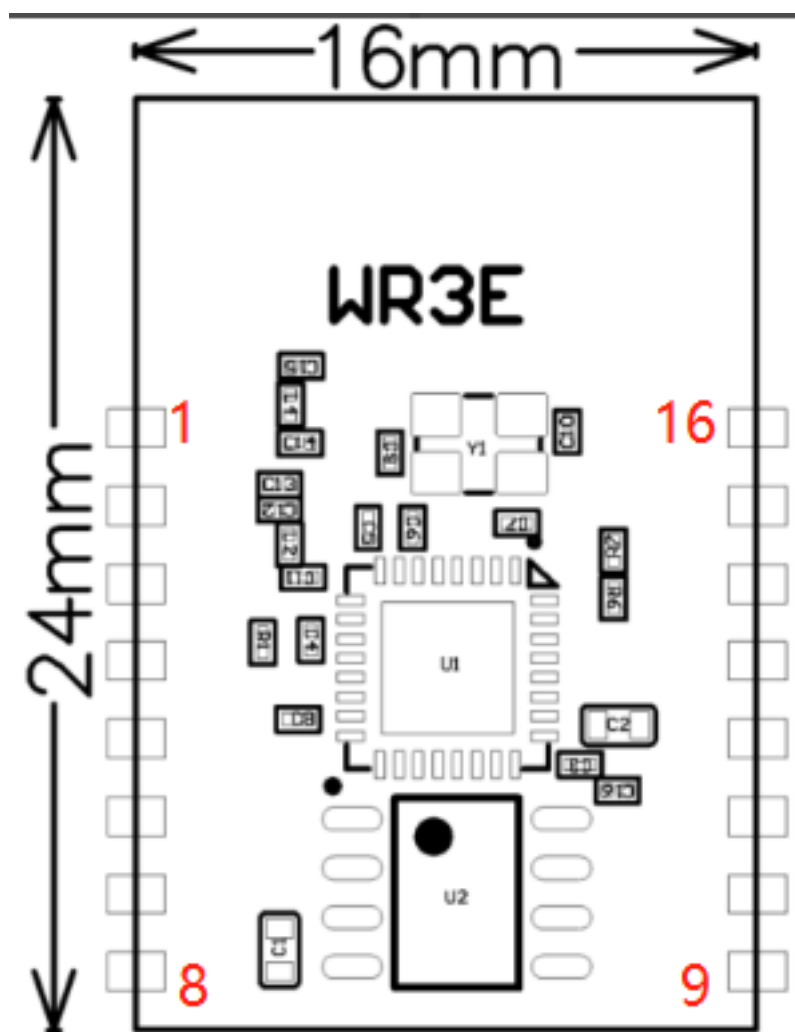
2.2 Pin definition

Descriptions on the arrangement of pins of WR3E:

Pin number	Symbol	I/O type	Function
1	NC	/	Pulled up and not connected, to be compatible with other modules

Pin number	Symbol	I/O type	Function
2	ADC	AI	ADC port, the maximum input voltage is 5V
3	CHIP_EN	I/O	When software disables the function, connection by a user fails
4	GPIOA_29	I/O	UART_Log_RXD (used to print the internal information of the module), which can be configured as a universal GPIO. The module has been pulled up and cannot be used for triggering the high level
5	GPIOA_14	I/O	GPIOA_14, hardware PWM, Pin 13 of the IC
6	GPIOA_15	I/O	GPIOA_15, hardware PWM, Pin 14 of the IC
7	GPIOA_22	I/O	GPIOA_22, hardware PWM, Pin 31 of the IC
8	VCC	P	Power supply pin (3.3V)

Pin number	Symbol	I/O type	Function
9	GND	P	Power supply reference ground
10	GPIOA_0	I/O	GPIOA_0, which cannot be pulled high when powered on, and which is configurable after the level is pulled to be high, hardware PWM, Pin 16 of the IC
11	GPIOA_30	I/O	UART_Log_TXD (used to print the internal information of the module), which can be configured as a universal GPIO
12	GPIOA_19	I/O	GPIOA_19, a universal I/O port, Pin 30 of the IC
13	GPIOA_5	I/O	GPIOA_5, hardware PWM, Pin 28 of the IC
14	GPIOA_12	I/O	GPIOA_12, hardware PWM, Pin 17 of the IC
15	RXD	I/O	UART0_RXD (user-side serial interface)

Pin number	Symbol	I/O type	Function
16	TXD	I/O	UART0_TXD (user-side serial interface)

Note: P indicates a power supply pin, I/O indicates an input/output pin and AI indicates an analog input pin.

3 Electrical parameters

3.1 Absolute electrical parameters

Parameter	Description	Minimum value	Maximum Value	Unit
Ts	Storage temperature	-40	105	℃
VCC	Power supply voltage	-0.3	3.6	V
Static electricity discharge (human body model)	TAMB-25℃	-	2	kV
Static electricity discharge (machine model)	TAMB-25℃	-	0.5	kV

3.2 Working conditions

Parameter	Description	Minimum value	Typical value	Maximum value	Unit
Ta	Working temperature	-20	-	85	℃
VDD	Working voltage	3.0	-	3.6	V

Parameter	Description	Minimum value	Typical value	Maximum value	Unit
VIL	I/O low level input	-0.3	-	VDD*0.25	V
VIH	I/O high level input	VDD*0.75	-	3.6	V
VOL	I/O low level output	-	-	VDD*0.1	V
VOH	I/O high level output	VDD*0.8	-	VDD	V
Imax	I/O drive current	-	-	16	mA
Cpad	Input pin capacitance	-	2	-	pF

3.3 RF power consumption

Working status	Mode	Rate	Transmit power/Receive	Average value	Peak value (Typical value)	Unit
Transmit	11b	11Mbps	+17dBm	287	367	mA
Transmit	11b	11Mbps	+18dBm	295	382	mA
Transmit	11g	54Mbps	+15dBm	255	406	mA
Transmit	11g	54Mbps	+17.5dBm	267	428	mA
Transmit	11n-HT20	MCS7	13dBm	244	395	mA
Transmit	11n-HT20	MCS7	16.5dBm	257	422	mA

Working status	Mode	Rate	Transmit power/Receive	Average value	Peak value (Typical value)	Unit
Transmit	11n-HT40	MCS7	13dBm	220	393	mA
Transmit	11n-HT40	MCS7	16.5dBm	230	420	mA

RX power consumption:

Symbol	Mode	Average value	Unit
Receive	CPU Sleep	90	mA
Receive	CPU Active	120	mA

3.4 Working power consumption

Working mode	Working status, TA = 25°C	Average value	Peak value (Typical value)	Unit
Quick network connection state	The module is in the fast network connection state and the Wi-Fi indicator flashes fast	115	376	mA

Working mode	Working status, TA = 25°C	Average value	Peak value (Typical value)	Unit
Hotspot network configuration state	The module is in the hotspot network configuration state and the Wi-Fi indicator flashes slowly	60	386	mA
Network connection idle state	The module is connected to the network and the Wi-Fi indicator is always on	105	389	mA
Network connection operation state	The module is connected to the network and the Wi-Fi indicator is always on	105	389	mA
Disconnected state	The module is disconnected and the Wi-Fi indicator is dark	45	381	mA

Note: The peak value lasts about 5us. The above parameters may vary with firmware functions.

4 RF parameters

4.1 Basic RF features

Parameter	Description
Working frequency	2.412 to 2.484 GHz
Wi-Fi standard	IEEE 802.11n/g/n (channels 1 to 14)
Data transmission rate	11b: 1, 2, 5.5, 11 (Mbps)
	11g: 6, 9, 12, 18, 24, 36, 48, 54 (Mbps)
	11n: HT20 MCS0 to 7
	11n: HT40 MCS0 to 7
Antenna type	PCB antenna with a gain of 2.5 dBi

4.2 TX performance

Parameter	Minimum value	Typical value	Maximum value	Unit
Average RF output power, 802.11b CCK Mode 11M	-	17.5	-	dBm
Average RF output power, 802.11g OFDM Mode 54M	-	14.5	-	dBm

Parameter	Minimum value	Typical value	Maximum value	Unit	
Average RF output power, 802.11n OFDM Mode MCS7	-	13.5	-	dBm	
Frequency error	-20	-	-20	ppm	
EVM@802.11 CCK 11Mbps Mode 17.5dBm	-	-16	-		dB
EVM@802.11g OFDM 54Mbps Mode 15.0dBm		-30	-		dB
EVM@802.11 OFDM MCS7 Mode 14.0dBm	-	-31	-		dB

4.3 RX performance

| Parameter	Minimum value	Typical value	Maximum value	Unit
PER<8%, RX sensitivity, 802.11b CCK Mode 11M	-	-91	-	dBm
PER<10%, RX sensitivity, 802.11g OFDM Mode 54M	-	-75	-	dBm
PER<10%, RX sensitivity, 802.11n OFDM Mode MCS7	-	-72	-	dBm

5 Antenna information

5.1 Antenna type

By default, WR3E uses only the onboard PCB antenna.

5.2 Antenna interference reduction

To ensure the 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. The main points of the layout: 1. Make sure that there is no substrate medium directly below or above the printed antenna. 2. Make sure that the area around the printed antenna is far away from copper, so as to ensure the radiation effect of the antenna to the greatest extent.
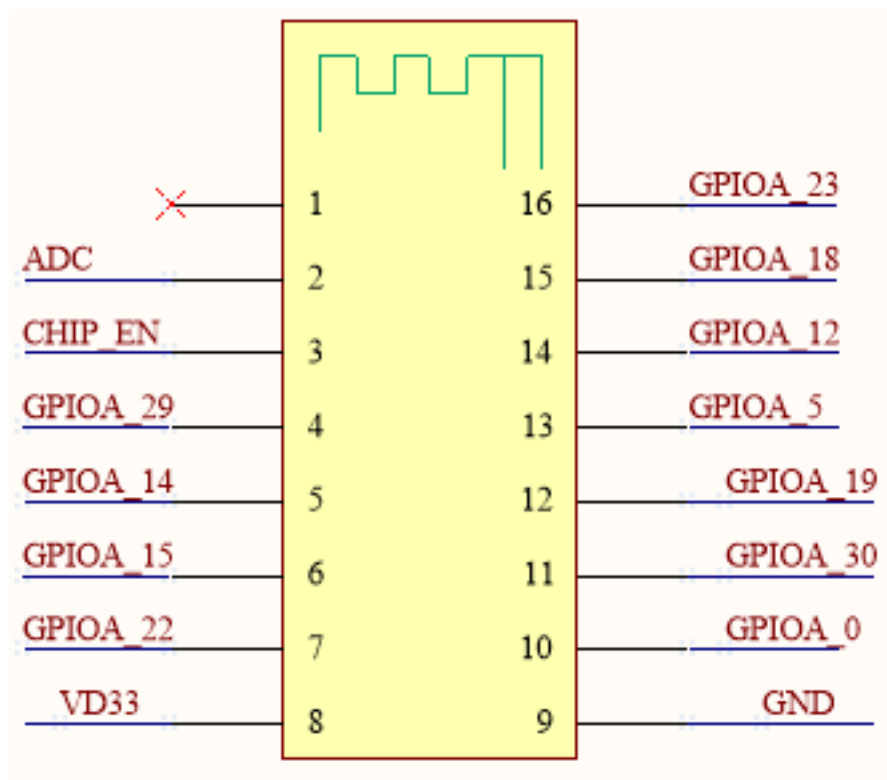
Don't cover the framed areas with copper
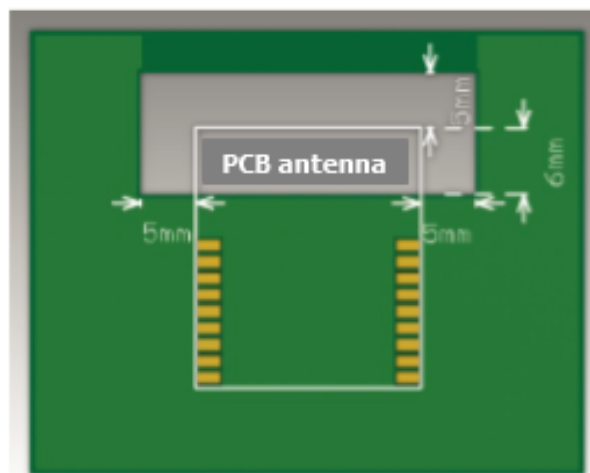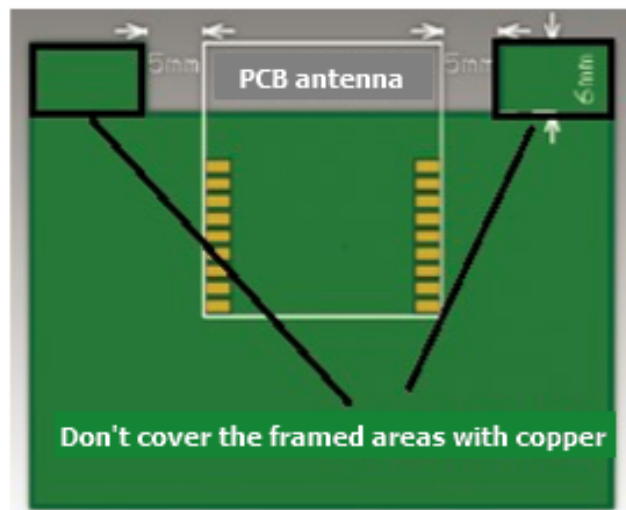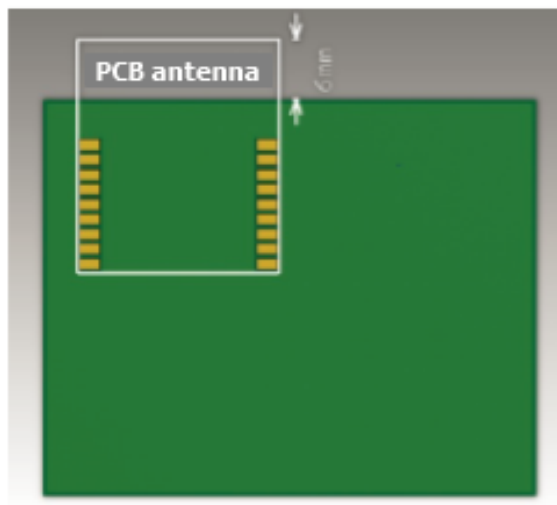
6 Packaging information and production instructions

6.1 Mechanical dimensions
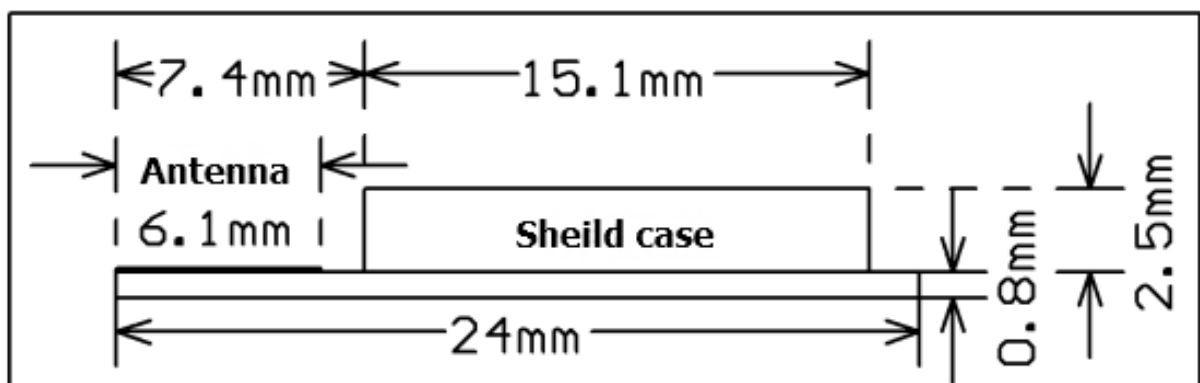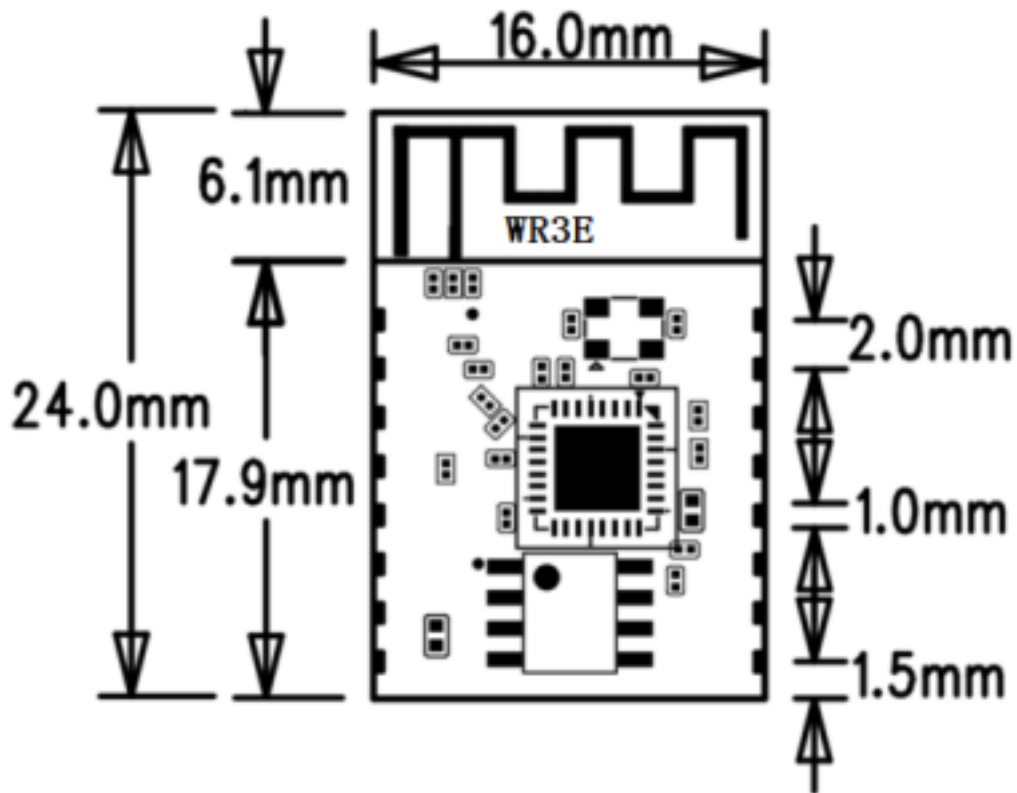
## 6.2 Recommended PCB packaging

6.3 Production instructions

1. Mount Tuya's stamp hole package module with an SMT machine within 24 hours after unpacking and burning the firmware. Otherwise, the module must be packaged again under vacuum. The module must be baked before mounting.

   - SMT equipment:

- Reflow soldering machine
- Automated optical inspection (AOI) equipment
- Nozzle with a 6 to 8 mm diameter

- Baking equipment:
  - Cabinet oven
  - Anti-static heat-resistant trays
  - Anti-static heat-resistant gloves

2. Storage conditions for a delivered module are as follows:

   - The moisture-proof bag must be placed in the environment where the temperature is below 30°C and the relative humidity is lower than 70%.
   - The shelf life of a dry-packaged product is 6 months from the date when the product is packaged and sealed.
   - The package contains a humidity indicator card (HIC).
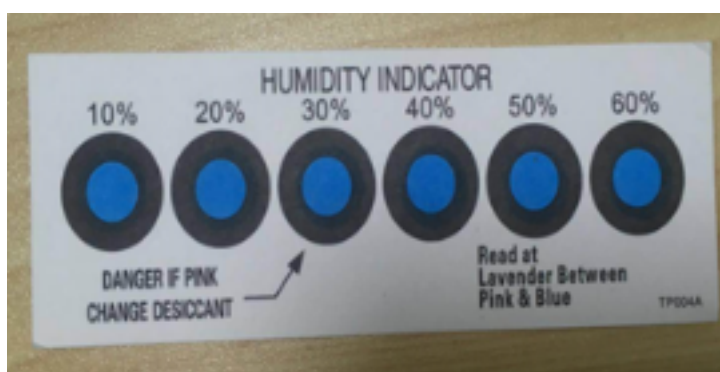
1. Bake a module based on HIC status as follows when you unpack the module package:

   - If the 30%, 40%, and 50% circles are blue, bake the module for 2 consecutive hours.
   - If the 30% circle is pink, bake the module for 4 consecutive hours.
   - If the 30% and 40% circles are pink, bake the module for 6 consecutive hours.
   - If the 30%, 40%, and 50% circles are pink, bake the module for 12 consecutive hours.
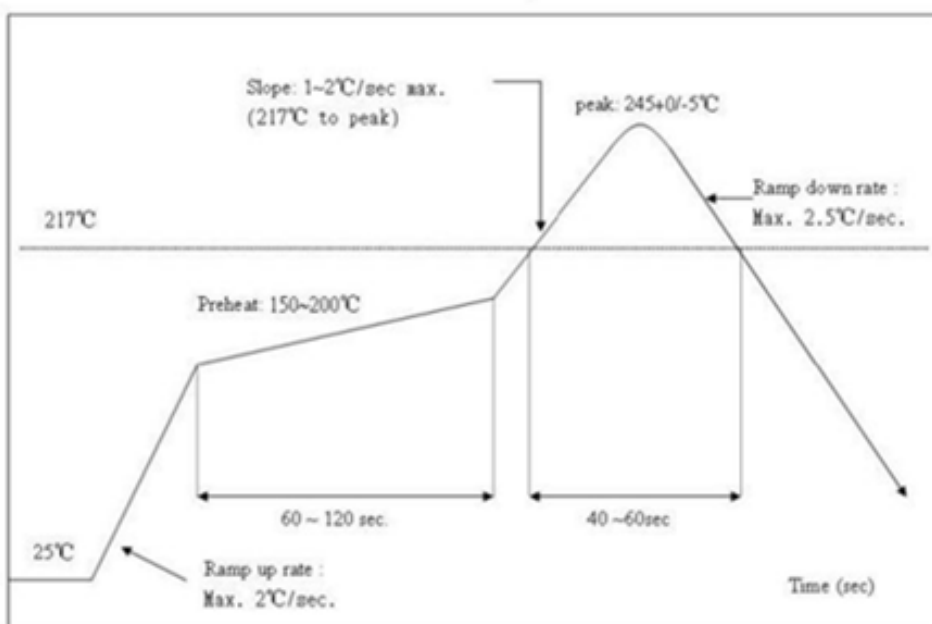
2. Baking settings:

   - Baking temperature: 125±5°C
   - Alarm temperature: 130°C

- SMT ready temperature: naturally cooling temperature: < 36°C
- The number of drying times: 1
- Rebaking condition: The module is not soldered within 12 hours after baking.

3. Do not use SMT to process modules that have been unpacked for more than 3 months, because electroless nickel/immersion gold (ENIG) is used for PCBs and they are seriously oxidized for over 3 months. SMT is very likely to cause pseudo and missing soldering. Tuya is not liable for such problems and consequences.

4. Before using SMT, take electrostatic discharge (ESD) protective measures.

5. To reduce the reflow defect rate, draw 10% of the products for visual inspection and AOI before the first mounting to determine proper methods for controlling the oven temperature and attaching and placing components. Draw 5 to 10 modules from subsequent batches each hour for visual inspection and AOI.

6.4 Recommended oven temperature curve

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

Refer to IPC/JEDEC standard ; Peak Temperature : <**245**°C ; Number of Times: ≤2 times ;

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

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this device.

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.
2. This device must accept any interference received, including interference that may cause undesired operation.

Note: This device has been tested and found to comply with the limits for a Class B digital device, according to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This device generates, uses, and can radiate radio frequency energy and, if not installed and used following 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 device does cause harmful interference to radio or television reception, which can be determined by turning the device 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 device and receiver.
- Connect the device 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 device complies with FCC radiation exposure limits set forth for an uncontrolled rolled environment. This device should be installed and operated with a minimum distance of 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 the host system except following FCC multi-transmitter product procedures. Additional testing and device authorization may be required to operate simultaneously with other radios.

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 with 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/warnings 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 has got an FCC ID: 2ANDL-WR3E. The end product must be labeled in a visible area with the following: "Contains Transmitter Module FCC ID: 2ANDL-WR3E".

This device is intended only for OEM integrators under the following conditions: 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 the 2 conditions above are met, further transmitter tests 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 the 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.