

## 1. Product Overview

WRG1 is a low power-consuming built-in Wi-Fi module developed by Hangzhou Tuya Information Technology Co., Ltd. It consists of a highly integrated radio frequency chip (RTL8711AM) and an external flash chip, with a built-in Wi-Fi network protocol stack and robust library functions. WRG1 also contains a low power-consuming ARM-Cortex M3 MCU, a WLAN MAC, a 1T1R WLAN, and the maximum basic frequency of 166 MHz, and is embedded with a 2MB SDRAM, 4Mbyte flash, and robust peripheral resources.

WRG1 is an RTOS platform that integrates all the function libraries of the Wi-Fi MAC and TCP/IP protocols. You can develop built-in Wi-Fi products as required.

### 1.1 Features

Built-in low power-consuming 32-bit CPU functioning as an application processor

- Basic frequency: 166 MHz
- ◇ Working voltage: 3 V to 3.6 V
- ◇ Peripherals: ten GPIOs, two UARTs, and one ADC
- ◇ Wi-Fi connectivity
  - 802.11 B/G/N20/N40
  - Channels 1-11@2.4GHz
  - Supports WPA/WPA2 safe modes
  - SmartConfig mode (for Android and iOS devices)
  - Passing the CE, FCC, and SRRC certification
  - Working temperature: -20°C to +85°C

### 1.2 Major Application Fields

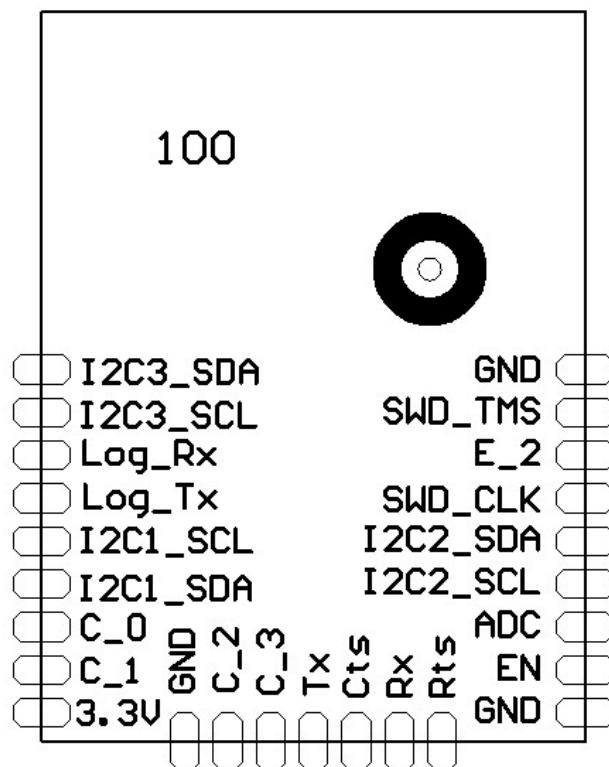
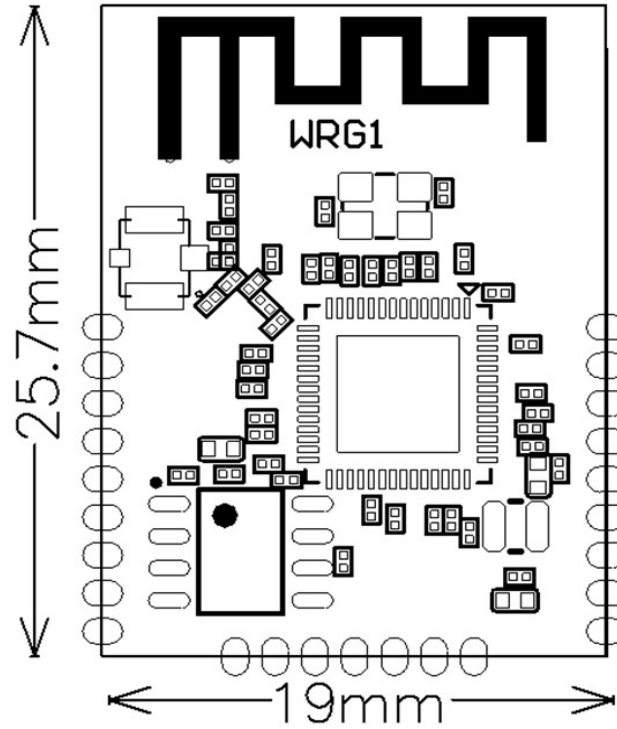
- ◇ Intelligent building
- ◇ Intelligent home and household appliances
- ◇ Healthcare
- ◇ Industrial wireless control
- ◇ Baby monitors
- ◇ Network camera
- ◇ Intelligent bus

## 2. Module Interfaces

### 2.1 Dimensions and Pin Layout

WRG1 provides three rows of pins with the distance of 1.5 mm between every two pins.

WRG1 dimensions: 19±0.25 mm (W) x 25.7±0.25 mm (L) x 3.6±0.2 mm (H)



## 2.2 Pin definition

Table 2.1 describes the common pins.

**Table 2.1, WRG1 pins description**

No.	Symbol	I/OType	Function
1	GND	P	Power Reference Ground
2	SWD_TMS	AI	GPIOE_3, JTAG_TMS, used as JLink Burning foot
3	E_2	I	GPIOE_2, if E3/E4 configured to JTAG, the foot is not configurable to GPIO.
4	SWD_CLK	I/O	GPIOE_4, JTAG_CLK, used as JLink Burning foot
5	I2C2_SDA	I/O	GPIOE_1, if E3/E4 configured to JTAG, the foot is not configurable to GPIO.
6	I2C2_SCL	I/O	GPIOE_0, if E3/E4 configured to JTAG, the foot is not configurable to GPIO.
7	ADC	AI	ADC port <sup>(1)</sup> , 16-bit accuracy ADC
8	EN	P	Module enabling foot, normal use needs to be connected to 3.3V, module has been pulled up
9	GND	P	Power Reference Ground
10	Rts	I/O	GPIOA_3, Flow control send request foot, if A6/A7 is configured as UART0, the foot is not configurable to GPIO.
11	Rx	I/O	GPIOA_6, UART0_Rx, User docking serial port
12	Cts	I/O	GPIOA_5, Flow control sending allowable foot, if A6/A7 configured to UART0, the foot is not configurable to GPIO.
13	Tx	I/O	GPIOA_7, UART0_Tx, User docking serial port
14	C_3	I/O	GPIOC_3, hardware PWM3
15	C_2	I/O	GPIOC_2, hardware PWM2
16	GND	P	Power Reference Ground
17	3.3V	P	Power pin of module (3.3V)
18	C_1	I/O	GPIOC_1, hardware PWM1
19	C_0	I/O	GPIOC_0, hardware PWM0
20	I2C1_SDA	I/O	GPIOC_4, the foot is not configurable to I2C or GPIO
21	I2C1_SCL	I/O	GPIOC_5, can be configurable to I2C or GPIO
22	Log_Tx	I/O	GPIOB_0, Log Tx, Serial port print information pin, can not connect high level
23	Log_Rx	I/O	GPIOB_1, Log Rx, Serial port printing information pin
24	I2C3_SCL	I/O	GPIOB_2, can be configurable to I2C or GPIO
25	I2C3_SDA	I/O	GPIOB_3, can be configurable to I2C or GPIO

Note: P indicates power-supply pins, I/O indicates input/output pins

(1)The pin can only be used as ADC port, not ordinary IO port. When not in use, it needs to be suspended.

As the input port of ADC, the range of input voltage is limited to 0-3.3V.

(2)UART0 is the user serial port. When the module is powered on and started, the serial port has information output, which can be ignored by the user.

### 3. Electrical Parameters

#### 3.1 Absolute electrical parameters

**Table 3.1, Absolute Parameters**

Parameters	Description	Minimum value	Maximum value	Unit
Ts	Storage temperature	-40	105	°C
VDD	Power-supply voltage	-0.3	3.6	V
Static electricity voltage (human model)	TAMB – 25°C	-	2	kV
Static electricity voltage (machine model)	TAMB – 25°C	-	0.5	kV

#### 3.2 Electrical Conditions

**Table 3.2 Normal electrical conditions**

Parameters	Description	Min	Typ	Max	Unit
Ta	Working temperature	-20	-	85	°C
VDD	Working voltage	3.0	3.3	3.6	V
VIL	I/O low-level input	-	-	0.8	V
VIH	I/O high-level input	2.0	-	-	V
VOL	I/O low-level output	-	-	0.4	V
VOH	I/O high-level output	2.4	-	-	V
Imax	I/O drive current	-	-	16	mA
Cpad	Input pin capacitance	-	2	-	pF

### 3.3 Wi-Fi TX power consumption

**Table 3.3 TX power during constant emission**

<b>Symbol</b>	<b>Mode</b>	<b>Power</b>	<b>Typ</b>	<b>Unit</b>
IRF	11b 11 Mbit/s	22.13dBm	287	mA
IRF	11g 54 Mbit/s	25.18dBm	255	mA
IRF	11n BW20 MCS7	25.38 dBm	244	mA
IRF	11n BW40 MCS7	23.56dBm	230	mA

### 3.4 Wi-Fi RX power consumption

**Table 3.4 RX power during constant receiving**

<b>Symbol</b>	<b>Mode</b>	<b>Typ</b>	<b>Unit</b>
IRF	11b 11M (Pin=-60dBm)	68	mA
IRF	11n Mcs7 BW20 (Pin=-60dBm)	74	mA

### 3.5 Power consumption in operating mode

**Table 3.5, Module operating current**

Operation Mode	Operating condition, TA=25°C	Typ	Peak	Unit
EZ mode	The module is in the EZ state and the Wi-Fi indicator fast flashes.	135	170	mA
Idle mode	The module is in the connected state and the Wi-Fi indicator is steady on.	70	140	mA
Working mode	The module is in the connected state and the Wi-Fi indicator is steady on.	143	295	mA
Disconnection mode	The module is in the disconnected state and the Wi-Fi indicator is steady off.	52	115	mA

Notes: The peak period is approx. 5us.

The preceding parameter values vary depending on the firmware functions.

## 4. RF Characteristics

### 4.1 Basic RF characteristics

**Table 4.1, Basic RF characteristics**

Parameter	Description
Frequency band	2.412 GHz to 2.462 GHz
Wi-Fi standard	IEEE 802.11b/g/n20/n40 (channels 1 to 11)
Data transmission rate	11b:1,2,5.5, 11 (Mbps) 11g:6,9,12,18,24,36,48,54(Mbps) 11n:HT20 MCS0~7 11n:HT40 MCS0~7
Antenna type	PCB Antenna (default)

## 4.2 Wi-Fi Output Performance

**Table 4.2 TX power during constant emission**

Parameter		Min	Typ	Max	Unit
RF average output power, 802.11b CCK mode	11 Mbit/s	-	22.13	-	dBm
RF average output power, 802.11g OFDM mode	54 Mbit/s	-	25.18	-	dBm
RF average output power, 802.11n20 OFDM mode	MCS7	-	25.38	-	dBm
RF average output power, 802.11n40 OFDM mode	MCS7		23.56		dBm
Frequency error		-20		20	ppm

## 4.3 Wi-Fi RX sensitivity

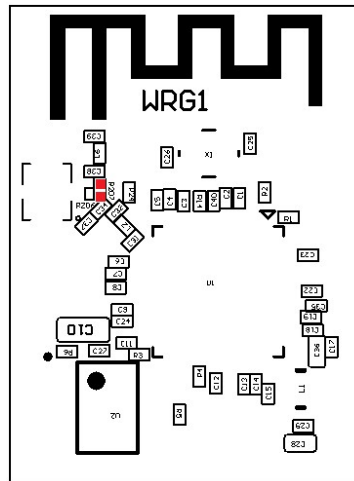
**Table 4.3,RX Sensitivity**

Parameter		Min	Typ	Max	Unit
PER < 8%, RX sensitivity, 802.11b CCK mode	11 Mbit/s	-	-93	-	dBm
PER < 10%, RX sensitivity, 802.11g OFDM mode	54 Mbit/s	-	-76	-	dBm
PER < 10%, RX sensitivity, 802.11n OFDM mode	MCS7	-	-73	-	dBm

## 5. Antenna Information

### 5.1 Antenna types

PCB board antenna .

**Figure 5.1 On-board antenna equipped with resistance position**


### 5.2 Antenna interference reduction

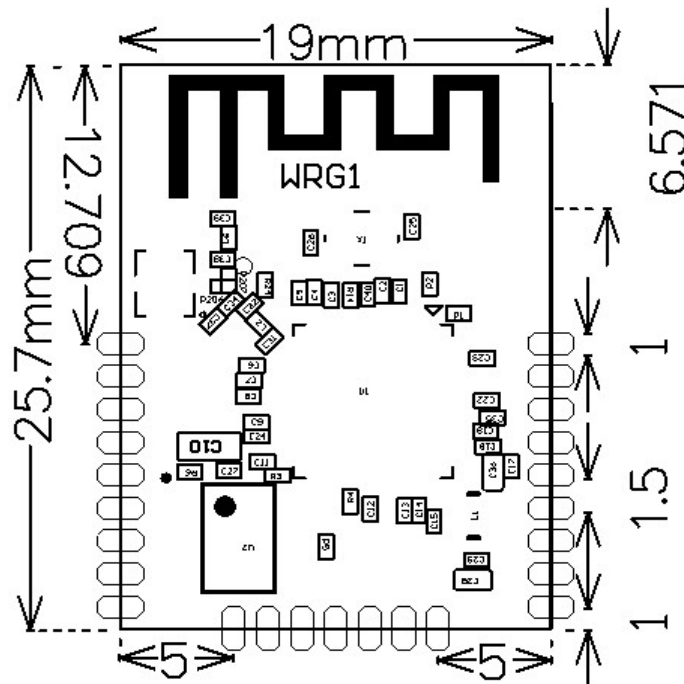
When using an onboard PCB antenna on a Wi-Fi module, make sure that the antenna on the module is at least 15 mm away from other metal parts to ensure optimal wireless performance.

## 6. Packaging information and production guidance

### 6.1 Mechanical dimensions

**Figure 6.1 Module dimensions**

Figure 6.1 Module elevation



## 6.2 Production Instructions

Storage conditions of a delivered module are as follows:

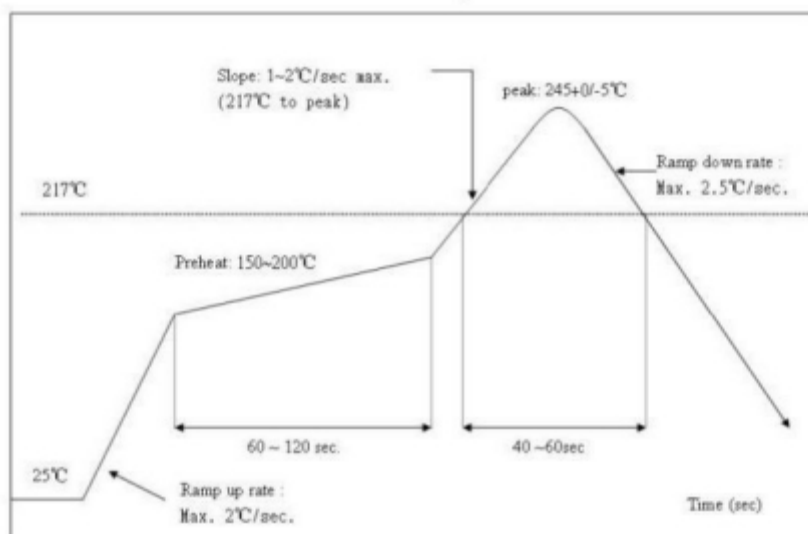
1. The anti-moisture bag must be placed in an environment where the temperature is under 30°C and the relative humidity is under 85%.
2. The shelf life of a dry-packaged product is six months from the date when the product is packaged and sealed.

Note:

1. Throughout the production process, each involved operator must wear an electrostatic ring.
2. During the operation, strictly protect the module from water and strains.

## 6.3 Recommended Oven Temperature Profile

Refer to IPC/JEDEC standard ; Peak Temperature : <math><250^{\circ}\text{C}</math> ; Number of Times :  $\leq 2</math> times ;$





## Regulatory Module Integration Instructions

### 2.2 List of applicable FCC rules

This device complies with part 15.247 of the FCC Rules.

### 2.3 Summarize the specific operational use conditions

This module can be used in household electrical appliances as well as lighting equipments. The input voltage to the module should be nominally 3.0~3.6 V<sub>DC</sub>, typical value 3.3V<sub>DC</sub> and the ambient temperature of the module should not exceed 85°C.

This module using only one kind of antennas with maximum gain is 2.5 dBi. Other antenna arrangement is not covered by this certification.

The antenna is not field replaceable. If the antenna needs to be changed, the certification should be re-applied.

### 2.4 Limited module procedures

Not applicable

### 2.5 Trace antenna designs

Not applicable

### 2.6 RF exposure considerations

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body. If the device built into a host as a portable usage, the additional RF exposure evaluation may be required as specified by § 2.1093.

## 2.7 Antennas

Module only contains one PCB antenna. No additional external connectors.

## 2.8 Label and compliance information

The outside of final products that contains this module device must display a label referring to the enclosed module. This exterior label can use wording such as: “Contains Transmitter Module FCC ID: 2ANDL-WRG1 ”,or “Contains FCC ID: 2ANDL-WRG1 ”, Any similar wording that expresses the same meaning may be used.

## 2.9 Information on test modes and additional testing requirements

a) The modular transmitter has been fully tested by the module grantee on the required number of channels, modulation types, and modes, it should not be necessary for the host installer to re-test all the available transmitter modes or settings. It is recommended that the host product manufacturer, installing the modular transmitter, perform some investigative measurements to confirm that the resulting composite system does not exceed the spurious emissions limits or band edge limits (e.g., where a different antenna may be causing additional emissions).

b) The testing should check for emissions that may occur due to the intermixing of emissions with the other transmitters, digital circuitry, or due to physical properties of the host product (enclosure). This investigation is especially important when integrating multiple modular transmitters where the certification is based on testing each of them in a stand-alone configuration. It is important to note that host product manufacturers should not assume that because the modular transmitter is certified that they do not

have any responsibility for final product compliance.

c) If the investigation indicates a compliance concern the host product manufacturer is obligated to mitigate the issue. Host products using a modular transmitter are subject to all the applicable individual technical rules as well as to the general conditions of operation in Sections 15.5, 15.15, and 15.29 to not cause interference. The operator of the host product will be obligated to stop operating the device until the interference has been corrected

Below are steps for TX verification :

```
wpriv mp_start //enter MP mode

iwpriv mp_channel 1 //set channel to 1 . 2, 3, 4~11 etc.

iwpriv mp_bandwidth 40M=0,shortGI=0 //40M=0 set 20M mode and long GI ,
                                     40M=1 set 40M mode

iwpriv mp_ant_tx a //select antenna A for operation

iwpriv mp_txpower patha=44,pathb=44 //set path A and path B Tx power level

iwpriv mp_rate 108 //set OFDM data rate to 54Mbps,ex:
CCK 1M = 2, CCK 5.5M = 11, KK, OFDM54M = 108 N Mode: MCS0 = 128, MCS1
= 129.....etc.

iwpriv mp_ctx background,pkt //start packet continuous Tx

iwpriv mp_ctx stop //stop continuous Tx
```

## 2.10 Additional testing, Part 15 subpart B disclaimer

The final host / module combination need to be evaluated against the FCC Part 15B criteria for unintentional radiators in order to be properly authorized for operation as a Part 15 digital device.

The host integrator installing this module into their product must ensure that the final composite product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operation and should refer to guidance in KDB 996369.

### **Frequency spectrum to be investigated**

For host products with certified modular transmitter, the frequency range of investigation of the composite system is specified by rule in Sections 15.33(a)(1) through (a)(3), or the range applicable to the digital device, as shown in Section 15.33(b)(1), whichever is the higher frequency range of investigation.

### **Operating the host product**

When testing the host product, all the transmitters must be operating. The transmitters can be enabled by using publicly-available drivers and turned on, so the transmitters are active. In certain conditions it might be appropriate to use a technology-specific call box (test set) where accessory devices or drivers are not available.

When testing for emissions from the unintentional radiator, the transmitter shall be placed in the receive mode or idle mode, if possible. If receive mode only is not possible then, the radio shall be passive (preferred) and/or active scanning. In these cases, this would need to enable activity on the communication BUS (i.e., PCIe, SDIO, USB) to ensure the unintentional radiator circuitry is enabled. Testing laboratories may need to add attenuation or filters depending on the signal strength of any active beacons (if applicable) from the enabled radio(s). See ANSI C63.4, ANSI C63.10 and ANSI C63.26 for further

general testing details.

The product under test is placed into a normal 'paired' mode with another ZigBee device, as per the normal intended use of the product (for example, transferring data).

### **FCC Statement**

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the 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.