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<tr><td></td><td>Version: 2.0.0   Date: 2019-08-24   No.: 0000000001</td></tr>
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1 Product Overview

XR1 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. XR1 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.

1.1 Features

✧ Working voltage: 2.7 V to 5.5 V

✧ Clock rate: 160 MHz

✧ Peripherals: two universal asynchronous receivers/transmitters (UARTs), 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

- 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

✧ Network camera

✧ Intelligent bus

Change History

No.	Date	Change Description	Version After Change
1	2019-08-24	This is the first release.	2.0.0
2	2020-01-13	Change Electrical parameters	2.0.1
3	2020-02-22	Update pin information	2.0.2
4	2020-03-18	Update Tx power parameters	2.0.3

Contents

Tables

Figures

2 Module Interfaces

2.1 Dimensions and Footprint

XR1 has two rows of 18 pins with a 1.5 mm pin spacing.

The XR1 dimensions (H x W x D) are 3.5±0.15 mm x 18±0.35 mm x 23.5±0.35 mm. The PCB thickness is 1.0±0.1 mm.
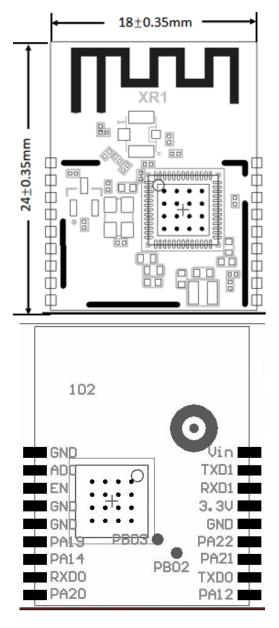
Figure 2-1 shows the XR1 front and rear views.

Figure 2-1 XR1 front and rear views

2.2 Interface Pin Definition

Table 2-1 XR1 interface pins

Pin No.	Symbol	I/O Type	Function
1	VIN	P	TXD1 level convertor，5V or 3.3V
2	TXD1	I/O	Serial interface transmission pin (UART_TX), which is connected to PA17 (pin 39) on the internal IC
3	RXD1	I/O	Serial interface receiving pin (UART_RX), which is connected to PA18 (pin 40) on the internal IC
4	VCC	P	Power input pin (3.3 V)
5	GND	P	Power supply reference ground pin
6	PA22	I/O	PA22, which is connected to PA22 (pin 44) on the internal IC
7	PA21	I/O	PA21, which is connected to PA21 (pin 43) on the internal IC
8	TXD0	I/O	Can be used as a debugging serial interface pin and is connected to PB00 (pin 49) on the internal IC
9	PA12	I/O	PA12, which is connected to PA12 (pin 30) on the internal IC
10	PA20	I/O	PA20, which is connected to PA20 (pin 42) on the internal IC
11	RXD0	I/O	Can be used as a debugging serial interface pin and is connected to PB01 (pin 48) on the internal IC
12	PA14	I/O	PA14, which is connected to PA14 (pin 32) on the internal IC
13	PA19	I/O	PA19, which is connected to PA19 (pin 41) on the internal IC
14	GND	P	Power supply reference ground pin
15	GND	P	Power supply reference ground pin
16	EN	I/O	Enable/Reset pin (This pin is active at a high level, and is at a high level by default.)

Pin No.	Symbol	I/O Type	Function
17	ADC	AI	ADC pin (See the following Note 2.)
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. This pin can only function as an ADC input and not a common I/O. 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.

2.3 Test Pin Definition

Table 2-2 XR1 test pins

Pin No.	Symbol	I/O Type	Function
N/A	PB02	I/O	Connected to PB02 (pin 10) on the internal IC
N/A	PB03	I/O	Connected to PB03 (pin 11) on the internal IC

Note:

1 I/O indicates input/output pins.

2 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 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	125	°C
VDD	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_{IL}	I/O low-level input	−0.3	N/A	1.32	V
V_{IH}	I/O high-level input	2.06	N/A	3.6	V
V_{OL}	I/O low-level output	-0.3	N/A	0.4	V
V_{OH}	I/O high-level output	2.9	N/A	3.3	V
Imax	I/O drive current	-40	N/A	40	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	+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 XR1 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.	50	181	mA
AP	The module is in AP mode, and the Wi-Fi indicator blinks slowly.	101	180	mA
Network connect	The internet is connected, and the Wi-Fi indicator always blinks.	38	131	mA
Network disconnect	The internet is disconnected, and the Wi-Fi indicator not blink.	50	184	mA

4　RF Features

4.1　Basic RF Features

Table 4-1 Basic RF features

Parameter	Description
Frequency band	2.412 GHz to 2.483.5 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，gain 2.0 dBi (Default) U.FL RF connector to connect external ANT（Optional）

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	1 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		−20	N/A	+20	ppm
EVM under 802.11b CCK, 11 Mbit/s, 17.5 dBm			−16		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

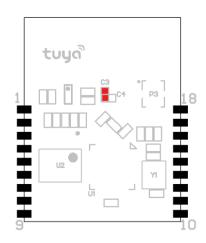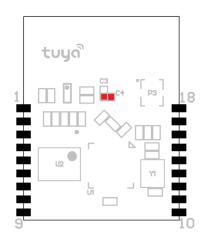**Table 4-3 RX sensitivity**

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

XR1 has two types of antenna, one uses external antenna, another uses an onboard PCB antenna(default way). Onboard PCB antenna meandered inverted-F antenna (MIFA) operating in the 2.4 GHz Wi-Fi frequency band.But it has two types of antenna

(1) Onboard PCB Antenna   (2)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.
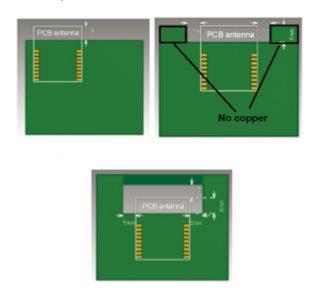

Figure 5-1 Antenna clearance part

For details about the onboard PCB antenna area on XR1, see Figure 6-1.

6 Packaging Information and Production Instructions
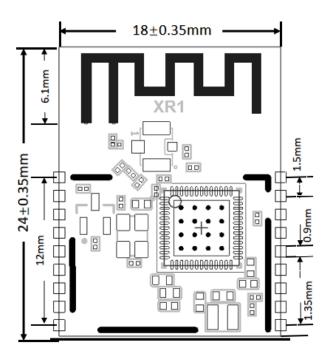
6.1 Mechanical Dimensions

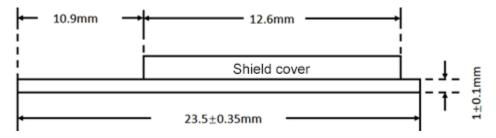**Figure 6-1 XR1 mechanical dimensions**

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.
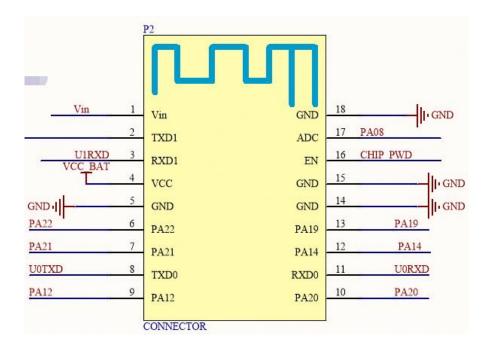
6.2 Recommended PCB Layout
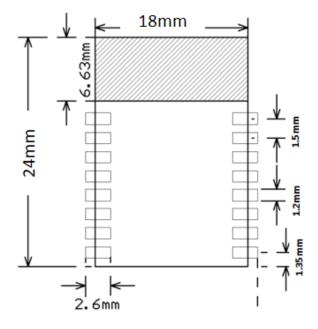

Figure 6-3 XR1 pins

Figure 6-4 Layout of the PCB to which XR1 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.

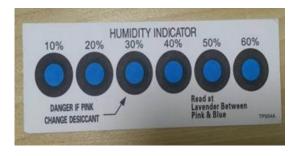   (3) The package contains a humidity indicator card (HIC).

Figure 6-5 HIC for XR1

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

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

Based on the IPC/JEDEC standard, perform reflow soldering on a module at most twice.
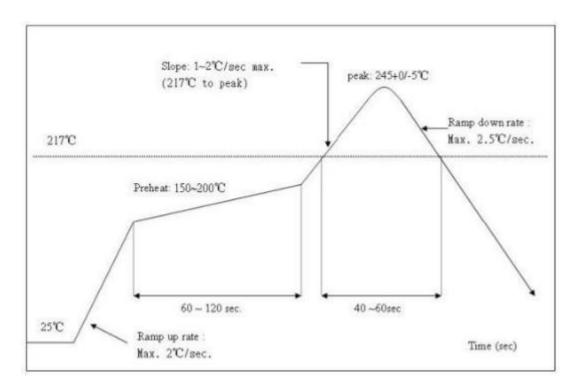
Figure 6-6 Oven temperature curve

6.5 Storage Conditions

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-XR1.The final end product must be labeled in a visible area with the following: "Contains Transmitter Module FCC ID:2ANDL-XR1"

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.