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Tuya TYZS4 Zigbee Module

Version: 2.0.0   **Date: 2019-07-26**   **No.:**

1   Product Overview

TYZS4 is a low-power embedded Zigbee module that Hangzhou Tuya Inc. has developed. It consists of a highly integrated wireless radio processor chip (EFR32MG1B232F256GM48-C0) and several peripheral components, with an embedded 802.15.4 PHY/MAC Zigbee network protocol stack and robust library functions. TYZS4 is embedded with a low-power 32-bit ARM Cortex-M4 core, 256 KB flash memory, and 32 KB random-access memory (RAM), and has extensive peripherals.

TYZS4 is a FreeRTOS platform that integrates all the function libraries of the Zigbee MAC protocol. You can develop built-in Zigbee products as required.

1.1 Features

✧ Embedded low-power 32-bit ARM Cortex-M4 processor, which provides digital signal processor (DSP) instructions and floating-point units (FPUs) and also functions as an application processor

● Dominant frequency: 40 MHz

✧ Working voltage: 1.8 V to 3.8 V

✧ Peripherals: four GPIOs and one universal asynchronous receiver/transmitter (UART) that supports flow control

✧ Zigbee features

- 802.15.4 MAC/PHY

- Working channels 11 to 26 at 2.400 GHz to 2.483 GHz; 250 kbit/s air interface rate

- Embedded DC-DC circuit, maximizing the power efficiency

- Maximum output power: +10 dBm; dynamic output power: > 35 dB

- Runtime power consumption: 63 µA/MHz; current in sleep mode: 1.4 µA

- Proactive network configuration for terminals

- Onboard PCB antenna

- The module also contains a PCB print antenna with 2.2 dBi gain.

- Working temperature: –20°C to +85°C

- AES-128/AES-256 hardware encryption

- Wireless air interface packet capture

1.2 Applications

- Intelligent building

- Smart household and home appliances

- Intelligent socket and light

- Industrial wireless control

- Health care and measurement

- Asset tracing

Change History

No.	Date	Change Description	Version After Change
1	2019-08-06	Updated the document template.	2.0.0

Contents

2 Module Interfaces

2.1 Dimensions and Footprint

TYZS4 has two rows of pins with a 2 mm pin spacing.

TYZS4 dimensions (H x W x D): 3.5±0.1 mm x 21±0.35 mm x 28±0.35 mm

Figure 2-1 shows the TYZS4 front and rear views.
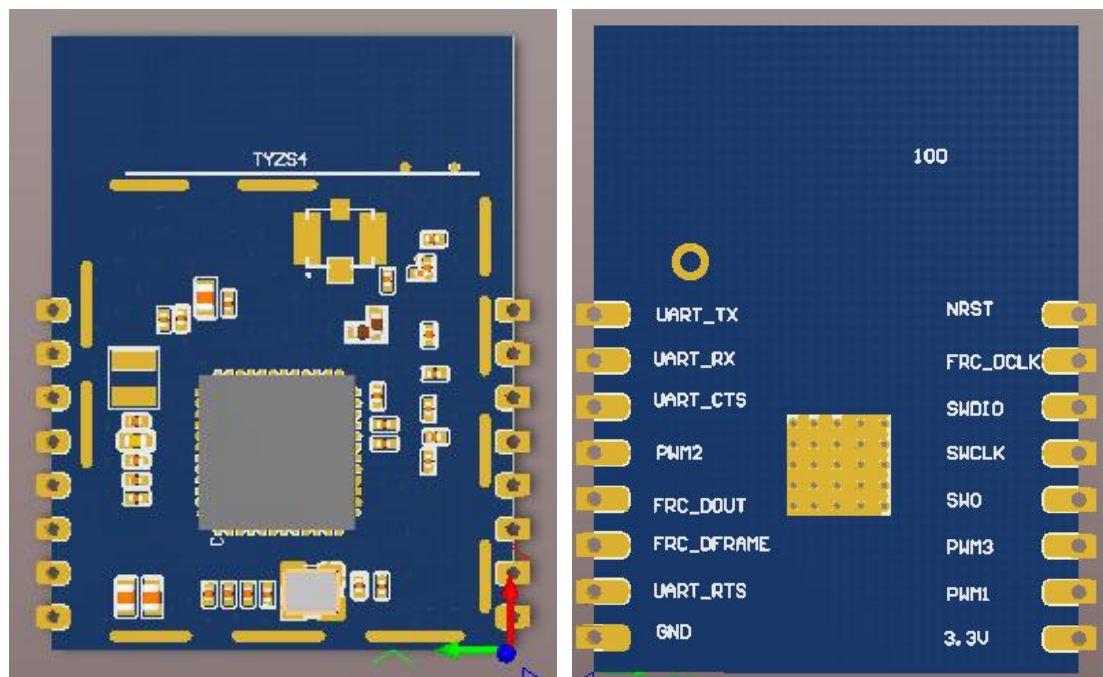
Figure 2-1 TYZS4 front and rear views

2.2 Pin Definition

Table 2-1 TYZS4 interface pins

Pin No.	Symbol	I/O Type	Function
1	nRST	I	Hardware reset pin. When the pin is at a low level, the chip is reset. TYZS4 is reset upon power-on, and therefore, this pin may not be used.
2	FRC_DCLK	I/O	Packet trace interface (PTI) clock signal.
3	SWDIO	I/O	J-Link SWDIO programming pin. It can be configured

Pin No.	Symbol	I/O Type	Function
			as a GPIO in actual application programs.
4	SWCLK	I/O	J-Link SWCLK programming pin. It can be configured as a GPIO in actual application programs.
5	SWO	I/O	Used as an output pin in J-Link debugging communication state or a GPIO in actual application programs.
6	PWM3	I/O	Used as a GPIO. It supports Packet Traffic Arbitration (PTA).
7	PWM1	I/O	Used as a GPIO. It supports PTA.
8	VCC	P	Power supply pin. The typical power supply voltage is 3.3 V.
9	GND	P	Reference ground pin.
10	UART_RTS	I/O	Reserved serial interface UART RTS signal. This pin is connected to the external CTS pin on the MCU. It can also be used as a GPIO in actual application programs.
11	FRC_DFRAME	I/O	Debugging PTI; frame signal.
12	FRC_DOUT	I/O	Debugging PTI, data signal.
13	PWM2	I/O	Reserved PWM output pin. It supports PTA.
14	UART_CTS	I/O	Reserved serial interface UART CTS signal. This pin is connected to the external RTS pin on the MCU.
15	RXD	I/O	UART0_RXD, used for receiving over the serial interface. This pin is connected to UART_TX of the upper computer.
16	TXD	Output	UART0_TXD, used for sending over the serial interface. This pin is connected to UART_RX of the upper computer.

Note:

1. **P** indicates power supply pins, **I/O** indicates input/output pins, and **AI** indicates analog input pins.

2. nRST is only a hardware reset pin. It cannot clear the Zigbee network configuration information.

3. As shown in Figure 2-1, Pin1 (the nRST pin) and Pin16 (the TXD pin) are respectively on the upper left and upper right of the module's front side.

2.3 Test Pin Definition

Table 2-2 TYZS4 test pins

Pin No.	Symbol	I/O Type	Function
N/A	N/A	I	Used for the module production test

Note: It is not recommended that test pins be used.

3 Electrical Parameters

3.1 Absolute Electrical Parameters

Table 3-1 Absolute electrical parameters

Parameter	Description	Minimum Value	Maximum Value	Unit
Ts	Storage temperature	–50	150	°C
VCC	Power supply voltage	–0.3	3.8	V
Static electricity voltage (human body model)	Tamb = 25°C	N/A	2.5	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
VCC	Working voltage	1.8	3.3	3.8	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	VCC	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
Imax	I/O drive current	N/A	N/A	12	mA

3.3 Zigbee TX Power Consumption

Table 3-3 Power consumption during constant transmission

Symbol	Parameter		Typical Value	Unit
	Rate	TX Power		
I_{RF}	250 kbit/s	+19 dBm	120	mA
I_{RF}	250 kbit/s	+13 dBm	50	mA
I_{RF}	250 kbit/s	+10 dBm	32	mA
I_{RF}	250 kbit/s	+4 dBm	17	mA
I_{RF}	250 kbit/s	+1 dBm	11.8	mA

Note: When the preceding data is being tested, the duty cycle is set to 100%.

3.4 Zigbee RX Power Consumption

Table 3-4 Power consumption during constant receiving

Symbol	Rate	Typical Value	Unit
I_{RF}	250 kbit/s	8	mA

Note: When the UART is in active state, the receiving current is 14 mA.

3.5 Working Current

Table 3-5 TYZS4 working current

Working Mode	Working Status (Ta = 25°C)	Average Value	Maximum Value	Unit
EZ	The module is in EZ mode.	10	40	mA
Connected	The module is connected to the network.	3	5	mA
Deep sleep mode	The module is in deep sleep mode, with 64 KB flash memory.	1.4	3	µA

4 RF Features

4.1 Basic RF Features

Table 4-1 Basic RF features

Parameter	Description
Frequency band	2.400 GHz to 2.484 GHz
Physical-layer standard	IEEE 802.15.4
Data transmission rate	250 kbit/s
Antenna type	Default PCB antenna or external antenna used with an I-PEX connector

Parameter	Description
Line-of-sight transmission distance	200 m

4.2 Zigbee Output Performance

Table 4-2 Performance during constant transmission

Parameter	Minimum Value	Typical Value	Maximum Value	Unit
Maximum output power	N/A	+19	N/A	dBm
Minimum output power	N/A	−30	N/A	dBm
Output power adjustment step	N/A	0.5	1	dB
Frequency error	−15	N/A	+15	ppm
Output spectrum adjacent-channel rejection ratio		−31		dBc

Note: The maximum output power can reach +19 dBm. The output power can be adjusted under normal use. The high-power output can be used for coverage in extremely complex conditions, for example, gateway-level indoor or outdoor coverage.

4.3 Zigbee RX Sensitivity

Table 4-3 RX sensitivity

Parameter	Minimum Value	Typical Value	Maximum Value	Unit
PER < 10%, 250 kbit/s, OQPSK	N/A	−101	N/A	dBm

5 Antenna Information

5.1 Antenna Type

By default, TYZS4 uses an onboard PCB antenna.

5.2 Antenna Interference Reduction

To ensure optimal wireless performance when the Zigbee module uses an onboard PCB antenna, it is recommended that the antenna be at least 15 mm away from other metal parts and that the antenna location on the PCB be hollowed out.

To prevent adverse impact on the antenna radiation performance, avoid copper or traces along the antenna area on the PCB, as shown in the following Figure 5-1.

For details about the onboard PCB antenna area on TYZS4, see Figure 6-1.
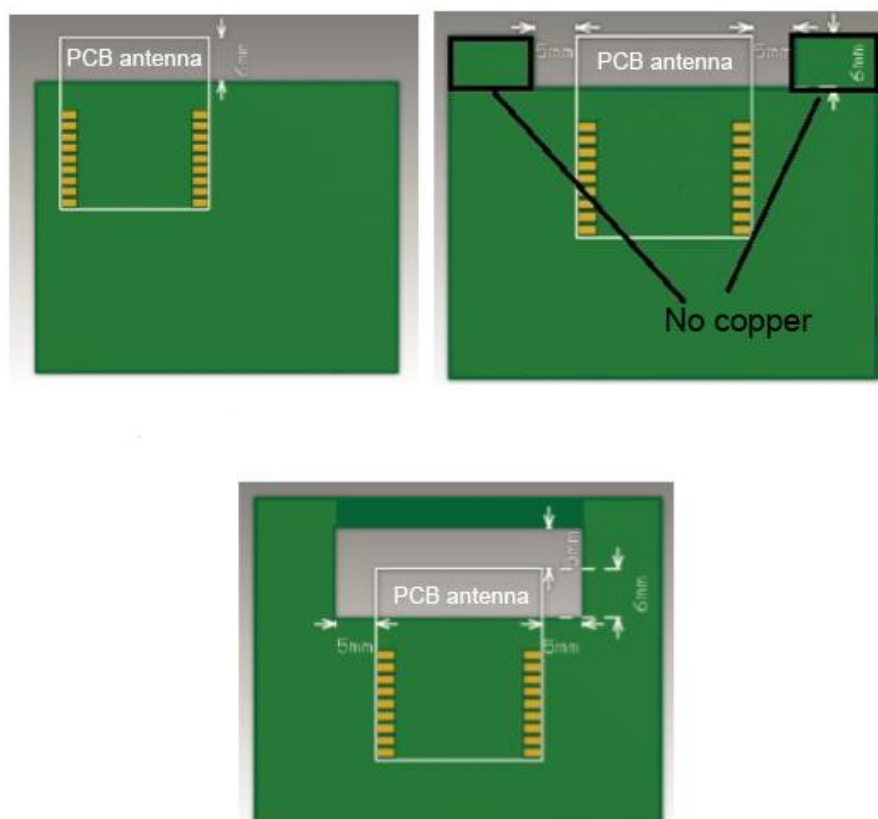
Figure 5-1 Antenna placement

6 Packaging Information and Production Instructions

6.1 Mechanical Dimensions

Figure 6-1 TYZS4 mechanical dimensions

6.2 Recable PCB Encapsulation

Figure 6-2 TYZS4 schematic diagram and pin connection

Figure 6-3 shows the connection between TYZS4 as a gateway module and an external MCU. The PWM1, PWM2, and PWM3 pins are reserved.

Figure 6-3 Connection between TYZS4 as a gateway module and an external MCU (without PTA)

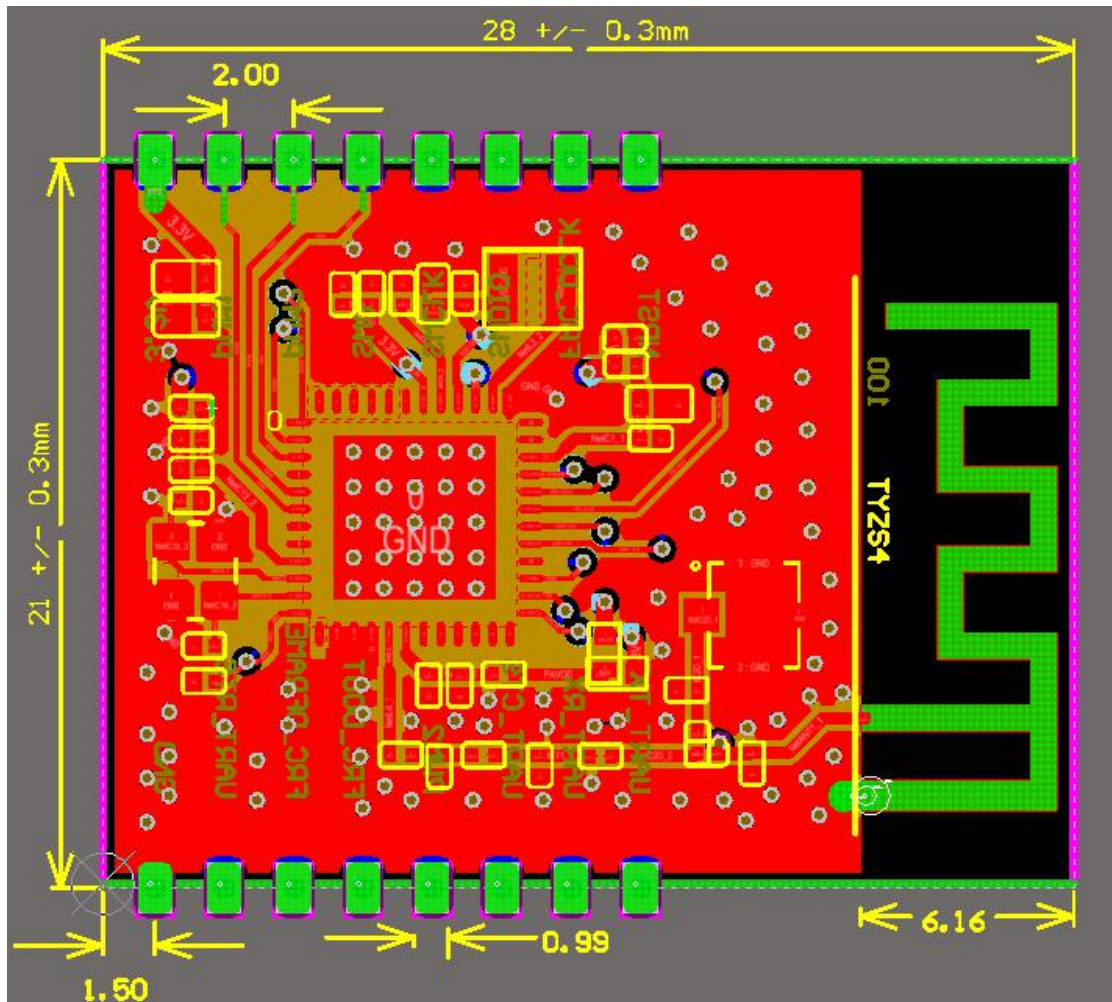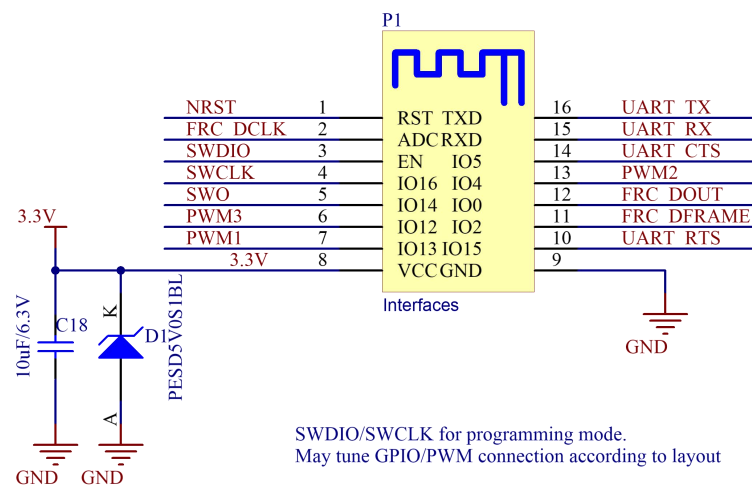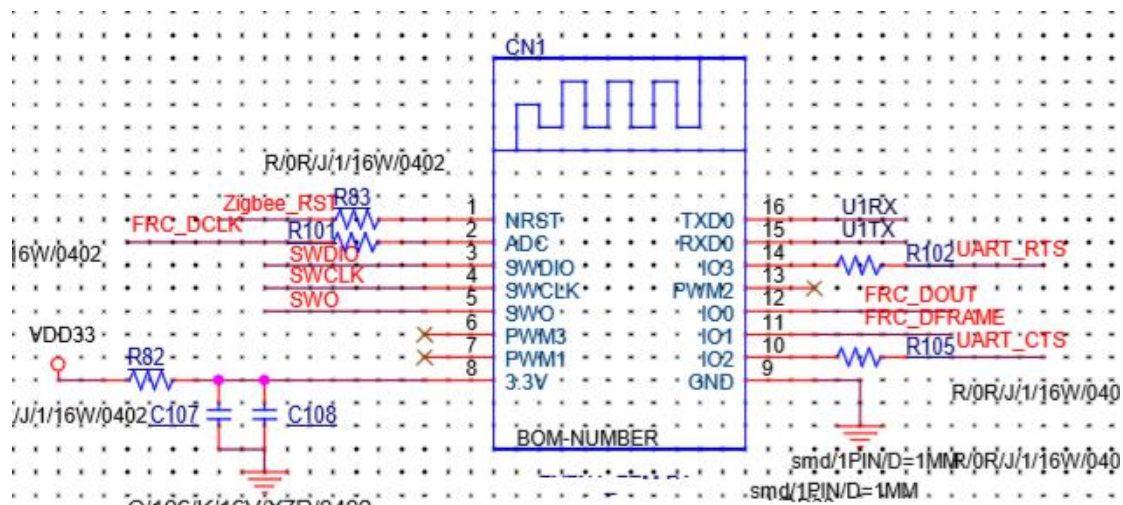| TYZS4 Signal	MCU	Remarks
uart_cts	uart_rts	115200 hardware flow control version: connected. Default TYZS4 version: supported. Hardware flow control: not connected. Baud rate: 57600. Confirm the version with the provider.
uart_rts	uart_cts	115200 hardware flow control version: connected. Default TYZS4 version: supported. Hardware flow control: not connected. Baud rate: 57600. Confirm the version with the provider.
rx	tx	
tx	rx	
vcc	vcc	
gnd	gnd	
nRST	gpio	Default GPIO level: high
frc_dclk	gpio	Default GPIO level: low
pw1 (REQUEST)	state	PTA (Not supported in the default version. Confirm the version with the provider.)
pw2(GRANT)	act	PTA (Not supported in the default version. Confirm the version with the provider.)
pw3(PRIORITY)	pri	PTA (Not supported in the default version. Confirm the version with the provider.)

Figure 6-3 Description of connection between TYZS4 as a gateway module and an external MCU (with PTA)

The following attachment is an encapsulation dimensions library file.

TYZS4
V1.0.0.PcbLib

You can directly reference the encapsulation file in Altium Designer format during encapsulation design.

6.3 Production Instructions

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 six months from the date when the product is packaged and sealed.

Precautions:

1. Throughout the production process, each involved operator must wear an ESD wrist strap and ESD suit.

2. During the operation, strictly protect the module from water and stains.

6.4 Recommended Oven Temperature Curve

Refer to IPC/JEDEC standard ; Peak Temperature : <250°C ; Number of Times: ≤2 times ;

6.5 Storage Conditions


```
         ⊘                CAUTION              LEVEL
                       This bag contains         3
              MOISTURE-SENSITIVE DEVICES
                                            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

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.

15.105 Information to the user.

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

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.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator and your body.

Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

The availability of some specific channels and/or operational frequency bands is country dependent and firmware programmed at the factory to match the intended destination.

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The firmware setting is not accessible by the end user.

The final end product must be labeled in a visible area with the following:

"Contains Transmitter Module 2ANDL-TYWXXX"

TYZS4 Module FCC ID: 2ANDL-TYZS4

This radio module must not be installed to co-locate and operating simultaneously with other radios in host system, additional testing and equipment authorization may be required to operating simultaneously with other radio.

Declaration of Conformity European notice

Hereby, Hangzhou AiXiangJi Technology Co., Ltd declares that this Wi-Fi module product is in compliance with essential requirements and other relevant provisions of Directive 2014/53/EC. A copy of the Declaration of conformity can be found at http://www.tuya.com.

EN 300 328 V2.1.1

EN 301 489-1 V2.1.1; EN 301 489-17 V3.1.1

EN 62311:2008

EN 60950-1:2006+A11:2009+A1:2010+A12:2011+A2:2013