



ZS24-U Module Datasheet

Version: 20230221

Contents

1	Product overview	2
1.1	Features	2
1.2	Applications	2
2	Module interfaces	3
2.1	Dimensions and footprint	3
2.2	Pin definition	4
3	Electrical parameters	9
3.1	Absolute electrical parameters	9
3.2	Normal working conditions	9
3.3	TX and RX power consumption	10
3.4	Working current	10
4	RF parameters	12
4.1	Basic RF features	12
4.2	TX performance	12
4.3	RX performance	12
5	Antenna information	14
5.1	Antenna type	14
5.2	Antenna interference reduction	14
6	Packaging information and production instructions	17
6.1	Mechanical dimensions	17
6.2	Side view	19
6.3	Schematic diagram of footprint	20
6.4	Recommended footprint	21
6.5	Production instructions	21
6.6	Recommended oven temperature curve	24
6.7	Storage conditions	27
7	MOQ and packaging information	28
8	Appendix: Statement	29



ZS24-U is a Zigbee module that Tuya has developed. It consists of a highly integrated RF processing chip EFR32MG24, a few peripherals, a built-in 802.15.4 PHY/MAC network protocol stack, and rich library functions.

1 Product overview

ZS24-U is embedded with a low-power 32-bit ARM Cortex-M33 core, 1024-KB flash program memory, 128-KB RAM, and abundant peripheral resources. It integrates all function libraries of the MAC and TCP/IP. You can develop embedded Zigbee products as required.

1.1 Features

- Embedded ARM Cortex-M33 processor having a low-power 32-bit CPU and DSP instructions and floating-point units, which can also function as an application processor.
- Clock rate: 78 MHz
- Wide operating voltage: 2.0 to 3.8 V
- Peripherals: 9 GPIOs, 1 UART, 2 ADCs, and 5 PWMs
- Zigbee connectivity
 - Support 802.15.4 MAC/PHY
 - Working channels 11 to 26 @2.400 to 2.483 GHz, air interface rate: 250 Kbps
 - Up to +10dBm output power
 - 35 μ A/MHz power consumption during running; 5- μ A sleep current
 - PCB antenna inside
 - Onboard antenna with a gain of 1.1 dBi
 - Operating temperature: -40°C to 105°C
 - Support hardware encryption and AES 128/256

1.2 Applications

- Intelligent building
- Smart household and home appliances
- Smart socket and light
- Industrial wireless control
- Baby monitor
- Network camera
- Intelligent bus

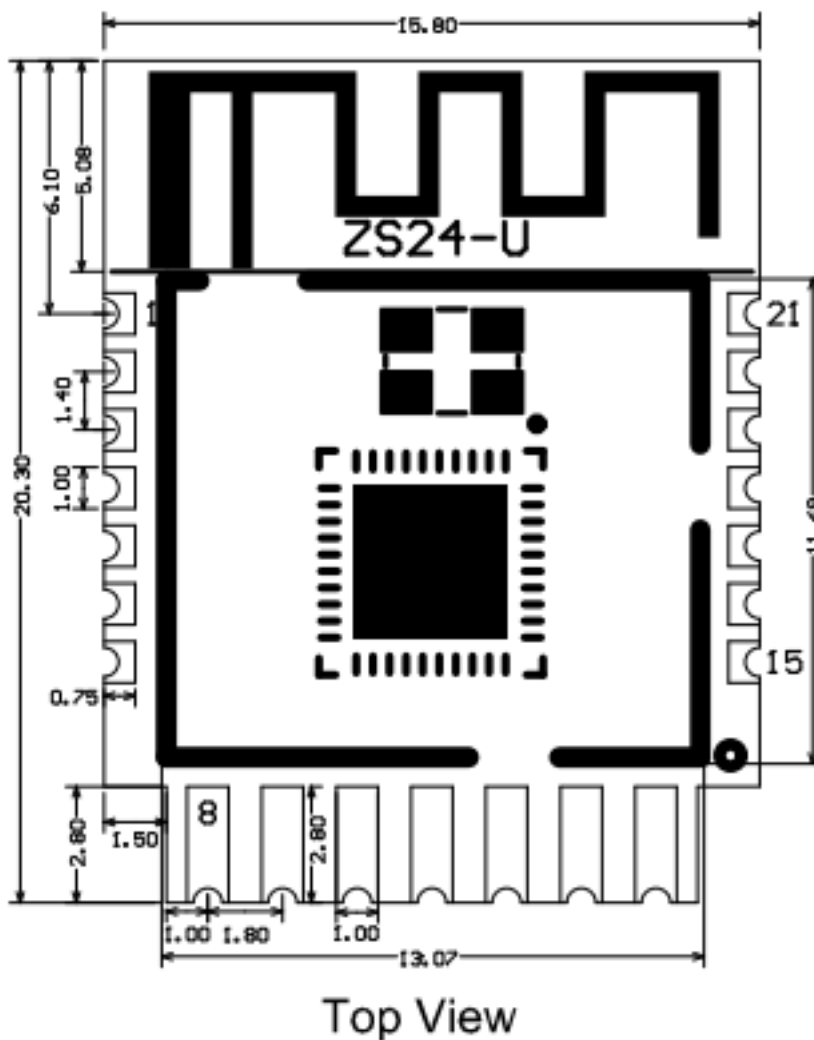
2 Module interfaces

2.1 Dimensions and footprint

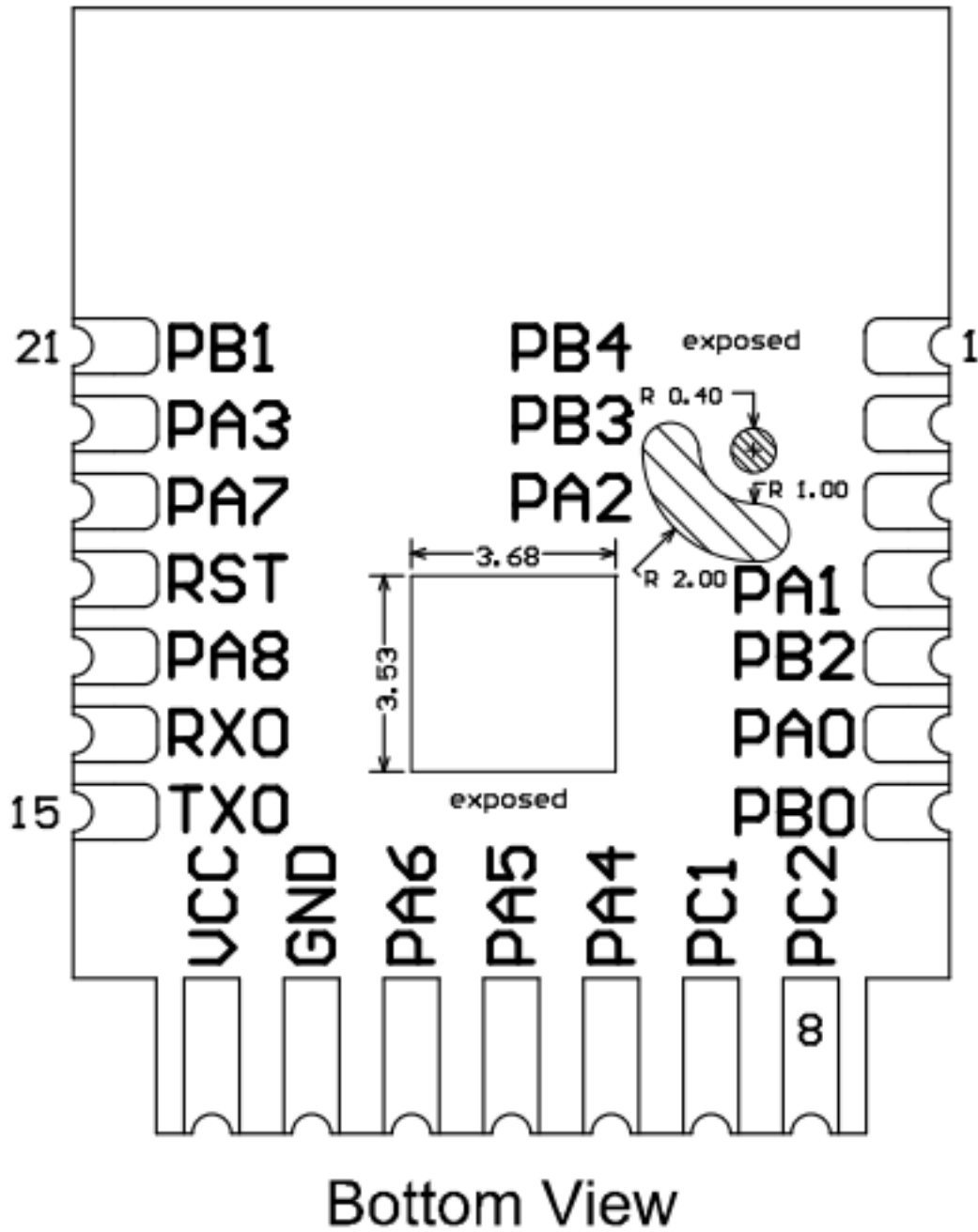
ZS24-U has 3 lines of pins. The spacing of pins at the two sides is 1.4 ± 0.1 mm, and the spacing of pins at the bottom is 1.8 ± 0.1 mm.

The dimensions of the ZS24-U are 20.3 ± 0.35 mm (L) \times 15.8 ± 0.35 mm (W) \times 2.5 ± 0.1 mm (H).

The dimensions of ZS24-U are as follows:



2.2 Pin definition



Pin number	Symbol	Type	Function
1	PB4	I/O	Common I/O pin, which corresponds to PB04 on the internal IC
2	PB3	I/O	Common I/O pin, which corresponds to PB03 on the internal IC
3	PA2	I/O	Burning pin, SWDIO, which corresponds to PA02 on the internal IC
4	PA1	I/O	Burning pin, SWCLK, which corresponds to PA01 on the internal IC
5	PB2	I	ADC pin, which corresponds to PB02 on the internal IC
6	PA0	I/O	Common I/O pin, which corresponds to PA00 on the internal IC
7	PB0	I/O	Common I/O pin, which corresponds to PB00 on the internal IC

Pin number	Symbol	Type	Function
8	PC2	I/O	Support hardware PWM and correspond to PC02 on the internal IC
9	PC1	I/O	Support hardware PWM and correspond to PC01 on the internal IC
10	PA4	I/O	Support hardware PWM and correspond to PA04 on the internal IC
11	PA5	I/O	Support hardware PWM and correspond to PA05 on the internal IC
12	PA6	I/O	Support hardware PWM and correspond to PA06 on the internal IC
13	GND	P	Power supply reference ground
14	VCC	P	Power supply pin (3.3V)

Pin number	Symbol	Type	Function
15	TX0	I/O	UART_TXD0 , burning authorization pin, which corresponds to PD03 on the internal IC
16	RX0	I/O	UART_RXD0 , burning authorization pin, which corresponds to PD02 on the internal IC
17	PA8	I	ADC pin, which corresponds to PA08 on the internal IC
18	RST	I/O	Reset pin, low active, which corresponds to RESETn on the internal IC
19	PA7	I/O	Common I/O pin, which corresponds to PA07 on the internal IC
20	PA3	I/O	Common I/O pin, which corresponds to PA03 on the internal IC
21	PB1	I/O	Common I/O pin, which corresponds to PB01 on the internal IC

:::info

- P indicates a power supply pin and I/O indicates an input/output pin.
 - Pin 3, 4, 13, 14, and 18 are burning pins, which are not exposed by default. During routing, customers should bypass them.
- ⋮

3 Electrical parameters

3.1 Absolute electrical parameters

Parameter	Description	Minimum value	Maximum value	Unit
T _s	Storage temperature	-50	150	°C
V _{BAT}	Power supply voltage	2.0	3.8	V
ESD voltage (human body model)	TAMB-25°C	-	2	KV
ESD voltage (machine model)	TAMB-25°C	-	0.5	KV

3.2 Normal working conditions

Parameter	Description	Minimum value	Typical value	Maximum value	Unit
T _a	Operating temperature	-40	-	105	°C
VCC	Operating voltage	2.0	3.3	3.6	V
VIL	I/O low level input	-	-	VDD*0.3	V
VIH	I/O high level input	VDD*0.7	-	-	V
VOL	I/O low level output	-	-	VDD*0.2	V

Parameter	Description	Minimum value	Typical value	Maximum value	Unit
VOH	I/O high level output	VDD*0.8	-	-	V

3.3 TX and RX power consumption

Working status	Mode	Rate	Transmit power/receive	Average value	Peak value (Typical value)	Unit
Transmit	-	250 Kbps	+10 dBm	19.3	20.6	mA
Transmit	-	250 Kbps	+0 dBm	9.3	11.6	mA
Receive	-	250Kbps	Constantly receive	5.9	7.9	mA

3.4 Working current

Working mode	Working status, Ta = 25°C	Average value	Maximum value (Typical value)	Unit	Remark
EZ mode	The module is in fast network connection state.	2.27	19.3	mA	

Working mode	Working status, Ta = 25°C	Average value	Maximum value (Typical value)	Unit	Remark
Connected and busy	The module is connected to the network and in running state.	2.05	18.6	mA	
Connected and idle	The module is connected to the network and in idle state.	3.5	-	μA	Low Power Firmware
Deep sleep mode	Deep sleep mode	3.54	-	μA	

4 RF parameters

4.1 Basic RF features

Parameter	Description
Working frequency	2.405 to 2.480 GHz
Zigbee standard	IEEE 802.15.4
Data transmission rate	250 Kbps
Antenna type	PCB antenna with a gain of 1.1 dBi

4.2 TX performance

TX performance

Parameter	Minimum value	Typical value	Maximum value	Unit
Output power (250Kbps)	-30	15	10	dBm
Output power adjustment stepping	-	0.5	1	dBm
Output spectrum adjacent channel suppression	-	-31	-	dBc
Frequency error	-15	-	15	ppm

4.3 RX performance

RX sensitivity

Parameter	Minimum value	Typical value	Maximum value	Unit
PER<8%, RX sensitivity (250 Kbps)	-105	-105	-104	dBm

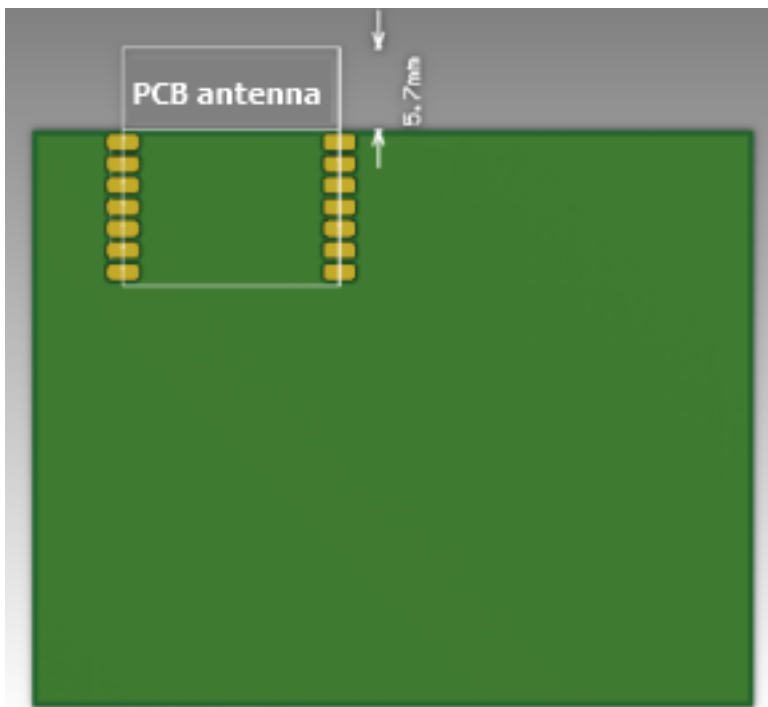
5 Antenna information

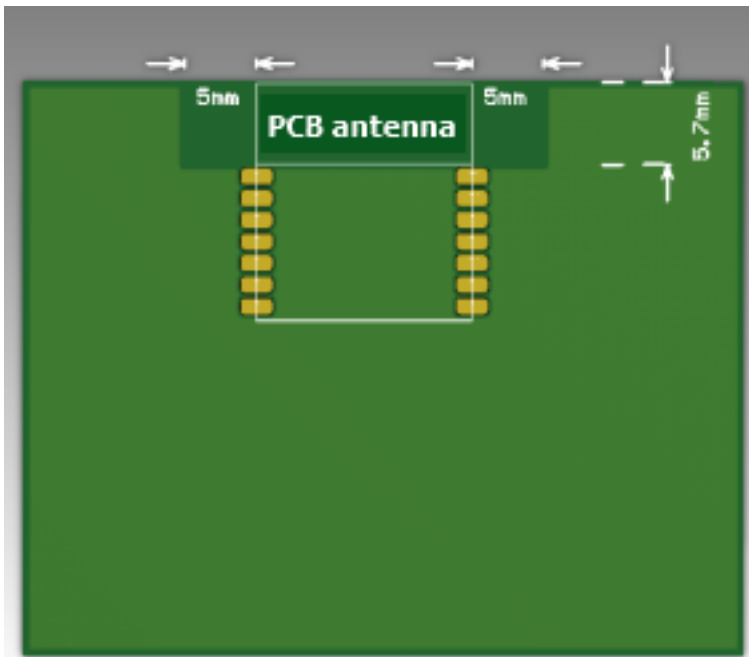
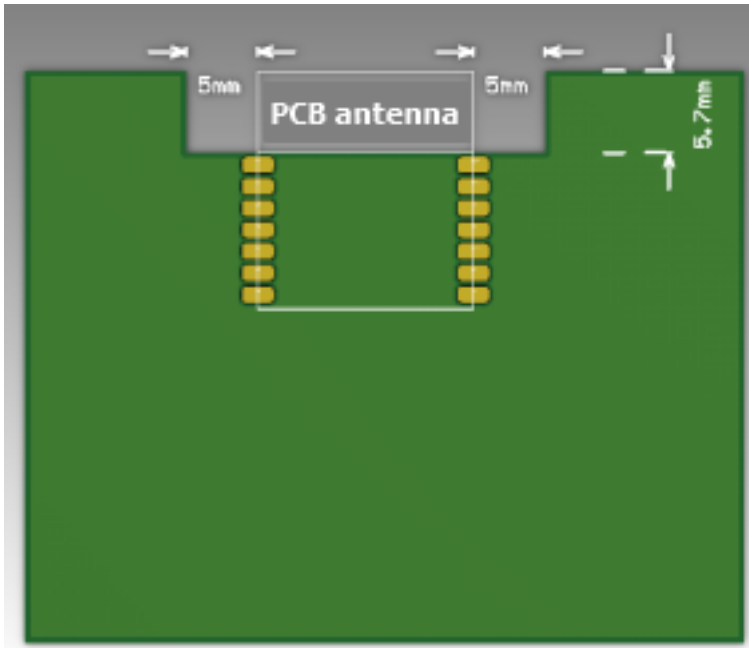
5.1 Antenna type

ZS24-U uses the PCB antenna.

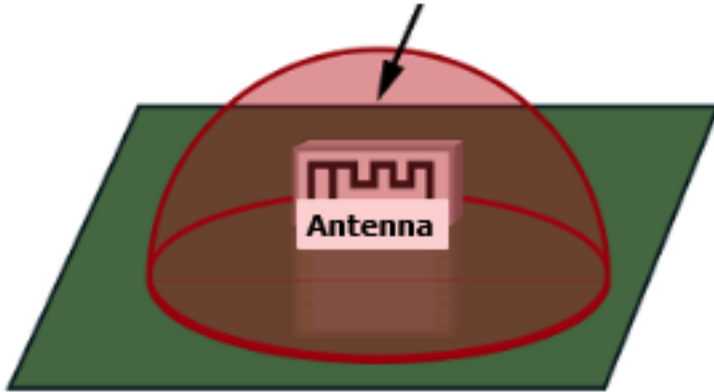
5.2 Antenna interference reduction

To ensure optimal RF performance when the Zigbee module uses a 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 within the antenna area on the PCB.





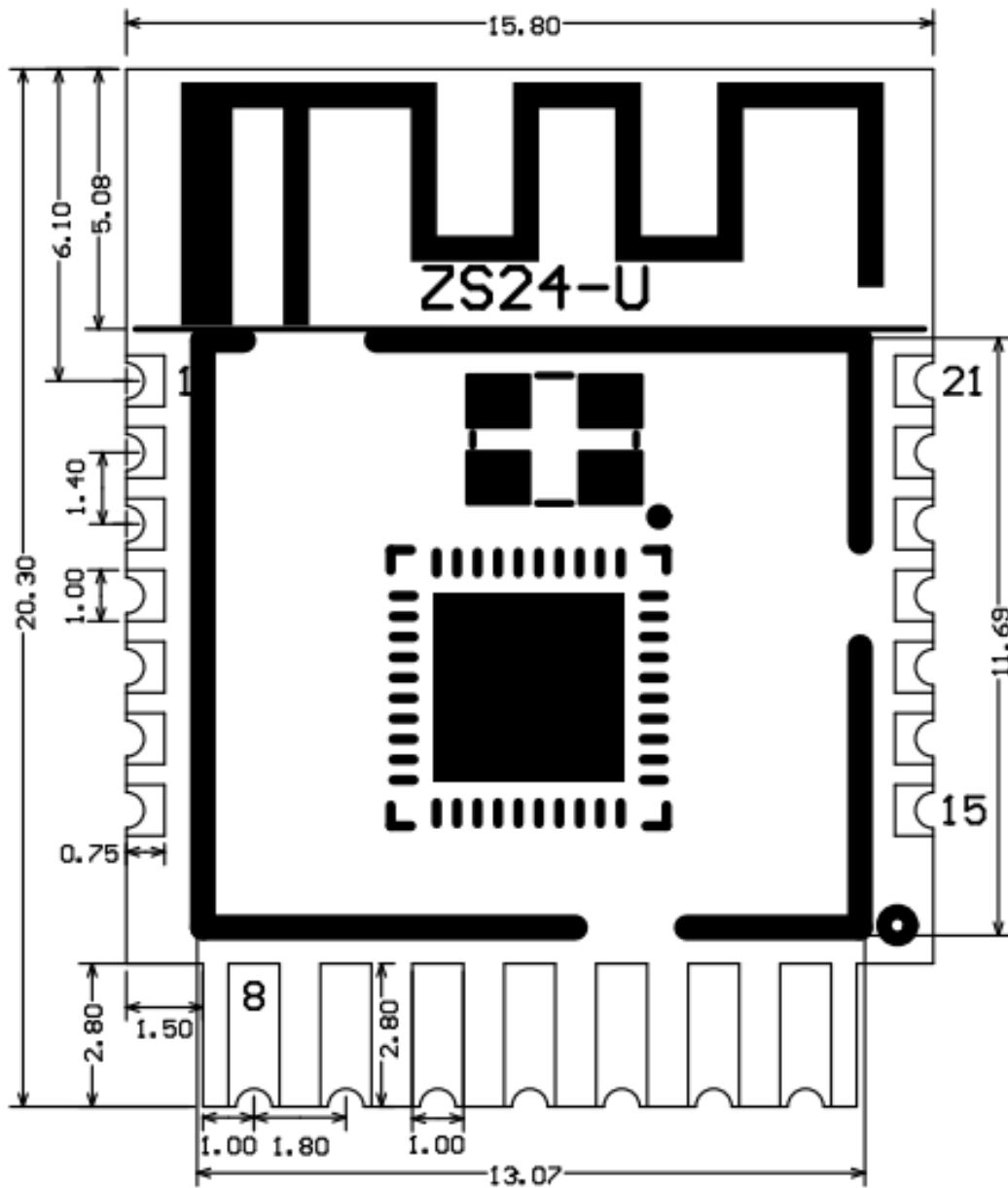
**Do not place any metal in the red area above the antenna.
The recommended diameter of the circular arc is greater than 3 cm.**



6 Packaging information and production instructions

6.1 Mechanical dimensions

The PCB dimensions are 20.3 ± 0.35 mm (W) \times 15.8 ± 0.35 mm (L) \times 1.0 ± 0.1 mm (H).



Top View

6.2 Side view



Side View

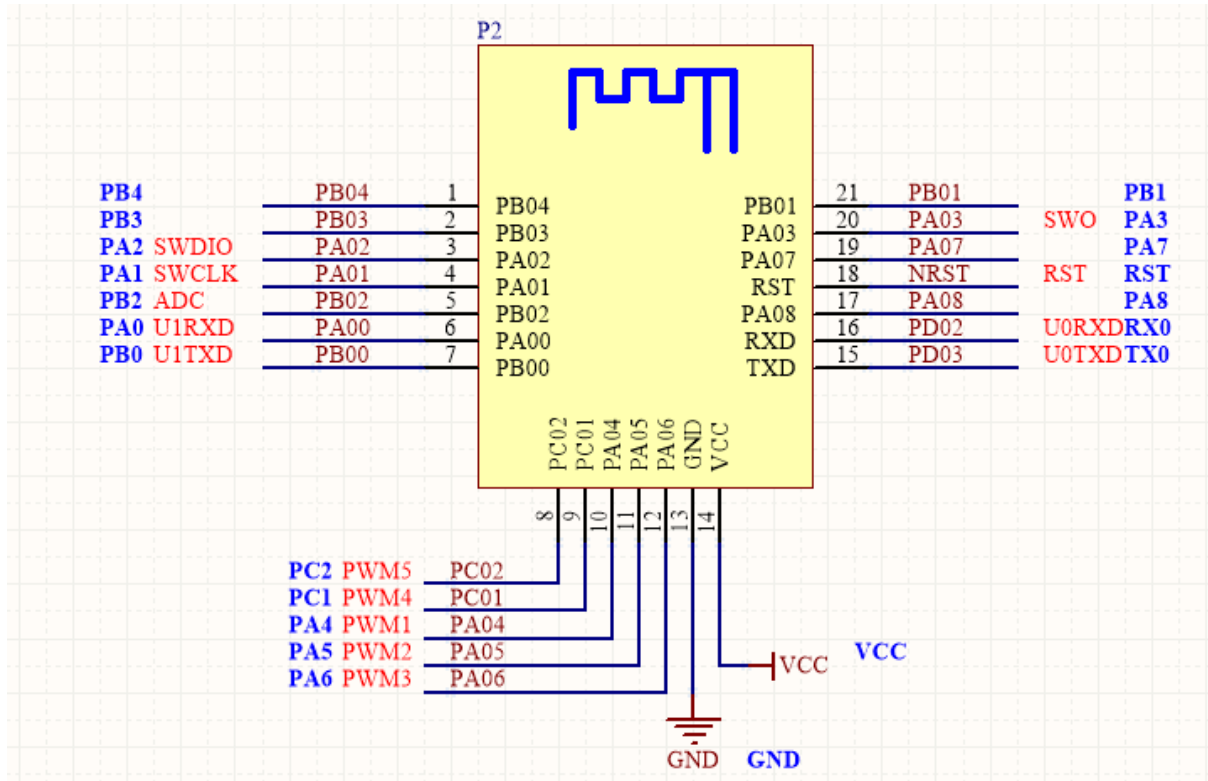
Unit: mm

Module form factor tolerance: $\pm 0.35\text{mm}$

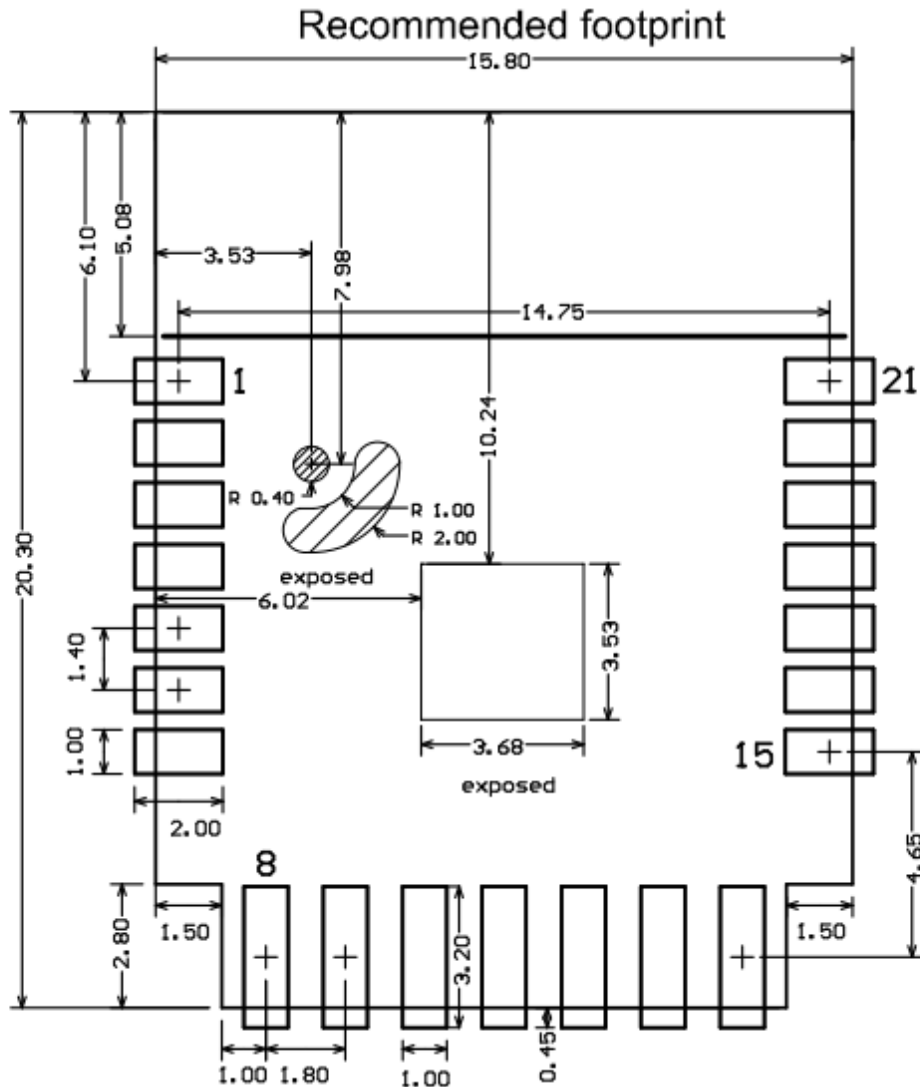
PCB thickness tolerance: $\pm 0.1\text{mm}$

Shield cover height tolerance: $\pm 0.05\text{mm}$

6.3 Schematic diagram of footprint



6.4 Recommended footprint



6.5 Production instructions

1. For the modules that can be packaged with the SMT or in an in-line way, you can select either of them according to the PCB design solutions of customers. If a PCB is designed to be SMT-packaged, package the module with the SMT. If a PCB is designed to be in-line-packaged, package the module in an in-line way. After being unpacked, the module must be soldered within 24 hours. Otherwise, it

needs to be put into the drying cupboard where the relative humidity is not greater than 10%; or it needs to be packaged again under vacuum and the exposure time needs to be recorded (the total exposure time cannot exceed 168 hours).

- (SMT process) SMT devices:
 - Mounter
 - SPI
 - Reflow soldering machine
 - Thermal profiler
 - Automated optical inspection (AOI) equipment
- (Wave soldering process) Wave soldering devices
 - Wave soldering equipment
 - Wave soldering fixture
 - Constant-temperature soldering iron
 - Tin bar, tin wire, and flux
 - Thermal profiler
- Baking devices:
 - Cabinet oven
 - Anti-electrostatic and heat-resistant trays
 - Anti-electrostatic and heat-resistant gloves

2. Storage conditions for a delivered module:

- The moisture-proof bag must be placed in an environment in which the temperature is below 40°C and the relative humidity is lower than 90%.
- The shelf life of a dry-packaged product is 12 months from the date when the product is packaged and sealed.
- There is a humidity indicator card (HIC) in the packaging bag.

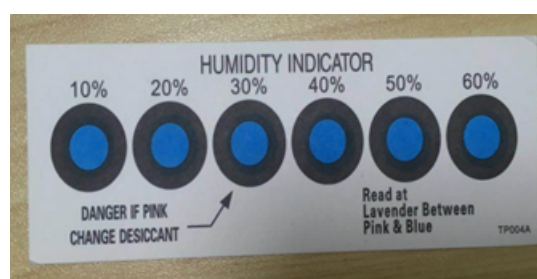


Figure 1: HIC-SMT and in-line module.png

3. The module needs to be baked in the following cases:

- The packaging bag is damaged before unpacking.
- There is no humidity indicator card (HIC) in the packaging bag.
- After unpacking, circles of 10% and above on the HIC become pink.
- The total exposure time has lasted for over 168 hours since unpacking.
- More than 12 months have passed since the sealing of the bag.

4. Baking settings:

- Temperature: 40°C and $\leq 5\%$ RH for reel package and 125°C and $\leq 5\%$ RH for tray package (please use the heat-resistant tray rather than plastic container)
- Time: 168 hours for reel package and 12 hours for tray package
- Alarm temperature: 50°C for reel package and 135°C for tray package
- Production-ready temperature after natural cooling: $< 36^\circ\text{C}$
- Re-baking situation: If a module remains unused for over 168 hours after being baked, it needs to be baked again.
- If a batch of modules is not baked within 168 hours, do not use reflow soldering or wave soldering to solder them. Because these modules are Level-3 moisture-sensitive devices, they are very likely to get damp when exposed beyond the allowable time. In this case, if they are soldered at high temperatures, it may result in device failure or poor soldering.

5. In the whole production process, take electrostatic discharge (ESD) protective measures.

6. To guarantee the passing rate, it is recommended that you use the SPI and AOI to monitor the quality of solder paste printing and mounting.

7. Due to the built-in crystal of the product, ordinary detergent or ultrasonic cleaning can be used in general, but in some cases, the vibration generated by the ultrasonic cleaning machine may cause damage to the internal structure of the crystal. If ultrasonic cleaning is used, it needs to be verified in advance to ensure that the internal crystal of the module will not be damaged after ultrasonic cleaning.

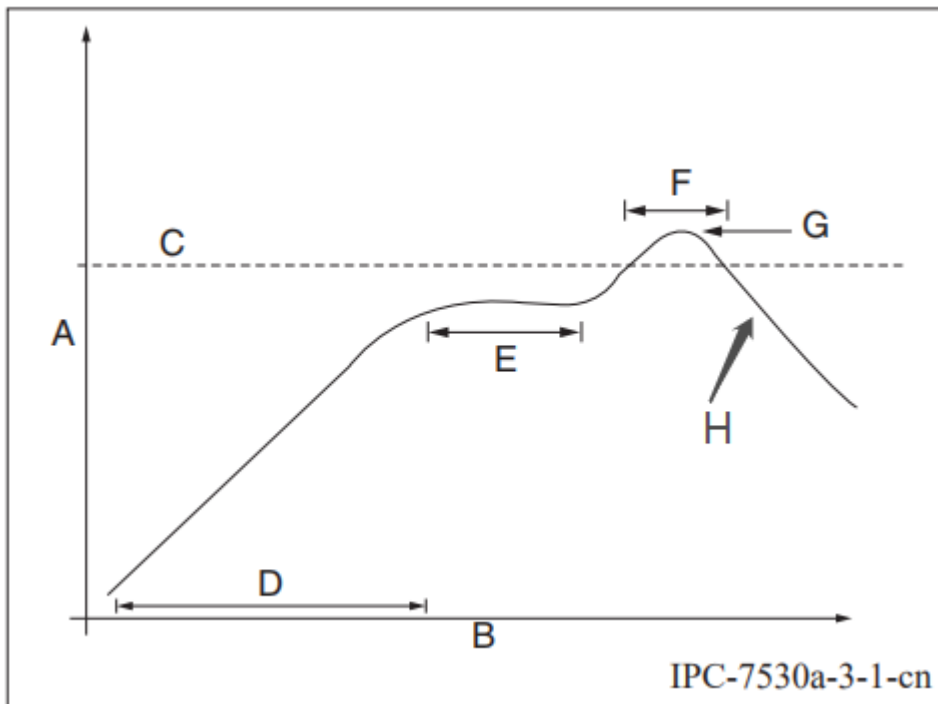
8. Try to avoid using ultrasonic welding to install or process products. This processing method may cause excessive crystal vibration in the module and lead to crystal failure.

6.6 Recommended oven temperature curve

Select a proper soldering manner according to the process. For the SMT process, please refer to the recommended oven temperature curve of reflow soldering. For the wave soldering process, please refer to the recommended oven temperature curve of wave soldering. There are some differences between the set temperatures and the actual temperatures. All the temperatures shown in this module datasheet are obtained through actual measurements.

Manner 1: SMT process (Recommended oven temperature curve of reflow soldering)

Set oven temperatures according to the following curve.



- A: Temperature axis
- B: Time axis
- C: Liquidus temperature: 217 to 220°C
- D: Ramp-up slope: 1 to 3°C/s
- E: Duration of constant temperature: 60 to 120s; the range of constant temperature: 150 to 200°C

- F: Duration above the liquidus: 50 to 70s
- G: Peak temperature: 235 to 245°C
- H: Ramp-down slope: 1 to 4°C/s

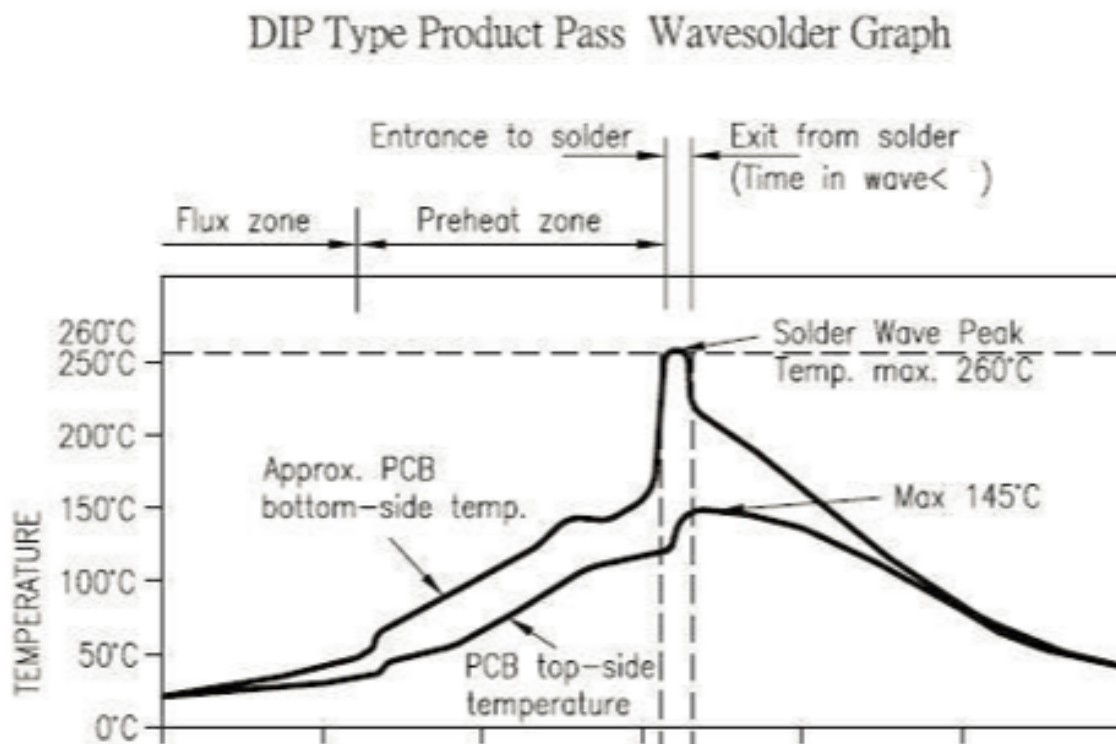
∴important

The above curve is just an example of the solder paste SAC305. For more details about other solder pastes, please refer to Recommended oven temperature curve in the solder paste specifications.

∴


Manner 2: Wave soldering process (Oven temperature curve of wave soldering)

Set oven temperatures according to the following temperature curve of wave soldering. The peak temperature is $260^{\circ}\text{C} \pm 5^{\circ}\text{C}$.



Suggestions on oven temperature curve of wave soldering		Suggestions on manual soldering temperature	
Preheat temperature	80 to 130 °C	Soldering temperature	360±20°C
Preheat time	75 to 100s	Soldering time	< 3s/point
Peak contact time	3 to 5s	NA	NA
Temperature of tin cylinder	260±5°C	NA	NA
Ramp-up slope	≤2°C/s	NA	NA
Ramp-down slope	≤6°C/s	NA	NA

6.7 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 <math><40^{\circ}\text{C}</math> and <math><90\%</math> 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 be
 - a) Mounted within: 168 hours of factory conditions
If blank, see adjacent bar code label
≤30 °C/60% RH, or
 - b) Stored per J-STD-033
4. Devices require bake, before mounting, if:
 - a) Humidity Indicator Card reads >10% for level 2a - 5a devices or >60% for level 2 devices when read at $23 \pm 5^{\circ}\text{C}$
 - b) 3a or 3b are not met
5. If baking is required, refer to 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 MOQ and packaging information

Product model	MOQ (pcs)	Packing method	Modules per reel	Reels per carton
ZS24-U	4400	Tape reel	1100	4

8 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. The module is limited to installation in mobile or fixed applications. 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 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 to 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. The OEM integrator is responsible for ensuring that the end-user has no manual instructions to remove or install the module.

Important Note

This radio module must not be installed to co-locate and operate 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 to 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 separate approval is required for all other operating configurations including portable configurations with respect to Part 2.1093 and different antenna configuration.

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-ZS24-U. The end product must be labeled in a visible area with the following: “Contains Transmitter Module FCC ID: 2ANDL-ZS24-U” .

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 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 from the human body.