ZPU Module Datasheet

Version: 20220512

Online Version

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ZPU is a Zigbee module developed by Tuya. It consists of a highly integrated RF processor chip (PHY6222) and a few peripheral circuits. ZPU has an embedded low-power 32-bit MCU, a 1 MB flash, a 64 KB static random-access memory (SRAM), and 18 I/O pins that support multiplexing.

1 Overview

ZPU enables you to build reliable Zigbee products based on your development requirements.

1.1 Features

- Built-in low-power 32-bit MCU, which can also be used as an application processor
- Operating voltage: 1.8 V to 3.6 V
- Peripherals: 5 PWM pins, 2 ADCs, 3 GPIO pins, 2 UARTs, and 1 SPI
- Zigbee connectivity
  - 802.15.4 MAC/PHY
  - Channels 11 to 26 at 2.405 GHz to 2.480 GHz; 250 kbit/s over the air interface
  - TX power: +6 dBm
  - RX sensitivity: –100 dBm at 250 kbit/s
  - PCB antenna with a gain of 2.19 dBi
  - Operating temperature: –40°C to 105°C
- Hardware encryption and AES-128 encryption

1.2 Applications

- Smart building
- Smart home and smart appliances
- Smart socket and light
- Industrial wireless control

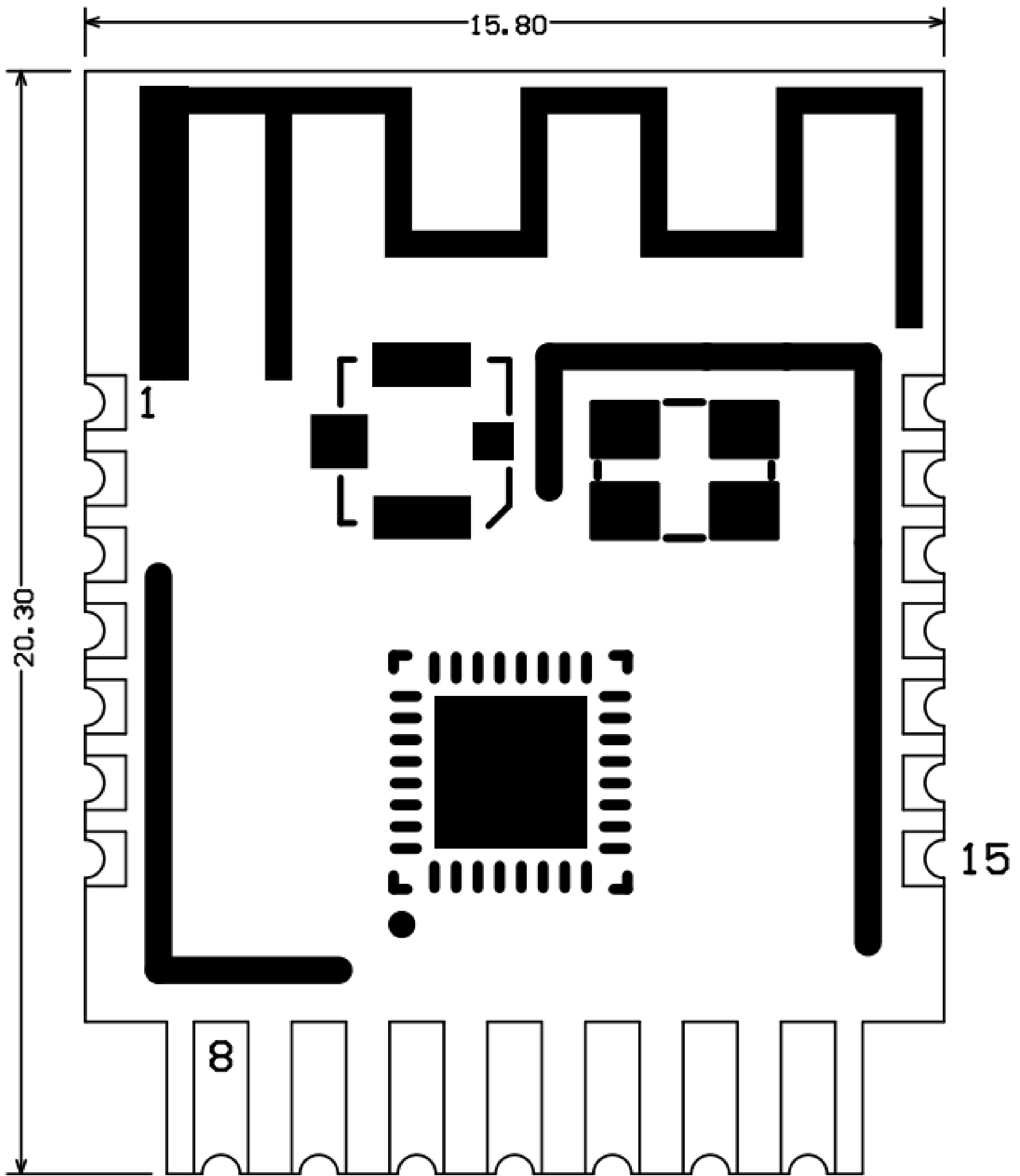
1.3 Change history

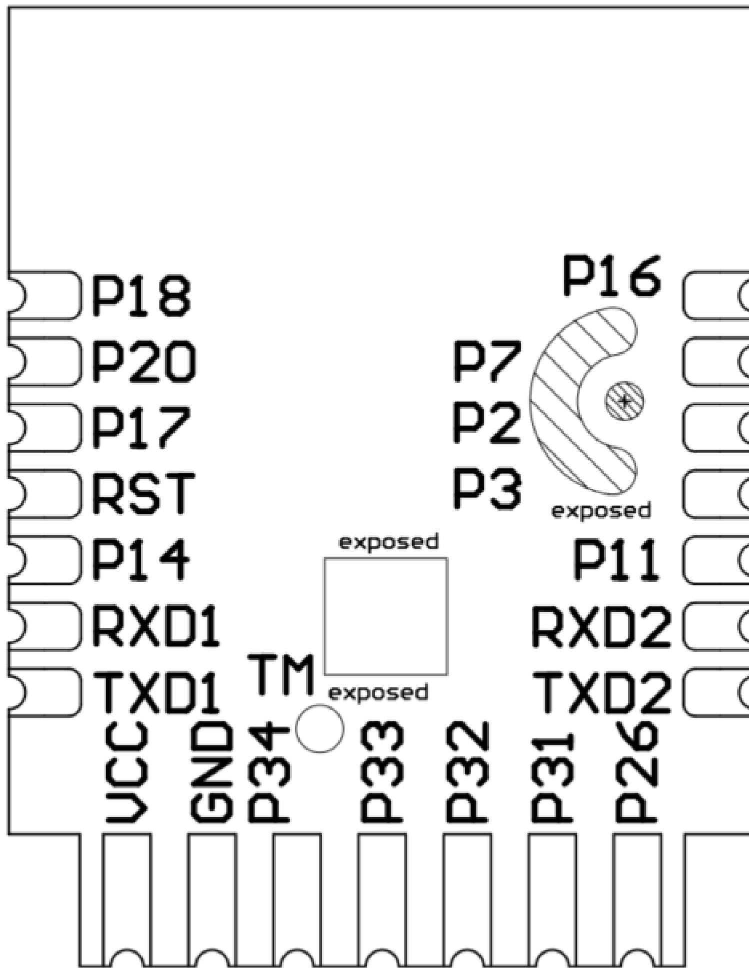
Date	Change description	Document version
January 25, 2022	This is the first release.	V1.0.0

2 Module interfaces

2.1 Dimensions and packaging

ZPU has 21 pins arranged in three rows with a spacing of 1.4±0.1 mm between pins on the two sides and a spacing of 1.8±0.1 mm between pins at the bottom. The ZPU dimensions are 20.3±0.35 mm (L) × 15.8±0.35 mm (W) × 3.0±0.15 mm (H). The thickness of the PCB is 1.0±0.1 mm. The following figures show the dimensions and packaging design of the ZPU module.


15.80
20.30
1
15
8
Top View



2.2 Pin definition

The following table describes the interface pins.

No.	Symbol	I/O type	Description
1	P16	I/O	Common I/O pin, which can be used as the SCK of the SPI and corresponds to P16 of the IC.
2	P7	I/O	Common I/O pin, which can be used as the MOSI of the SPI and corresponds to P7 of the IC.
3	P2	I/O	Common I/O pin, which corresponds to P2 of the IC.
4	P3	I/O	Common I/O pin, which corresponds to P3 of the IC.
5	P11	I/O	The pin for 12-bit ADCs, which can be reused as a common I/O pin and corresponds to P11 of the IC.
6	RXD2	I/O	The pin for `UART2_RX`, which can be reused as a common I/O pin and corresponds to P11 of the IC.

No.	Symbol	I/O type	Description
7	TXD2	I/O	The pin for `UART2_TX`, which can be reused as a common I/O pin and corresponds to P15 of the IC. The pin can be used for printing log output.
8	P26	I/O	Common I/O pin, which can be used as the PWM output of the LED drive and corresponds to P26 of the IC.
9	P31	I/O	Common I/O pin, which can be used as the PWM output of the LED drive and corresponds to P31 of the IC.
10	P32	I/O	Common I/O pin, which can be used as the PWM output of the LED drive and corresponds to P32 of the IC.
11	P33	I/O	Common I/O pin, which can be used as the PWM output of the LED drive and corresponds to P33 of the IC.

No.	Symbol	I/O type	Description
12	P34	I/O	Common I/O pin, which can be used as the PWM output of the LED drive and corresponds to P34 of the IC.
13	GND	P	Common I/O pin, which can be used as the PWM output of the LED drive and corresponds to P26 of the IC.
14	VCC	P	Power supply pin (Typical value: 3.3 V).
15	TXD1	I/O	The `UART1_TX` pin for sending data, which can be reused as a common I/O pin and corresponds to P9 of the IC.
16	RXD1	I/O	The `UART1_RX` pin for receiving data, which can be reused as a common I/O pin and corresponds to P10 of the IC.

No.	Symbol	I/O type	Description
17	P14	I/O	The pin for 12-bit ADCs, which can be reused as a common I/O pin and corresponds to P14 of the IC.
18	RST	I/O	Hardware reset pin (active at a low level), which corresponds to `RESET_N` of the IC.
19	P17	I/O	Common I/O pin, which corresponds to P17 of the IC.
20	P20	I/O	Common I/O pin, which can be used as the MISO of the SPI and corresponds to P20 of the IC.
21	P18	I/O	Common I/O pin, which can be used as the CS of the SPI and corresponds to P18 of the IC.
Test point	TM	Input	Mode selection pin. In flashing mode, it is set to a high level. In other modes, it is set to a low level or disconnected.

:::info

- `P` indicates a power supply pin. I/O indicates an input/output pin.
- If you have special requirements for light colors controlled by the PWM output, contact our business manager. :::

3 Electrical parameters

3.1 Absolute electrical parameters

Parameter	Description	Minimum value	Maximum value	Unit
Ts	Storage temperature	-65	150	°C
VCC	Power supply voltage	-0.3	3.9	V
Static electricity voltage (human body model)	TAMB -25°C	-	2	kV
Static electricity voltage (machine model)	TAMB -25°C	-	0.5	kV

3.2 Working conditions

Parameter	Description	Minimum value	Typical value	Maximum value	Unit
Ta	Operating temperature	-40	-	105	°C
VCC	Operating voltage	1.8	3.3	3.6	V
VIL	I/O low-level input	VSS	-	VCC × 0.3	V

Parameter	Description	Minimum value	Typical value	Maximum value	Unit
VIH	I/O high-level input	VCC × 0.7	-	VCC	V
VOL	I/O low-level output	VSS	-	VCC × 0.1	V
VOH	I/O high-level output	VCC × 0.9	-	VCC	V

3.3 Power consumption in working mode

Working status	Mode	Rate	Transmit power/Receive	Average value	Peak value (Typical value)	Unit
Transmit	-	250 kbit/s	+6 dBm	9.5	14	mA
Receive	-	250 kbit/s	Constantly receive	7.5	14	mA

3.4 Operating current

Working mode	Working status (Ta = 25°C)	Average value	Peak value (Typical value)	Unit
Quick pairing state	The module is in the quick pairing state.	7.5	14	mA

Working mode	Working status (Ta = 25°C)	Average value	Peak value (Typical value)	Unit
Connected	The module is in the connected state.	7	14	mA
Weakly connected	The module is weakly connected.	9.5	21	mA
Deep sleep	The module is in deep sleep mode, with the 64 KB SRAM remaining active.	To be determined	To be determined	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 kbit/s
Antenna type	PCB antenna with a gain of 2.19 dBi

4.2 RF output power

Parameter	Minimum value	Typical value	Maximum value	Unit
Maximum output power (250 kbit/s)	-	6	-	dBm
Minimum output power (250 kbit/s)	-	-20	-	dBm
Output power adjustment step	-	2	-	dBm
Output spectrum adjacent-channel rejection ratio	-	-39	-	dBm
Frequency error	-15	-	10	ppm

4.3 RF RX sensitivity

Parameter	Minimum value	Typical value	Maximum value	Unit
RX sensitivity	-	-100	-	dBm
Frequency offset	-250	-	+300	kHz
Co-channel interference suppression	-	-10	-	dB

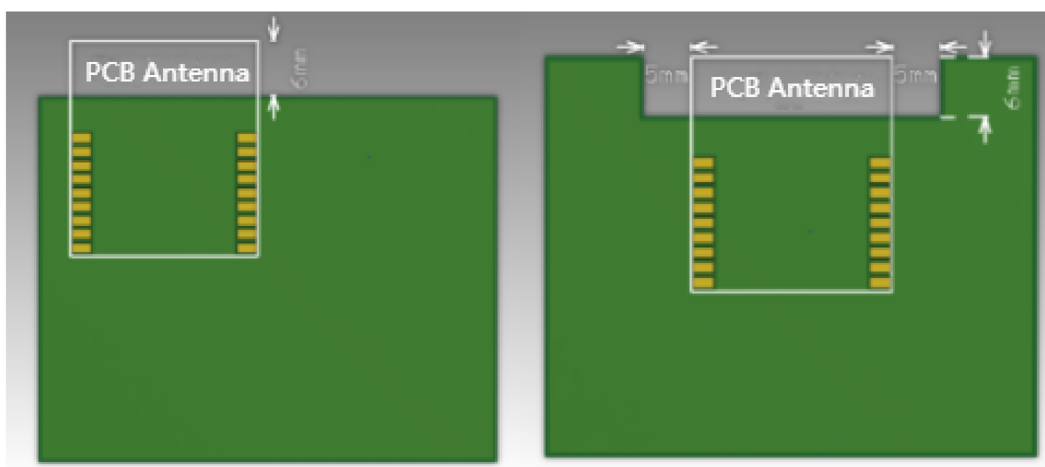
5 Antenna information

5.1 Antenna type

ZPU uses a PCB antenna with a gain of 2.19 dBi.

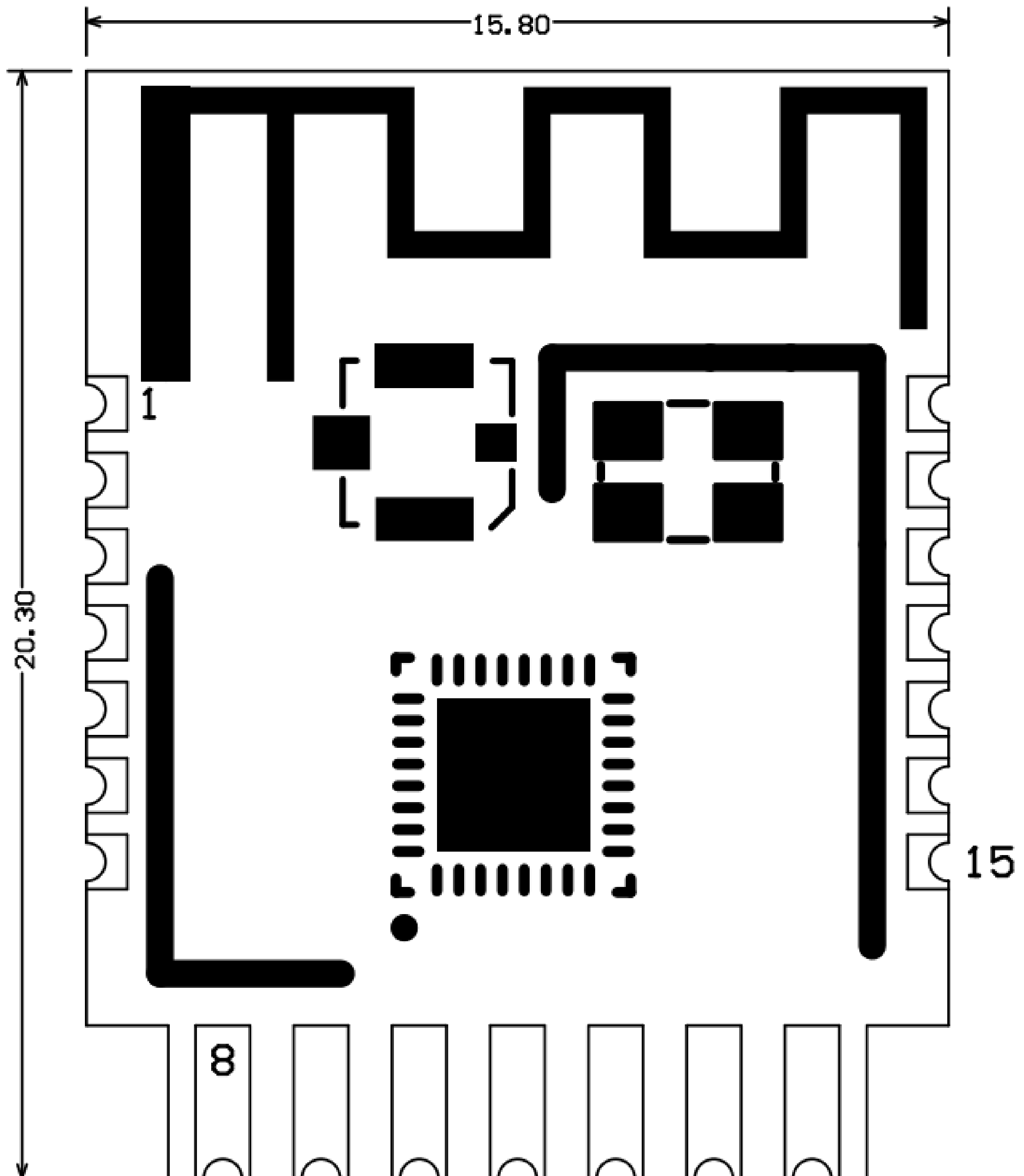
5.2 Antenna interference reduction

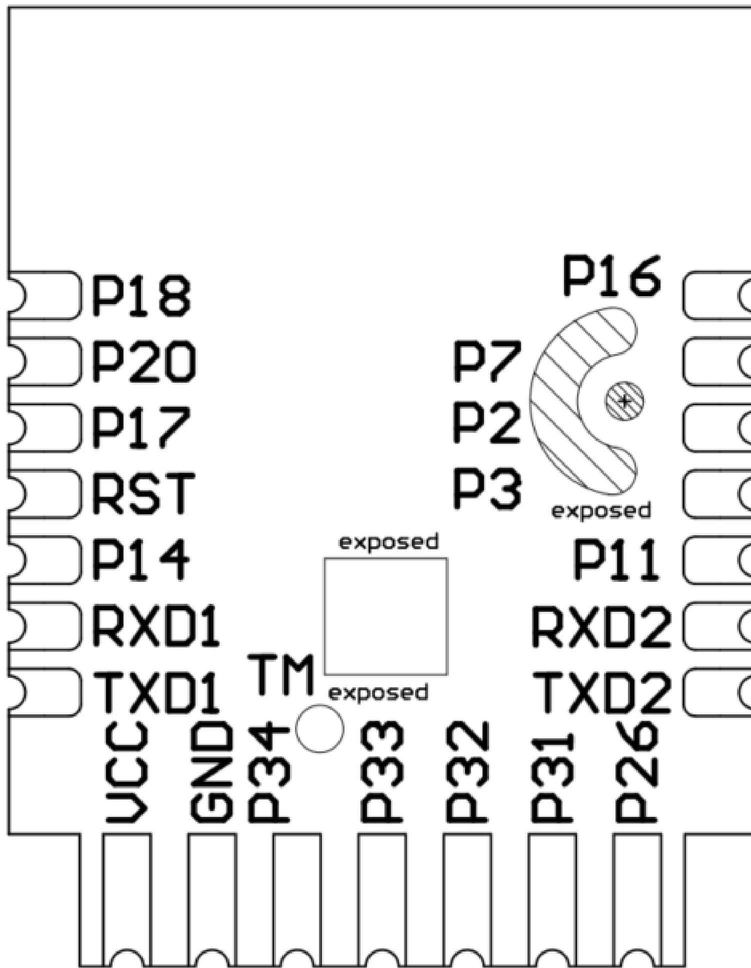
To ensure the optimal RF performance, we recommend that the antenna be at least 15 mm away from other metal parts. If metal materials are wrapped around the antenna, the wireless signals will be greatly reduced, deteriorating the RF performance. During the finished product design, sufficient space needs to be reserved for the antenna.

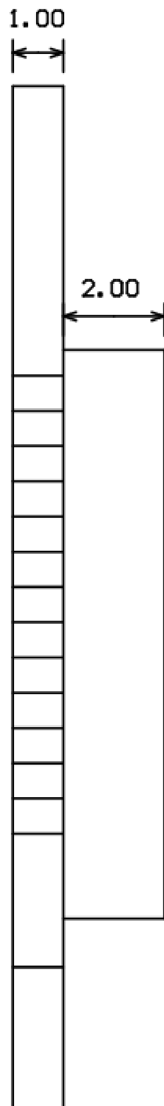


6 Packaging information and production instructions

6.1 Mechanical dimensions and rear pad dimensions




P18
P20
P17
RST
P14
RXD1
TXD1
P16
P7
P2
P3
exposed
exposed
P11
RXD2
TM
exposed
TXD2
VCC
GND
P34
P33
P32
P31
P26
Bottom View



Unit：mm

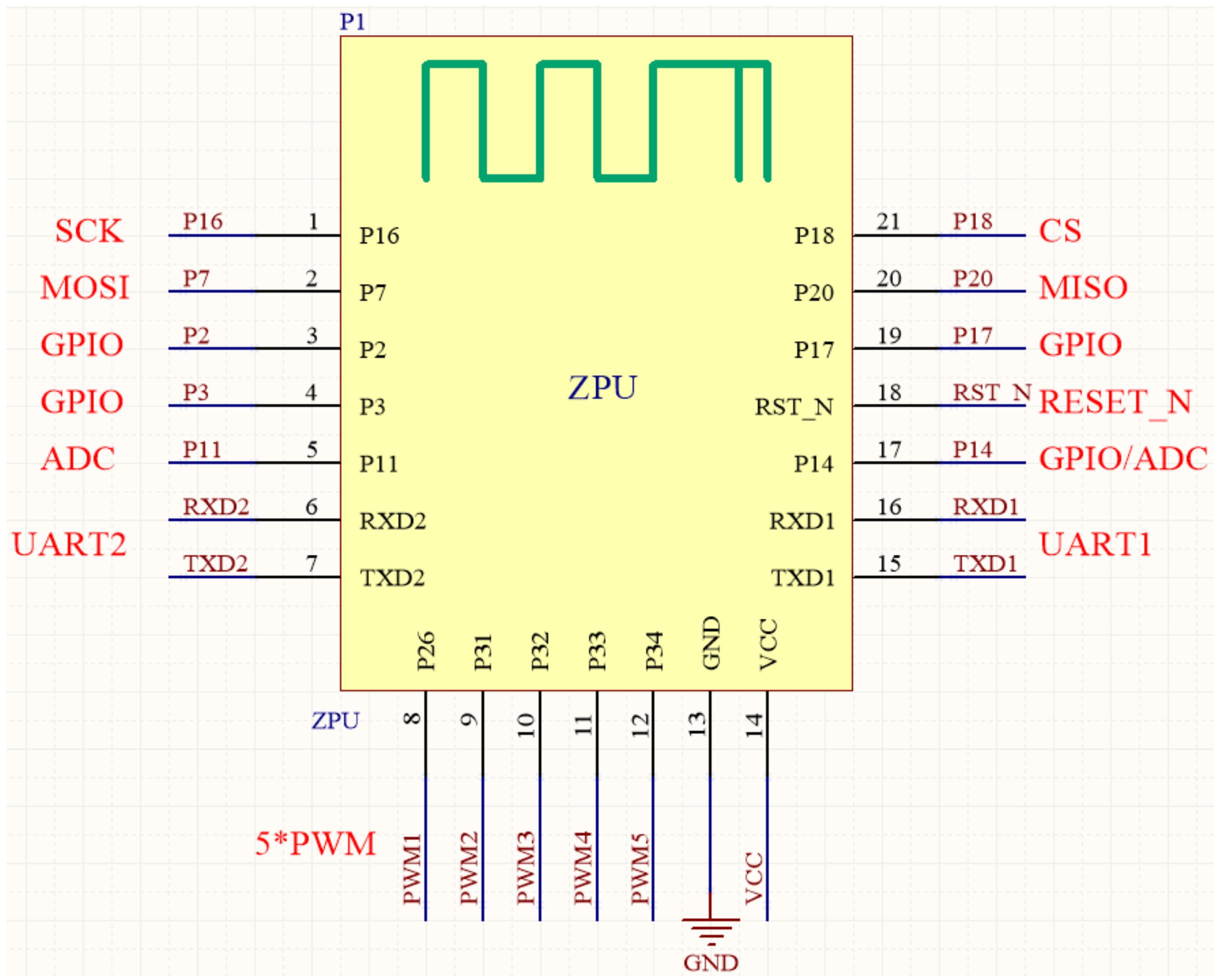
Module form factor tolerance: ± 0.35mm

PCB thickness tolerance: ±0.1mm

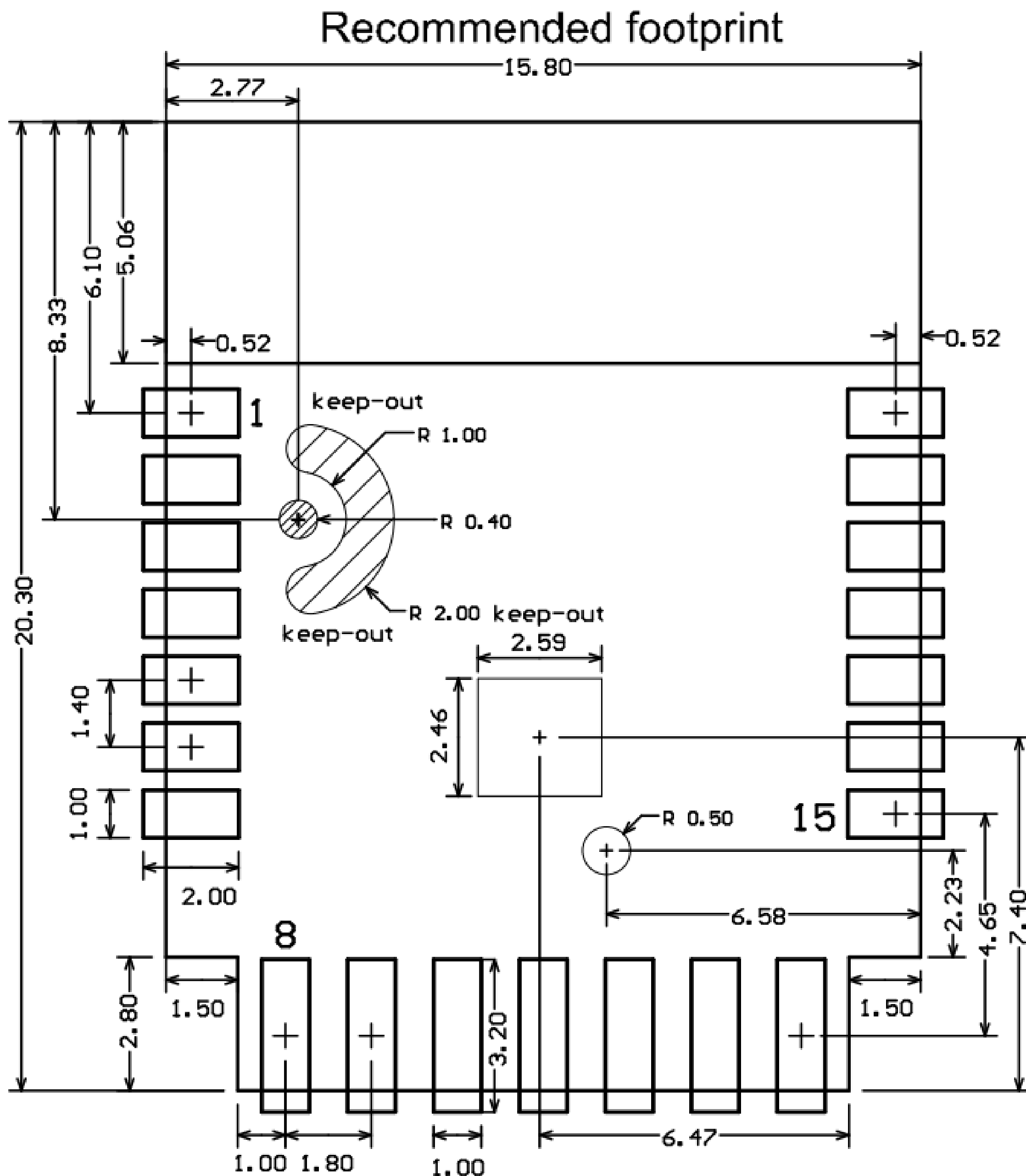
Shield cover height tolerance: ±0.05mm

Side View

ZPU schematic diagram and pin connection:



Recommended PCB footprint:



The default dimensional tolerance is ±0.35 mm and the critical tolerance is ±0.1 mm. If customers have specific requirements on key dimensions, these requirements should be made clear in the datasheet after communication with the customers.

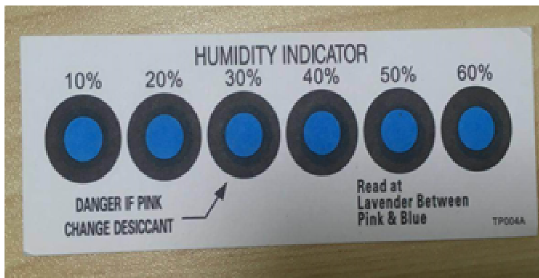
6.2 Production instructions

1. For the modules that can be packaged with the surface-mount technology (SMT) or in in-line form, 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 use an in-line package, use wave soldering. After being unpacked, the module must be soldered within 24 hours. Otherwise, it needs to be put into a drying cupboard where the relative humidity is not greater than 10% or packaged again in vacuum with the exposure time recorded. The total exposure time cannot exceed 168 hours.

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

2. A delivered module must meet the following storage requirements:

   - The moisture-proof bag must be placed in an environment where 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 indication card (HIC) in the sealed package.



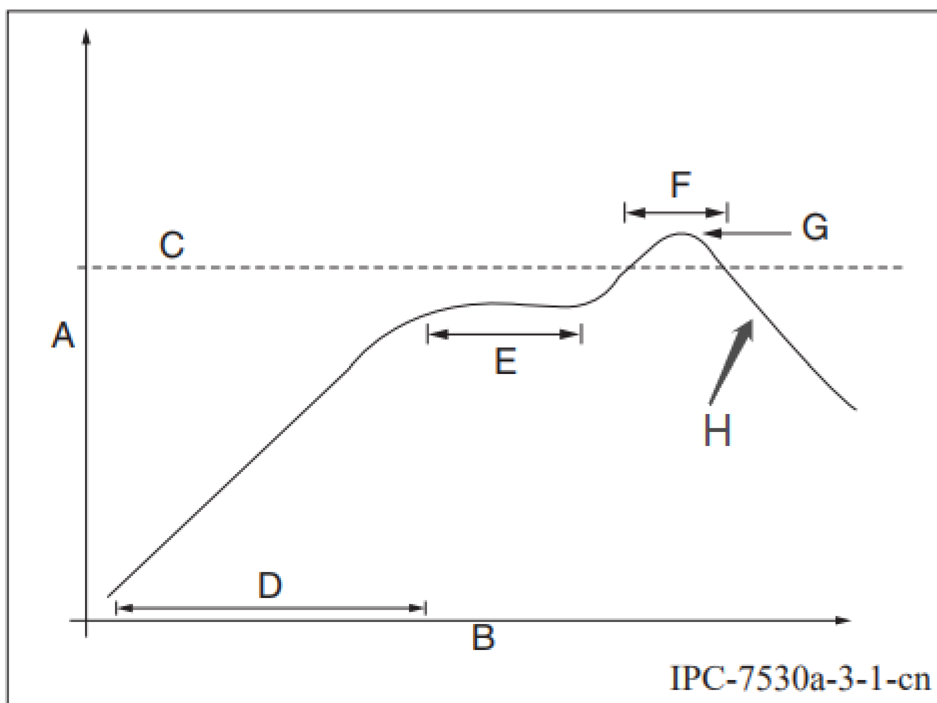
3. The module needs to be baked in the following cases:
   - The vacuum packaging bag is damaged before unpacking.
   - There is no HIC in the packaging bag.
   - After unpacking, the HIC indicates a humidity level of 10% or higher (the circle turns pink on the HIC).
   - The total exposure time has lasted for over 168 hours since unpacking.
   - More than 12 months have passed since the first sealing of the bag.
4. The baking parameter settings are described below:
   - Baking temperature: 60°C for reel packaging with relative humidity ≤ 5% and 125°C for tray packaging with relative humidity ≤ 5% (use the heat-resistant tray rather than plastic containers)
   - Baking time: 48 hours for reel packaging and 12 hours for tray packaging
   - Alarm temperature: 65°C for reel packaging and 135°C for tray packaging
   - Production-ready temperature after natural cooling: < 36°C
   - Re-baking: 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 performance.
5. In the whole production process, take electrostatic discharge (ESD) protective measures.
6. To guarantee the pass rate, we recommend that you use the SPI and AOI to monitor the quality of solder paste printing and mounting.

6.3 Recommended oven temperature curve

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

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

Set the oven temperatures according to the following curve.



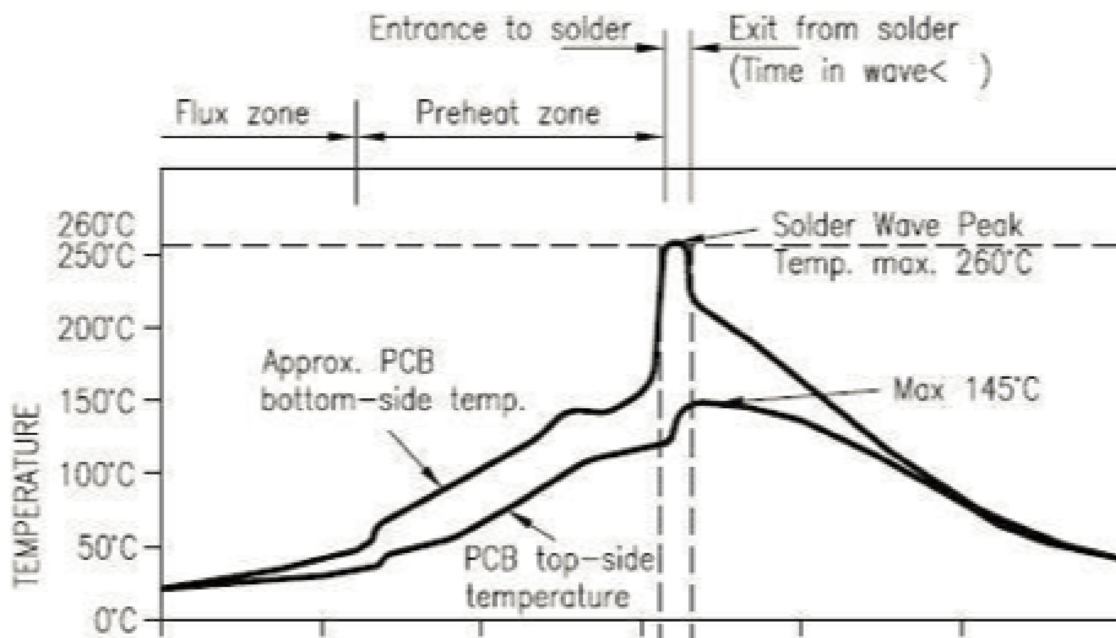
- A: Temperature axis
- B: Time axis
- C: Liquidus temperature: 217°C to 220°C
- D: Ramp-up slope: 1°C/s to 3°C/s
- E: Duration of constant temperature: 60s to 120s. The range of constant temperature: 150°C to 200°C
- F: Duration above the liquidus: 50s to 70s

- G: Peak temperature: 235°C to 245°C
- H: Ramp-down slope: 1°C/s to 4°C/s

  The curve above is based on solder paste SAC305. For more information about other solder pastes, see the recommended oven temperature curve in the solder paste specifications.

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

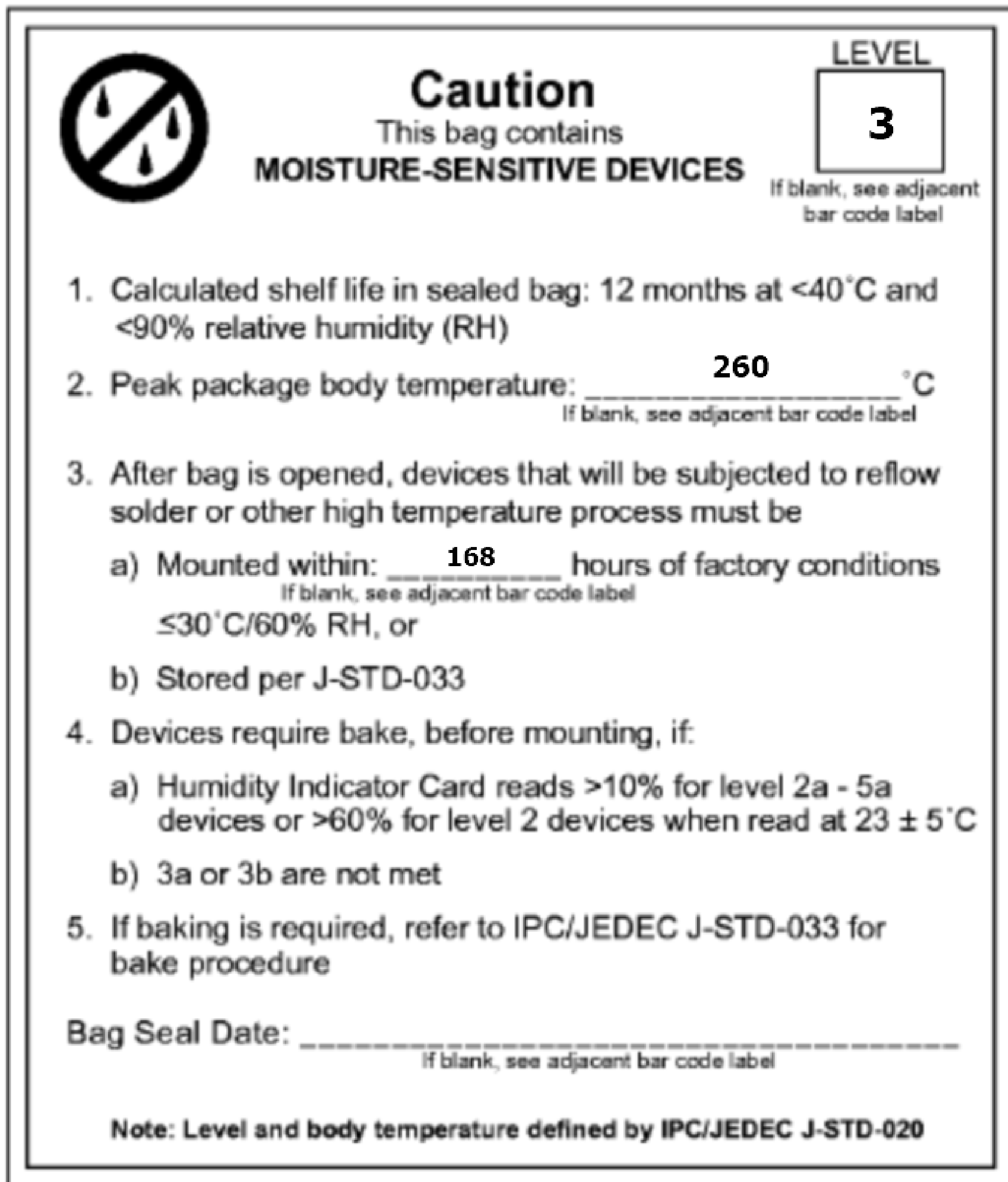
Set the oven temperatures according to the following temperature curve of wave soldering. The peak temperature is 260°C±5°C.



Suggestions on oven temperature curve of wave soldering		Suggestions on manual soldering temperature	
Preheat temperature	80°C to 130°C	Soldering temperature	360°C±20°C
Preheat time	75s to 100s	Soldering time	< 3s/point

Suggestions on oven temperature curve of wave soldering		Suggestions on manual soldering temperature	
Peak contact time	3s to 5s	N/A	N/A
Temperature of tin cylinder	260°C±5°C	N/A	N/A
Ramp-up slope	≤ 2°C/s	N/A	N/A
Ramp-down slope	≤ 6°C/s	N/A	N/A

6.4 Storage conditions



7 MOQ and packaging information

Product model	MOQ (pcs)	Shipping packaging method	Number of modules per reel	Number of reels per carton
ZPU	4,400	Tape reel	1,100	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.

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 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 20 cm 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.

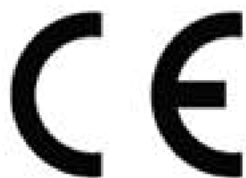
The end-user manual shall include all required regulatory information/warnings as shown in this manual, including "This product must be installed and operated with a minimum distance of 20 cm between the radiator and user body".

This device has got an FCC ID: 2ANDL-ZPU. The end product must be labeled in a visible area with the following: "Contains Transmitter Module FCC ID: 2ANDL-ZPU" This device is intended only for OEM integrators under the following conditions:

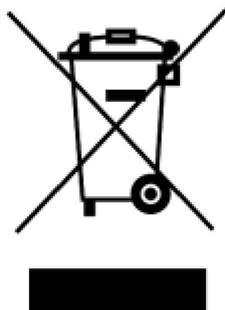
The antenna must be installed such that 20 cm is maintained between the antenna and users, and the transmitter module may not be co-located with any other transmitter or antenna.
As long as the 2 conditions above are met, further transmitter tests will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.
The module is limited to installation in mobile or fixed application.

The OEM integrator is responsible for ensuring the end-user has no manual instructions to remove or install module.

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 20 cm to the human body.