

# **ZPU-Pro Module Datasheet**

Version: 20240914

**Online Version** 



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ZPU-Pro is a Zigbee module developed by Tuya. It consists of a highly integrated RF processor chip (PHY6225) and a few peripheral circuits. ZPU-Pro integrates Radio Frequency Front End Module (FEM) GC1101, which can provide output power of up to 6dbm (typical value).ZPU-Pro 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-Pro 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: 3.0 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: Max +6 dBm
- RX sensitivity: -99 dBm at 250 kbit/s
- PCB antenna with a gain of 0.56 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



## 2. Module interfaces

## 2.1. Dimensions and packaging

ZPU-Pro has 21 pins arranged in three rows with a spacing of  $1.4\pm0.1$  mm between pins on the two sides and a spacing of  $1.8\pm0.1$  mm between pins at the bottom. The ZPU-Pro dimensions are  $20.3\pm0.35$  mm (L)  $\times$  15.8 $\pm0.35$  mm (W)  $\times$   $3.0\pm0.15$  mm (H). The thickness of the PCB is  $1.0\pm0.1$  mm. The following figures show the dimensions and packaging design of the ZPU-Pro module.



## 2.2. Pin definition

The following table describes the interface pins.

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No.	Symbol	I/O type	Description
			Common I/O pin,
			which can be used
1	D16	1/0	as the SCK of the
1	FIO	1/0	SPI and
			corresponds to
			P16 of the IC.
			Common I/O pin,
			which can be used
2	7	1/0	as the MOSI of the
2	Ρ/	1/0	SPI and
			corresponds to P7
			of the IC.
			Common I/O pin,
3	P2	I/O	which corresponds
			to P2 of the IC.
		I/O	Common I/O pin,
4	P3		which corresponds
			to P3 of the IC.
			The pin for 12-bit
			ADCs, which can
5	P11	1/0	be reused as a
5	111	1/0	common I/O pin
			and corresponds
			to P11 of the IC.
			The pin for
6			UART2_RX , which
	RXD2	1/0	can be reused as
		1/0	a common I/O pin
			and corresponds
			to P0 of the IC.

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

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No.	Symbol	l/O type	Description
			Common I/O pin,
			which can be used
			as the PWM
11	P33	I/O	output of the LED
			drive and
			corresponds to
			P33 of the IC.
			Common I/O pin,
			which can be used
			as the PWM
12	P34	I/O	output of the LED
			drive and
			corresponds to
			P34 of the IC.
			Power supply
			reference ground
13	GND	Р	pin, which must
			be properly
			grounded.
			Power supply pin
14	VCC	Р	(Typical value: 3.3
			V).
			The UART1_TX pin
			for sending data,
			which can be
15	TXD1	I/O	reused as a
			common I/O pin
			and corresponds
			to P9 of the IC.

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No.	Symbol	I/O type	Description
			The UART1_RX pin
			for receiving data,
			which can be
16	RXD1	I/O	reused as a
			common I/O pin
			and corresponds
			to P10 of the IC.
			The pin for 12-bit
			ADCs, which can
17	D1 4	1/0	be reused as a
Τ/	P14	1/0	common I/O pin
			and corresponds
			to P14 of the IC.
		I/O	Hardware reset
			pin (active at a
18	RST		low level), which
			corresponds to
			RESET_N of the IC.
		I/O	Common I/O pin,
19	P17		which corresponds
			to P17 of the IC.
			Common I/O pin,
20			which can be used
	P20	1/0	as the MISO of the
		1/0	SPI and
			corresponds to
			P20 of the IC.

3.3Electrical parameters



No.	Symbol	l/O type	Description
			Common I/O pin,
			which can be used
21	D1 9	1/0	as the CS of the
21	PIO	1/0	SPI and
			corresponds to
			P18 of the IC.
		Input	Mode selection
			pin. In flashing
			mode, it is set to a
Test point	ТМ		high level. In
			other modes, it is
			set to a low level
			or disconnected.

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• 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

Daramatar	Description	Minimum	Maximum	Unit
Parameter	Description	value	value	Onic
Te	Storage	65	150	°C
15	temperature	-05	150	C
VCC	Power supply	_0.3	3.0	V
VCC	voltage	-0.5	5.9	v
Static				
electricity				
voltage	TAMB –25°C	-	2	kV
(human body				
model)				
Static				
electricity				
voltage	TAMB –25°C	-	0.5	kV
(machine				
model)				

## 3.2. Working conditions

Parameter	Description	Minimum	Typical	Maximum	Unit
Farameter	Description	value	value value		Unit
т	Operating	40		105	۰C
Id	temperature	-40	-	105	Ľ
VCC	Operating	3.0	3.3	3.6	V
	voltage	5.0			v
VII	I/O low-				V
VIL	level input	V22	-	VCC × 0.5	v
ЛН	I/O high-			VCC	V
v II I	level input	VCC × 0.7	-	v.c.	v

Daramatar	Description	Minimum	Typical	Maximum	llait
Parameter		value	value	value	Unit
	I/O low-				
VOL	level	VSS	-	VCC $\times$ 0.1	V
	output				
	I/O high-				
VOH	level	VCC $\times$ 0.9	-	VCC	V
	output				

## 3.3. Power consumption in working mode

			Tuonamit		Peak	
Working	Mode	Rate	power/	Average	value	Unit
status			Receive	value	(Typical	
			Receive		value)	
Transmit	-	250 kbit/s	+6 dBm	76.3	93.5	mA
Pocoivo		250 kbit/c	Constantly	10.0	21	m۸
Receive	-		receive	10.9	51	ША

## 3.4. Operating current

Working	Working	Average	Peak value	
mode	status (Ta =	Average	(Typical	Unit
	25°C)	value	value)	
Quick pairing	The module is			
state	in the quick	21.6	368	mA
	pairing state.			
	The module is			
Connected	in the	17 4	363	
Connected	connected	17.4		MA
	state.			
Weekly	The module is			
connected	weakly	18.2	360	mA
	connected.			



Working mode	Working status (Ta = 25°C)	Average value	Peak value (Typical value)	Unit
Deep sleep	The module is in deep sleep mode, with the 64 KB SRAM	To be determined	To be determined	μΑ
	remaining active.			



## 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 0.56 dBi

## 4.2. RF output power

	Minimum	Typical yalua	Maximum	11 :+	
Parameter	value	iypical value	value	Unit	
Maximum					
output power	-	6	-	dBm	
(250 kbit/s)					
Minimum					
output power	-	-20	-	dBm	
(250 kbit/s)					
Output power					
adjustment	-	2	-	dBm	
step					
Output					
spectrum					
adjacent-	-	-39	-	dBm	
channel					
rejection ratio					
Frequency	15		10		
error	-12	-	10	ppm	

## 4.3. RF RX sensitivity



Davamatar	Minimum	Typical yalua	Maximum	Unit
Parameter	value	Typical value	value	
RX sensitivity	-	-99	-	dBm
Frequency	250	- +	1 200	L.I.I.=
offset	-250		+300	KHZ
Co-channel				
interference	-	-10	-	dB
suppression				



## 5. Antenna information

#### 5.1. Antenna type

ZPU-Pro uses a PCB antenna with a gain of 0.56 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











# Side View

ZPU-Pro schematic diagram and pin connection:





Recommended PCB footprint:





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The default dimensional tolerance is  $\pm 0.35$  mm and the critical tolerance is  $\pm 0.1$  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  $\leq$  5% and 125°C for tray packaging with relative humidity  $\leq$  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</li>
- 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



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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  $260^{\circ}C \pm 5^{\circ}C$ .



DIP Type Product Pass Wavesolder Graph



Suggestions on oven temperature curve of wave soldering		Suggestions on manual soldering temperature		
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



Ć	Caution This bag contains 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		
3.	After bag is opened, devices that will be subjected to reflow solder or other high temperature process must be		
	a) Mounted within: <u>168</u> 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:		
	<ul> <li>a) Humidity Indicator Card reads &gt;10% for level 2a - 5a devices or &gt;60% for level 2 devices when read at 23 ± 5°C</li> </ul>		
	b) 3a or 3b are not met		
5.	If baking is required, refer to IPC/JEDEC J-STD-033 for bake procedure		
Re	See Production Date		
100	If blank, see adjacent bar code label		



# 7. MOQ and packaging information

Product		Shipping	Number of	Number of
	MOQ (pcs)	packaging	modules per	reels per
model		method	reel	carton
ZPU-Pro	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 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 20 cm between the radiator and your body.

#### Important Note

This radio module must not be installed to co-locate and operate simultaneously with other radios in the host system except by 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-Pro. The end product must be labeled in a visible area with the following: "Contains Transmitter Module FCC ID: 2ANDL-ZPU-Pro".

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 endproduct 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 20 cm from the human body.