

## 1 Product Overview

BT8P is an embedded Bluetooth low energy (BLE) module that Tuya has developed. It consists of a highly integrated Bluetooth chip (TLSR8250F512ET32) and several peripheral circuits, with an embedded Bluetooth network protocol stack and robust library functions. BT8P also contains a low-power 32-bit multipoint control unit (MCU), BLE 4 . 2 or 2.4 GHz radio, 4 MB flash memory, 48 KB static random-access memory (SRAM), and six multiplexing I/O pins.

### 1.1 Features

- ✧ Embedded low-power 32-bit MCU, which can also function as an application processor
  - Clock rate: 48 MHz
- ✧ Working voltage: 1.8 V to 3.6 V (Under 1.8 V to 2.7 V, the module can start but the RF performance is not guaranteed. Under 2.8 V to 3.6 V, the module performance is normal.)
- ✧ Peripherals: five pulse width modulation (PWM) pins
- ✧ BLE RF features
  - Compatible with BLE 4 . 2
  - Up to 2 Mbit/s RF data rate
  - TX power: +10 dBm
  - RX sensitivity: -94.5 dBm at BLE 1 Mbit/s
  - Embedded advanced encryption standard (AES) hardware encryption
  - Onboard PCB antenna
  - Working temperature: -40°C to +105°C

## 1.2 Applications

- ✧ Smart LED lights
- ✧ Smart households
- ✧ Smart low-power sensors

## Change History

No.	Date	Change Description	Version After Change
1	2019-07-03	This is the first release.	1.0.0
2	2019-10-12	Deleted the architecture diagram.	2.0.0

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## 2 Module Interfaces

### 2.1 Dimensions and Footprint

BT8P has a row of pins with a 1.27 mm pin spacing.

The BT8P dimensions (H x W x D) are  $3.5\pm 0.15$  mm x  $16\pm 0.35$  mm x  $24.8\pm 0.35$  mm. The PCB thickness is  $1.2\pm 0.1$  mm. Figure 2-1 shows the BT8P front and rear views.

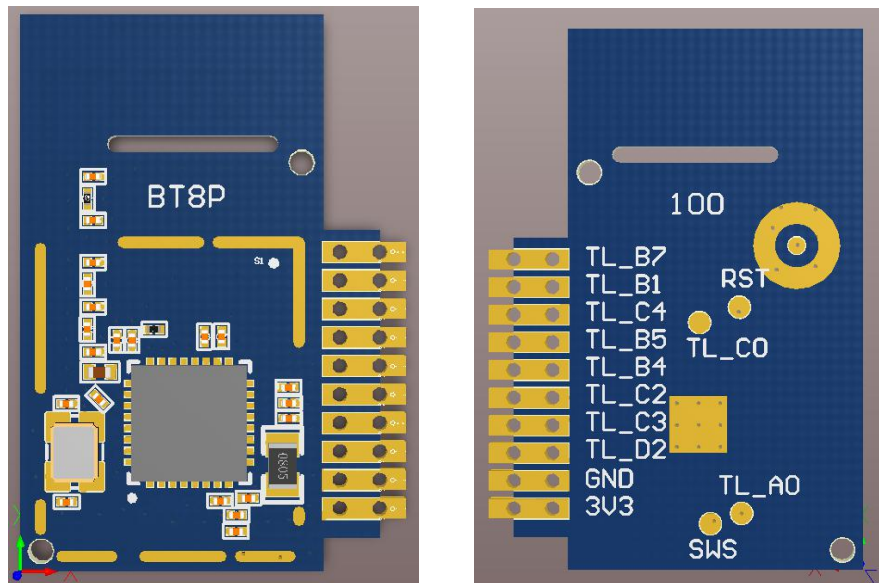


Figure 2-1 BT8P front and rear views

## 2.2 Interface Pin Definition

Table 2-1 BT8P interface pins

Pin No.	Symbol	I/O Type	Function
1	3V3	P	Power supply pin (3.3 V)
2	GND	P	Power supply reference ground pin
3	TL_D2	I/O	Common I/O pin, which can be used as a PWM output of the LED drive and is connected to the TL_D2 pin on the internal IC
4	TL_C3	I/O	Common I/O pin, which can be used as a PWM output of the LED drive and is connected to the TL_C3 pin on the internal IC
5	TL_C2	I/O	Common I/O pin, which can be used as a PWM output of the LED drive and is connected to the TL_C2 pin on the internal IC
6	TL_B4	I/O	Common I/O pin, which can be used as a PWM output of the LED drive and is connected to the TL_B4 pin on the internal IC
7	TL_B5	I/O	Common I/O pin, which can be used as a PWM output of the LED drive and is connected to the TL_B5 pin on the internal IC
8	TL_C4	Input	ADC pin, which is connected to the TL_C4 pin on the internal IC
9	TL_B1	I/O	Serial interface transmission pin (UART TX), which is connected to the TL_B1 pin on the internal IC
10	TL_B7	I/O	Serial interface receiving pin (UART RX), which is connected to the TL_B7 pin on the internal IC

Note:

1. **P** indicates power supply pins, and **I/O** indicates input/output pins.
2. If you have special requirements for light colors controlled by PWM outputs, contact Tuya business personnel.

## 3 Electrical Parameters

### 3.1 Absolute Electrical Parameters

Table 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	N/A	2	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	3.6	V
V <sub>IL</sub>	I/O low-level input	N/A	0	0.9	V
V <sub>IH</sub>	I/O high-level input	2	3.3	3.6	V
V <sub>OL</sub>	I/O low-level output	0	N/A	0.28	V
V <sub>OH</sub>	I/O high-level output	2.5	N/A	N/A	V

### 3.3 Power Consumption

Table 3-3 Power consumption in different working modes

Symbol	Description	Typical Value	Unit
I <sub>tx</sub>	Constant transmission, 10 dBm output power	20	mA
I <sub>rx</sub>	Constant receiving	6.3	mA
I <sub>DC</sub>	Connected to a mesh network	7.4	mA
I <sub>deepsleep1</sub>	Deep sleep mode 1 (16 KB RAM is reserved.)	1.2	μA
I <sub>deepsleep2</sub>	Deep sleep mode 2 (No RAM is reserved.)	0.4	μA

## 4 RF Features

### 4.1 Basic RF Features

Table 4-1 Basic RF features

Parameter	Description
Frequency band	2.4 GHz ISM band
Wireless standard	BLE 4 . 2
Data transmission rate	1 Mbit/s or 2 Mbit/s
Antenna type	Onboard PCB antenna



## 4.2 RF TX Power

Table 4-2 Power during constant transmission

Parameter	Minimum Value	Typical Value	Maximum Value	Unit
Average RF output power	-25	10	10.5	dBm
20 dB modulation signal bandwidth (1 Mbit/s)	N/A	1300	N/A	kHz
20 dB modulation signal bandwidth (2 Mbit/s)	N/A	2600	N/A	kHz

## 4.3 RF RX Sensitivity

Table 4-3 RX sensitivity

Parameter		Minimum Value	Typical Value	Maximum Value	Unit
RX sensitivity	1 Mbit/s	N/A	-94.5	N/A	dBm
	2 Mbit/s	N/A	-90	N/A	
Frequency offset	1 Mbit/s	-300	N/A	+300	kHz
	2 Mbit/s	-200	N/A	+200	
Co-channel interference suppression	N/A	N/A	-7	N/A	dB

## 5 Antenna Information

### 5.1 Antenna Type

BT8P uses an onboard PCB antenna.

## 5.2 Antenna Interference Reduction

To ensure optimal RF performance, it is recommended 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 reduced greatly, deteriorating the RF performance. As a dual in-line package (DIP), BT8P is through-hole mounted onto the PCB. Sufficient space needs to be reserved for the antenna.

## 6 Packaging Information and Production Instructions

### 6.1 Mechanical Dimensions and Rear Solder Pad Dimensions

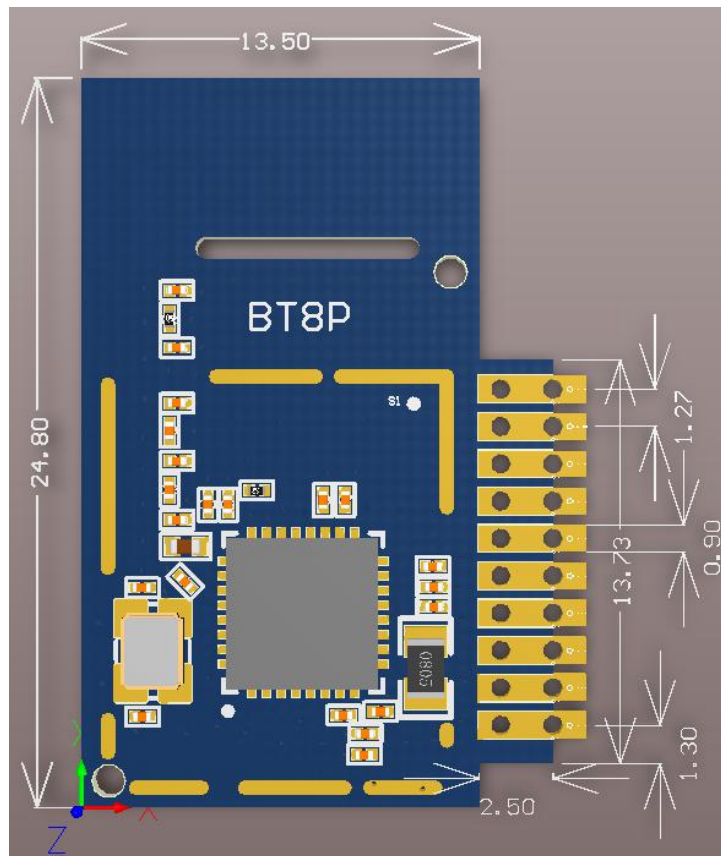


Figure 6-1 BT8P mechanical dimensions

## 6.2 Production Instructions

1. Preferentially use the wave soldering machine to solder the module, which is recommended for Tuya-developed modules that are through-hole mounted onto PCBs. Use hand soldering only when there is no operational wave soldering machine. Complete soldering within 24 hours after the module is unpacked. If not, vacuum pack the module again.
  - (1) Required materials for soldering:
    - i. Wave soldering machine
    - ii. Wave soldering fixture
    - iii. Constant-temperature iron
    - iv. Wave solder bar, wire, and flux
    - v. Oven temperature tester
  - (2) Baking equipment
    - i. Cabinet oven
    - ii. Anti-static heat-resistant trays
    - iii. Anti-static heat-resistant gloves
2. Bake the module if any of the following conditions is met:
  - (1) The vacuum package is damaged before the module is unpacked.
  - (2) The package does not contain a humidity indicator card (HIC).
  - (3) After the module is unpacked, the HIC shows that the 30% and higher rate circles are pink.
  - (4) Production is not completed within 72 hours after the module is unpacked.
  - (5) The module has been packed for more than six months.
3. Baking settings:
  - (1) Baking temperature:  $65\pm 5^{\circ}\text{C}$  in reel pack mode and  $125\pm 5^{\circ}\text{C}$  in tray pack mode
  - (2) Baking time: 48 hours in reel pack mode and 12 hours in tray pack mode
  - (3) Alarm temperature:  $70^{\circ}\text{C}$  in reel pack mode and  $130^{\circ}\text{C}$  in tray pack mode
  - (4) Production ready temperature after natural cooling:  $< 36^{\circ}\text{C}$

- (5) Number of baking times: 1
- (6) Rebaking condition: Production is not completed within 72 hours after baking.
- 4. Do not wave solder 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.
- 5. Throughout the production process, take electrostatic discharge (ESD) protective measures.
- 6. For a good product quality, ensure that the following items meet requirements:
  - (1) Flux amount
  - (2) Wave height
  - (3) Amount of tin dross and copper in the solder pot
  - (4) Wave soldering fixture window and thickness
  - (5) Oven temperature curve for wave soldering

### **6.3 Recommended Oven Temperature Curve**

Set the oven temperature to a value recommended for wave soldering. The peak temperature is  $260\pm 5^{\circ}\text{C}$ . Figure 6-2 shows the oven temperature curve for wave soldering.

## DIP Type Product Pass Wavesolder Graph

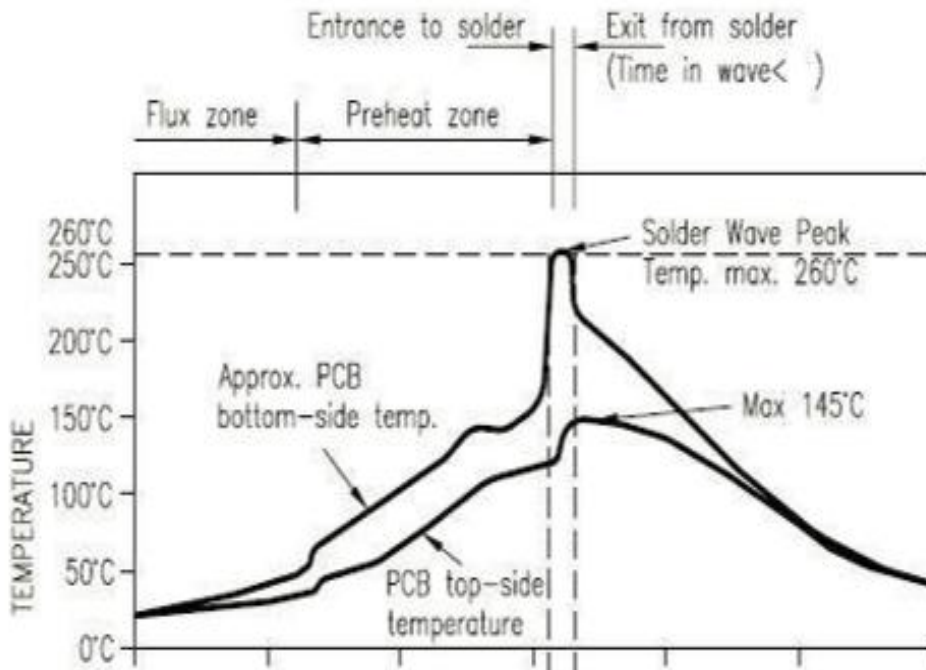


Figure 6-2 Oven temperature curve for BT8P

Table 6-1 Recommended wave soldering temperature

Wave Soldering		Hand Soldering	
Preheat temperature	80°C to 130°C	Wave soldering temperature	360±20°C
Preheat time	75s to 100s	Soldering time	< 3s per point
Contact time	3s to 5s	N/A	N/A
Solder pot temperature	260±5°C	N/A	N/A
Temperature increase rate	≤ 2°C per second	N/A	N/A
Temperature drop rate	≤ 6°C per second	N/A	N/A

## 6.4 Storage Conditions

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 HIC.

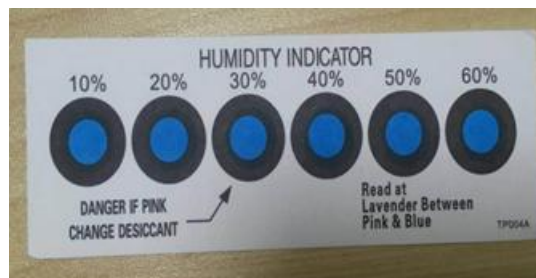


Figure 6-3 HIC for BT8P

	<b>CAUTION</b>	<b>LEVEL</b>
	<b>This bag contains MOISTURE-SENSITIVE DEVICES</b>	<b>3</b>
<small>If Blank, see adjacent bar code label</small>		
1. Calculated shelf life in sealed bag: 12 months at < 40°C and < 90% relative humidity (RH)		
2. Peak package body temperature: <u>260</u> °C <small>If Blank, see adjacent bar code label</small>		
3. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must		
a) Mounted within: <u>168</u> hrs. of factory conditions <small>If Blank, see adjacent bar code label</small>		
≤ 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: _____ <small>If Blank, see adjacent bar code label</small>		
Note: Level and body temperature defined by IPC/JEDEC J-STD-020		

## 7 MOQ and Packing Information

MOQ and packing information				
Product Model	MOQ	Packing Method	Number of Modules in Each Reel Pack	Number of Reel Packs in Each Box
BT8P	3600	Carrier tape and reel packing	900	4

## 8 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.

This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.

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.

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-BT8P"

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 Tuya Information Technology Co., Ltd. declares that this BLE 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