# BP3L Module Datasheet

Version: 20210817

# Contents

BP3L is a low-power embedded Bluetooth module that Tuya has developed. Embedded with the Bluetooth communication protocol stack and rich library functions, it mainly consists of a highly integrated Bluetooth chip (PHY6222) and a few peripheral circuits.

# 1 Product overview

BP3L contains a low-power 32-bit MCU, a Bluetooth LE 5.1/2.4-G Radio, 128-KB to 8-MB flash memory, 64-KB SRAM, and 11 reusable I/O ports.

## 1.1 Features

- Embedded with a low-power 32-bit MCU, which can also function as an application processor.
- Operating voltage: 1.8 to 3.6V
- Peripherals: 5 PWMs, 1 ADC, 4 GPIOs, and 1 UART
- Bluetooth RF features

  - Bluetooth LE 5.1
  - The RF data rate can be up to 1 Mbps.
  - TX power: +8 dBm
  - RX sensitivity: -97 dBm@ 1 Mbps
  - Embedded hardware AES encryption
  - Onboard antenna with a gain of 1.09 dBi
  - Operating temperature: -40℃ to +105℃

## 1.2 Applications

- Smart LED
- Smart home

## 1.3 Change history

| Update date | Updated content | Version after update |
|---|---|---|
| 07/01/2021 | This is the first release. | V1.0.0 |

# 2 Module interfaces

## 2.1 Dimensions and footprint

BP3L has 2 lines of pins, 16 pins in total, with a spacing of 2 mm. The BP3L dimensions are 16±0.35 mm (W)×24±0.35 mm (L) ×3.3±0.15 mm (H). The thickness of the PCB is 0.8±0.1 mm.
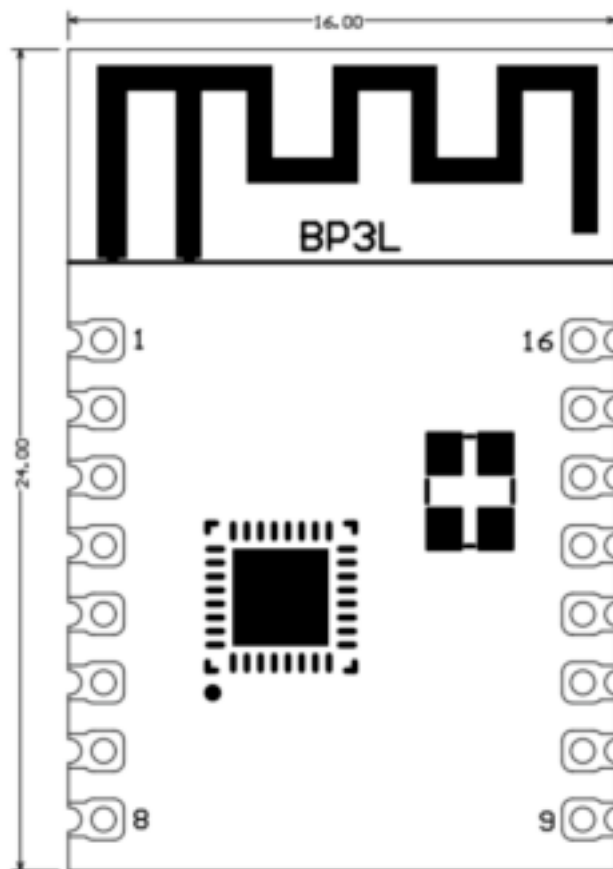
Top View

Bottom View
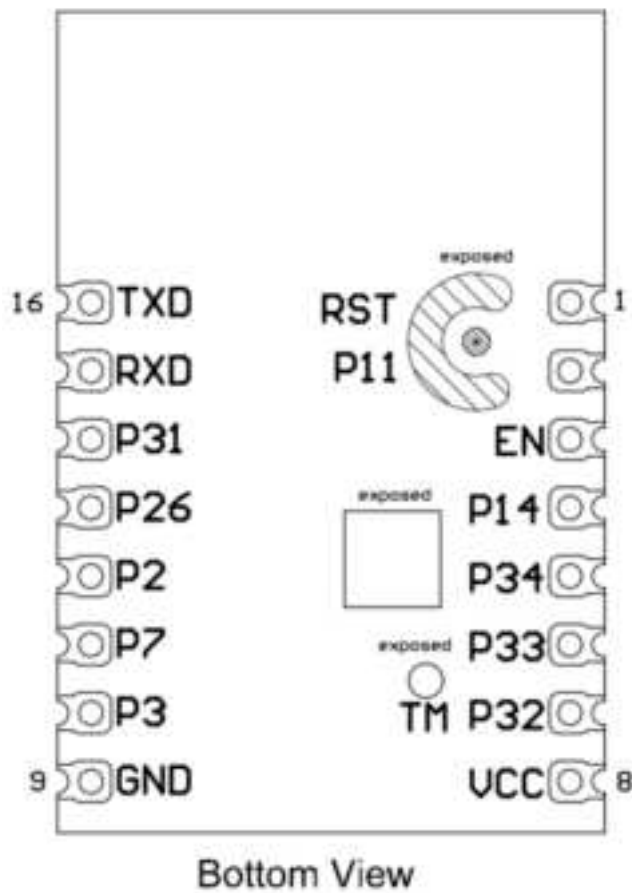
## 2.2 Pin definition

The definitions of pins are shown in the following table:

| Pin No. | Symbol | I/O type | Function |
| --- | --- | --- | --- |
| 1 | RESET_N | I/O | Reset pin (low active), correspond to RESET_N of the internal IC. |

| Pin No. | Symbol | I/O type | Function |
| --- | --- | --- | --- |
| 2 | P11 | AI | ADC port, 12 bit/s, which can be reused as a common I/O interface and corresponds to P11 of the IC |
| 3 | EN | I/O | Enabling pin, which is directly connected to the pin RESET_N. During normal operation of the module, do not connect the pin to anything. |
| 4 | P14 | I/O | Common I/O pin, which corresponds to P14 on the internal IC |
| 5 | P34 | I/O | Common I/O interface, which can be used as PWM output of the LED drive and corresponds to P34 of the IC |
| 6 | P33 | I/O | Common I/O interface, which can be used as PWM output of the LED drive and corresponds to P33 of the IC |

| Pin No. | Symbol | I/O type | Function |
| --- | --- | --- | --- |
| 7 | P32 | I/O | Common I/O interface, which can be used as PWM output of the LED drive and corresponds to P32 of the IC |
| 8 | VCC | P | Power supply pin (Typical value: 3.3V) |
| 9 | GND | P | Power supply reference ground |
| 10 | P3 | I/O | Common I/O pin, which corresponds to P3 on the internal IC |
| 11 | P7 | I | Common I/O pin, which corresponds to P7 on the internal IC |
| 12 | P2 | I/O | Common I/O pin, which corresponds to P2 on the internal IC |
| 13 | P26 | I/O | Common I/O interface, which can be used as PWM output of the LED drive and corresponds to P26 of the IC |

| Pin No. | Symbol | I/O type | Function |
|---------|--------|----------|----------|
| 14 | P31 | I/O | Common I/O interface, which can be used as PWM output of the LED drive and corresponds to P31 of the IC |
| 15 | RXD | I/O | Receiving pin, which can be reused as a common I/O interface and corresponds to P10 of the internal IC |
| 16 | TXD | I/O | Transmitting pin, which can be reused as a common I/O interface and corresponds to P9 of the internal IC |
| Test point | TM | I | Mode selection pin, which is pulled high in burning mode, but pulled down or not connected to anything in other modes. |

**Note**:

- P indicates a power supply pin and I/O indicates an input/output pin.
- If you have any special requirements on the light color controlled by the

PWM output, please contact Tuya business personnel.

# 3 Electrical parameters

## 3.1 Absolute electrical parameters

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

## 3.2 Working conditions

| Parameter | Description | Minimum value | Typical value | Maximum value | Unit |
|---|---|---|---|---|---|
| Ta | Operating temperature | -40 | - | 105 | ℃ |
| VCC | Operating voltage | 1.8 | 3.3 | 3.6 | V |
| $V_{IL}$ | I/O low-level input | VSS | - | VCC*0.3 | V |
| $V_{IH}$ | I/O high-level input | VCC*0.7 | - | VCC | V |

| Parameter | Description | Minimum value | Typical value | Maximum value | Unit |
|-----------|-------------|---------------|---------------|---------------|------|
| $V_{OL}$ | I/O low-level output | VSS | - | VCC*0.1 | V |
| $V_{OH}$ | I/O high-level output | VCC*0.9 | - | VCC | V |

## 3.3 Power consumption in working mode

| Symbol | Conditions | Maximum value (Typical value) | Unit |
|--------|------------|-------------------------------|------|
| Itx | Constantly transmit with the output power of 8 dBm | 24 | mA |
| Irx | Constantly receive | 15 | mA |
| IDC | Average value in mesh networking state | 13 | mA |
| IDC | Peak value in mesh networking state | 23 | mA |

# 4 RF parameters

## 4.1 Basic RF features

| Parameter | Description |
|---|---|
| Working frequency | 2.4 GHz ISM band |
| Wireless standard | Bluetooth LE 5.1 |
| Data transmission rate | 1 Mbps |
| Antenna type | PCB antenna |

## 4.2 RF output power

| Parameter | Minimum value | Typical value | Maximum value | Unit |
|---|---|---|---|---|
| Average RF output power | -20 | 8 | 10 | dBm |
| Bandwidth of 20-dB modulation signal (1M) | - | 2500 | - | KHz |

## 4.3 RF receiving sensitivity

| Parameter | Minimum value | Typical value | Maximum value | Unit |
|---|---|---|---|---|
| RX sensitivity 1 Mbps | - | -97 | - | dBm |
| Frequency offset error 1 Mbps | -250 | - | +300 | KHz |

| Parameter | Minimum value | Typical value | Maximum value | Unit |
|---|---|---|---|---|
| Co-channel interference suppression | - | -10 | - | dB |

# 5 Antenna information

## 5.1 Antenna type

BP3L uses the PCB antenna with a gain of 1.09 dBi.

## 5.2 Antenna interference reduction

To ensure the best RF performance, it is recommended that the antenna be at least 15 mm away from other metal parts. If metal materials wrap around the antenna, the wireless signal will be greatly attenuated, thereby deteriorating the RF performance. When designing the finished product, please leave enough space for the antenna.
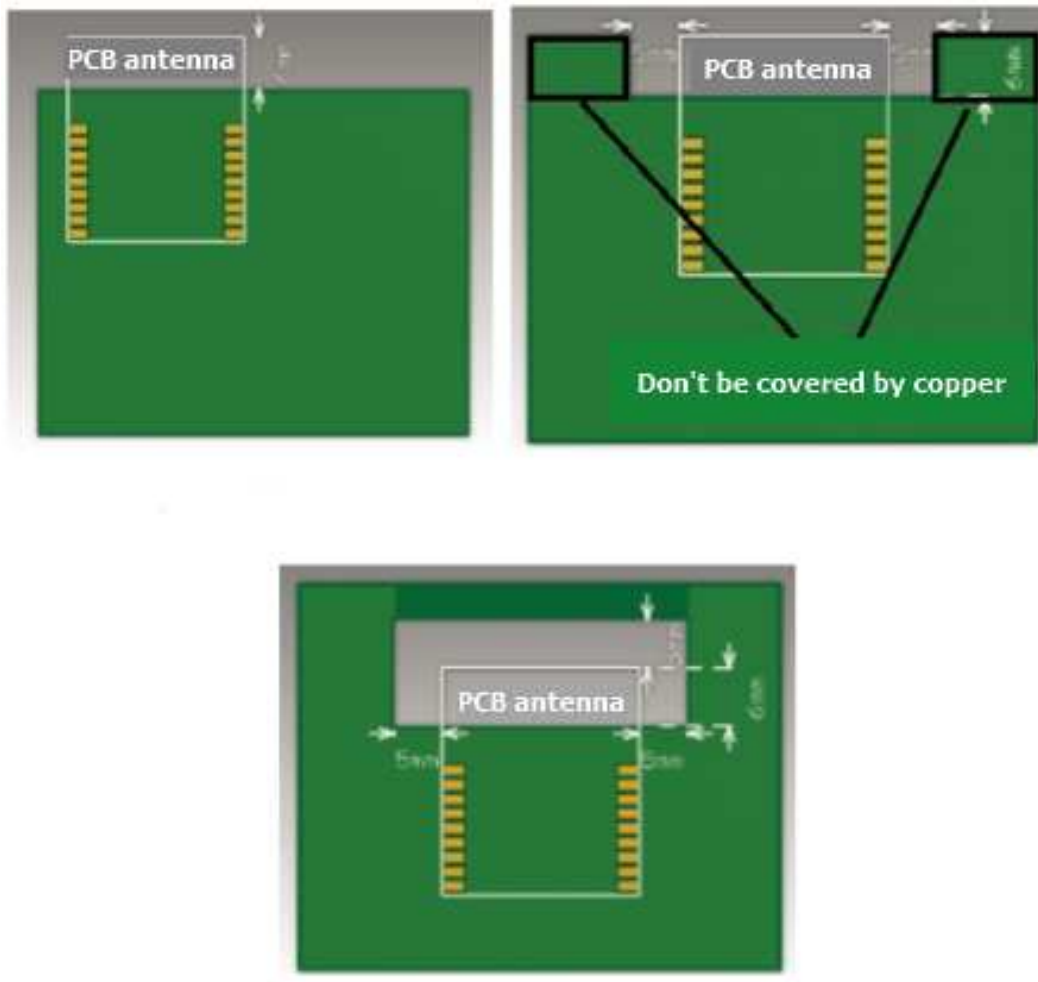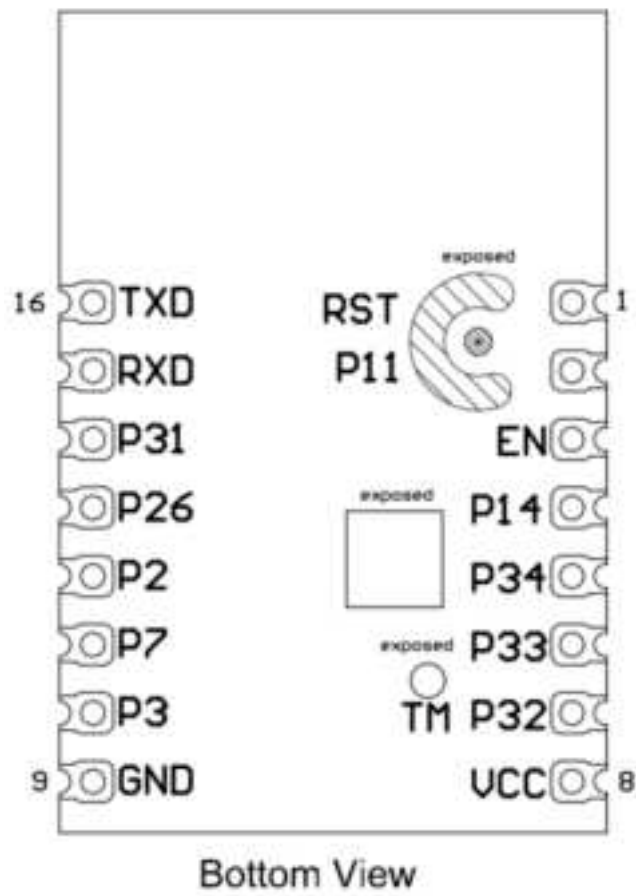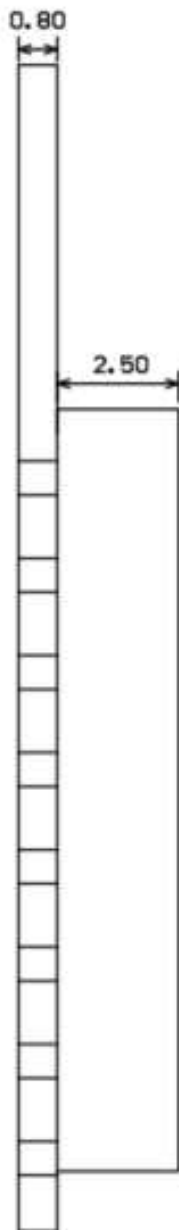
# 6 Packaging information and production instructions

## 6.1 Mechanical dimensions and dimensions of the back of the pad



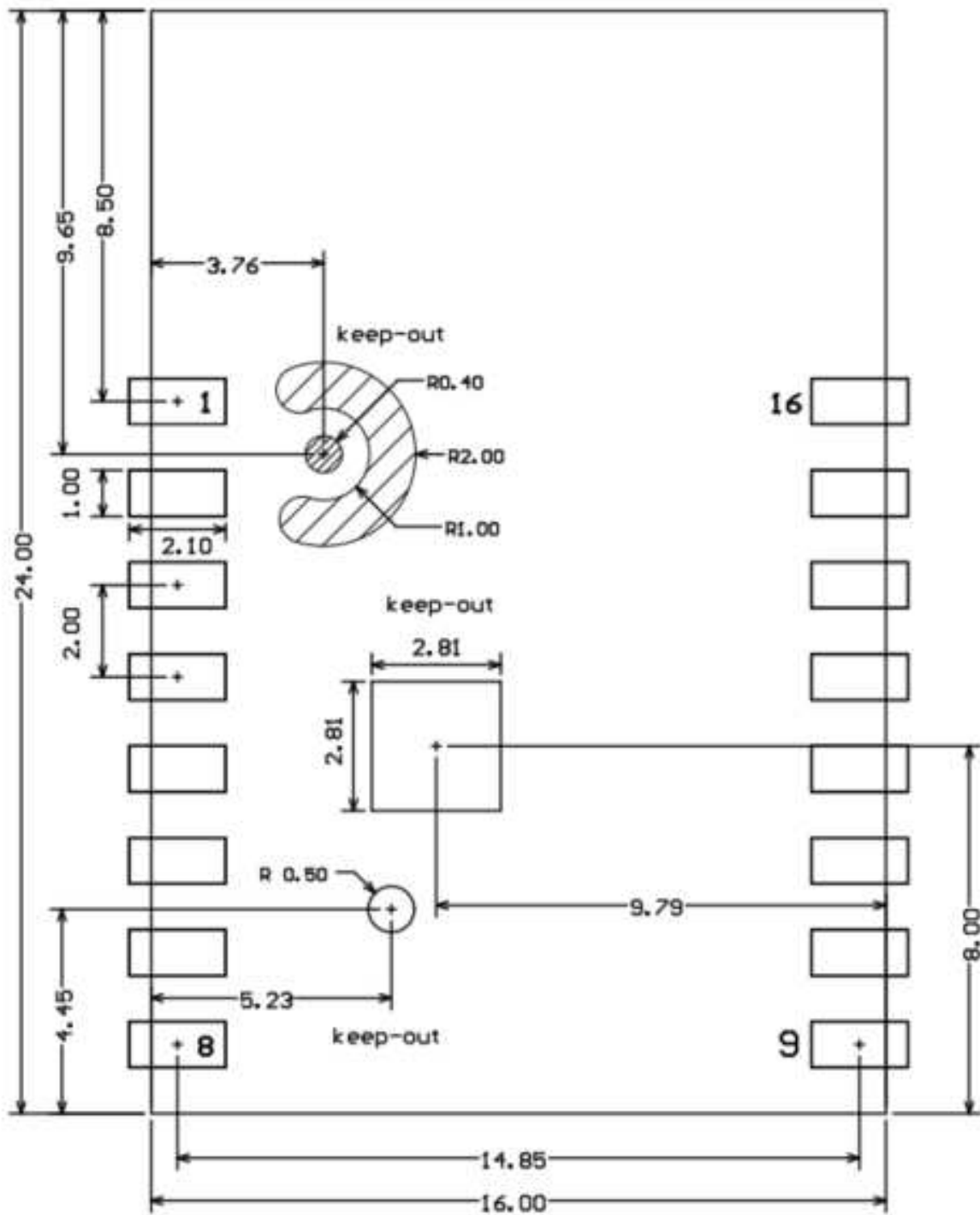Top View

Bottom View

0.80

2.50
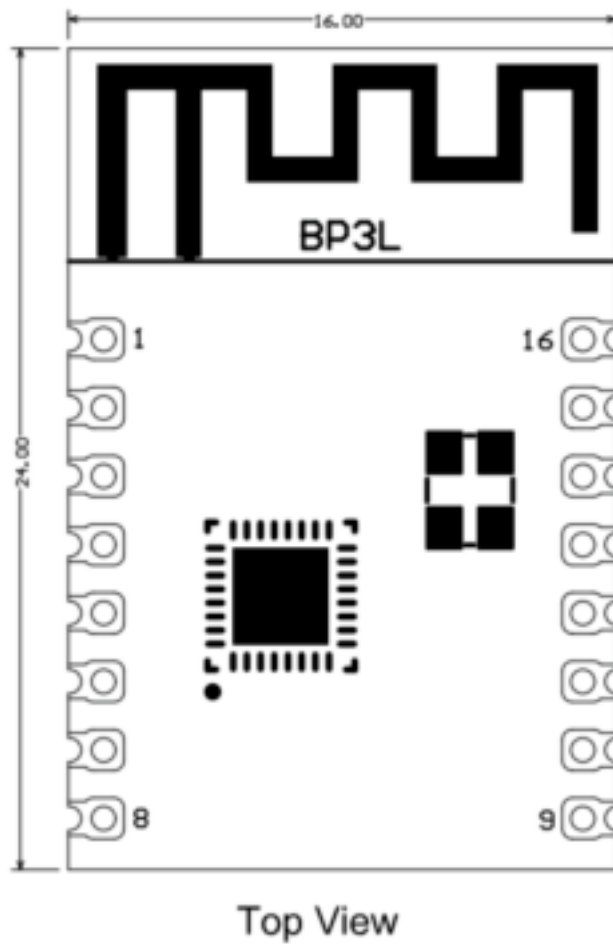
Unit: mm

Module form factor tolerance: ± 0.35mm

PCB thickness tolerance: ±0.1mm

Shield cover height tolerance: ±0.05mm

Side View

Recommended PCB footprint

Recommended footprint

The default outline dimension tolerance is ±0.35 mm, and the critical dimension tolerance is ±0.1 mm. If you have specific requirements on dimensions, specify them clearly in the datasheet after communication.

## 6.2 Production instructions

1. For the Tuya in-line module, wave soldering is most preferred and manual soldering is less preferred. After being unpacked, the module must be soldered within 24 hours. Otherwise, it must be put into the drying cupboard where the RH is not greater than 10%; or it needs to be packaged under vacuum again and record the exposure time (the total exposure time cannot exceed 168 hours).
2. Wave soldering devices and materials:

   - Wave soldering equipment
   - Wave soldering fixture
   - Constant-temperature soldering iron
   - Tin bar, tin wire, and flux
   - Thermal profiler

3. Baking devices:

   - Cabinet oven
   - Anti-electrostatic and heat-resistant trays
   - Anti-electrostatic and heat-resistant gloves

4. 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.

5. Baking settings:

   - Temperature: 60°C and ≤ 5% RH for reel package and 125°C and ≤5% RH for tray package (please use the heat-resistant tray rather than plastic container)
   - Time: 48 hours for reel package and 12 hours for tray package
   - Alarm temperature: 65°C for reel package and 135°C for tray package

- Production-ready temperature after natural cooling: < 36°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 the 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.

6. In the whole production process, take electrostatic discharge (ESD) protective measures.
7. To guarantee the quality of products, you must pay attention to the following items: The amount of soldering flux, the height of the wave peak, whether the tin slag and copper content in the wave soldering tank exceed standards, whether the window and thickness of the wave soldering fixture are appropriate, and whether the wave soldering oven temperature curve is appropriate.

**6.3 Recommended oven temperature curve and temperature**

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

DIP Type Product Pass Wavesolder Graph
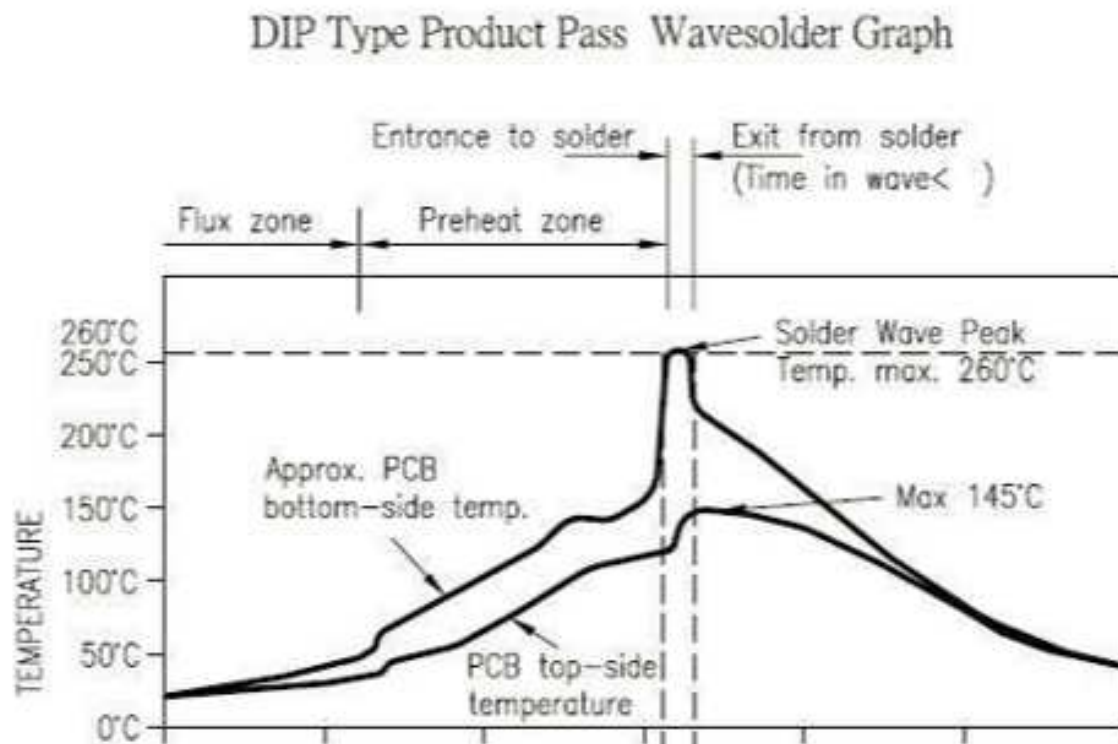


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Recommended soldering temperature:

| 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 |

## 6.4 Storage conditions

Storage conditions for a delivered module:

- The moisture-proof bag is 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 indicator card (HIC) in the packaging bag.

## 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 <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 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 ± 5°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: _____**See Production 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 |
| --- | --- | --- | --- | --- |
| BP3L | 3600 | Tape reel | 900 | 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 20cm 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-BP3L. The end product must be labelled in a visible area with the following: "Contains Transmitter Module FCC ID: 2ANDL-BP3L".

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 to the human body.