BP2S Module Datasheet

Version: 20240411

Online Version

Contents

1 Overview **2**
1.1 Features 2
1.2 Applications 2

2 Module interfaces **3**
2.1 Dimensions and footprint 3
2.2 Pin definition 3

3 Electrical parameters **7**
3.1 Absolute electrical parameters 7
3.2 Operating conditions 7
3.3 Power consumption in working mode 8

4 RF parameters **9**
4.1 Basic RF features 9
4.2 RF output power 9
4.3 RF receiver (RX) sensitivity 9

5 Antenna information **11**
5.1 Antenna type 11
5.2 Antenna interference reduction 11

6 Packing and production instructions **12**
6.1 Mechanical dimensions 12
6.2 Recommended PCB footprint 12
6.3 Production instructions 14
6.4 Recommended oven temperature curve 16
6.5 Storage conditions 19

7 MOQ and packaging information **20**

8 Appendix: Statement **21**

This topic describes Tuya’ s proprietary BP2S Bluetooth low energy (LE) module. It consists of a highly integrated PHY6222 Bluetooth chip and a few peripheral circuits. It has built-in Bluetooth protocol stacks and a rich set of library functions.

1 Overview

The BP2S module is built around a 32-bit MCU with 512 KB flash memory and 64 KB SRAM. It has 8 GPIOs. The embedded 2.4 GHz transceiver supports Bluetooth low energy (LE) 5.1.

1.1 Features

- Built-in low-power 32-bit MCU that also acts as an application processor.
- Operating voltage range: 1.8V to 3.6V
- Peripherals: five pulse-width modulators (PWMs), one analog-to-digital converter (ADC) pin, and one universal asynchronous receiver/transmitter (UART) pin.
- Bluetooth LE radio frequency (RF) features
  - Bluetooth LE 5.1
  - RF data rate of up to 1 Mbit/s
  - Transmitter (TX) power: +8 dBm
  - Receiver (RX) sensitivity: -97 dBm@Bluetooth LE 1 Mbit/s
  - Embedded hardware Advanced Encryption Standard (AES) encryption
  - Onboard PCB antenna with a gain of 0.57 dBi
  - Operating temperature range: -20°C to +85°C.

1.2 Applications

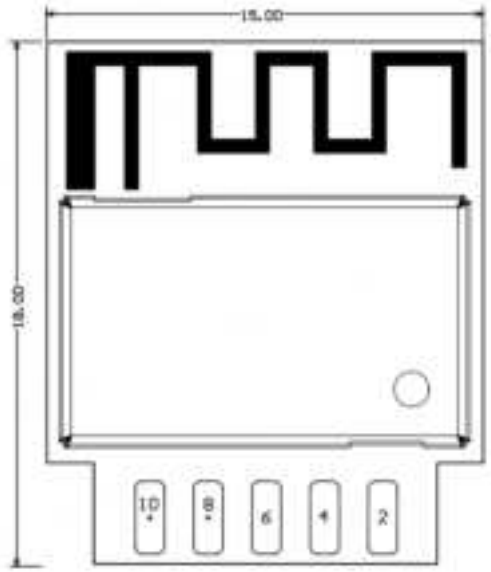
- Smart LED
- Smart home

2 Module interfaces

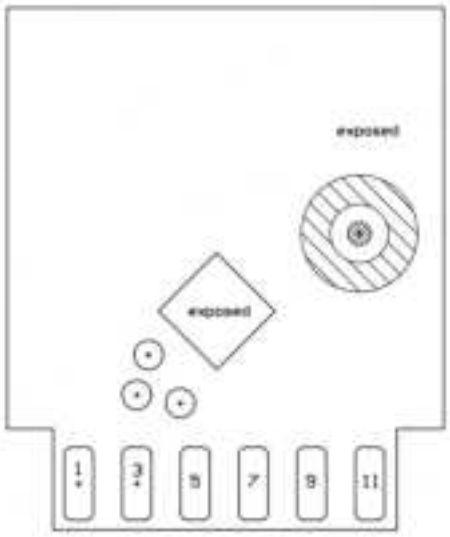
2.1 Dimensions and footprint

BP2S has two rows of pins with a 2 mm pin spacing.

Dimensions: 15±0.35 mm (W) × 18±0.35 mm (L) × 2.8±0.15 mm (H). The following figure shows the dimensions of the BP2S module.



Top View



Bottom View

2.2 Pin definition

The following table lists the pin definitions.

No.	Symbol	I/O type	Description
1	VCC	P	Power supply pin (3.3V).

No.	Symbol	I/O type	Description
2	P34	I/O	GPIO pin, corresponding to P34 on the IC. This pin can be used as PWM output for the LED driver.
3	GND	P	Ground pin.
4	P33	I/O	GPIO pin, corresponding to P33 on the IC. This pin can be used as PWM output for the LED driver.
5	RXD	I/O	Serial receiver pin `UART1_RX`, corresponding to P10 on the IC. This pin can be used as a GPIO pin.
6	P32	I/O	GPIO pin, corresponding to P32 on the IC. This pin can be used as PWM output for the LED driver.
7	TXD	I/O	Serial transmitter pin `UART1_TX`, corresponding to P9 on the IC. This pin can be used as a GPIO pin.

No.	Symbol	I/O type	Description
8	P11	I/O	12-bit ADC pin, corresponding to P11 on the IC. This pin can be used as a GPIO pin.
9	P31	I/O	GPIO pin, corresponding to P31 on the IC. This pin can be used as PWM output for the LED driver.
10	RST	I/O	Reset pin, corresponding to `RESET_N` on the IC. It is active when pulled down.
11	P26	I/O	GPIO pin, corresponding to P26 on the IC. This pin can be used as PWM output for the LED driver.
Test pin	TM	I	Mode selection pin. This pin is pulled up in flashing mode, and pulled down or left floating in other working states.

:::info

- P indicates the power pin, and I/O indicates the input and output pin.

- If you have requirements for the color of PWM output control, please contact Tuya’ s business personnel.
  :::

3 Electrical parameters

3.1 Absolute electrical parameters

Parameter	Description	Minimum value	Maximum value	Unit
Ts	Storage temperature	-40	125	°C
VCC	Supply voltage	-0.3	3.9	V
Electrostatic discharge voltage (human body model)	TAMB -25°C	-	2	kV
Electrostatic discharge voltage (machine model)	TAMB -25°C	-	0.5	kV

3.2 Operating conditions

Parameter	Description	Minimum value	Typical value	Maximum value	Unit
Ta	Operating tempera-ture	-20	-	85	°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

Symbol	Condition	Max (Typical)	Unit
Itx	Continuous transmission, with an output power of 8 dBm	24	mA
Irx	Continuous reception	15	mA
IDC	Average value when connected over Bluetooth mesh	13	mA
IDC	Peak value when connected over Bluetooth mesh	23	mA

4 RF parameters

4.1 Basic RF features

Parameter	Description
Operating frequency	2.4 GHz ISM band
Wireless standard	Bluetooth LE 5.1
Data transmission rate	1 Mbit/s
Antenna type	Onboard PCB antenna

4.2 RF output power

Parameter	Minimum value	Typical value	Maximum value	Unit
RF average output power	-20	8	10	dBm
Bandwidth of 20 dB modulation signal (1 Mbit/s)	-	2500	-	KHz

4.3 RF receiver (RX) sensitivity

Parameter	Minimum value	Typical value	Maximum value	Unit
RX sensitivity at 1 Mbit/s	-	-97	-	dBm
Frequency offset error at 1 Mbit/s	-250	-	+300	KHz

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

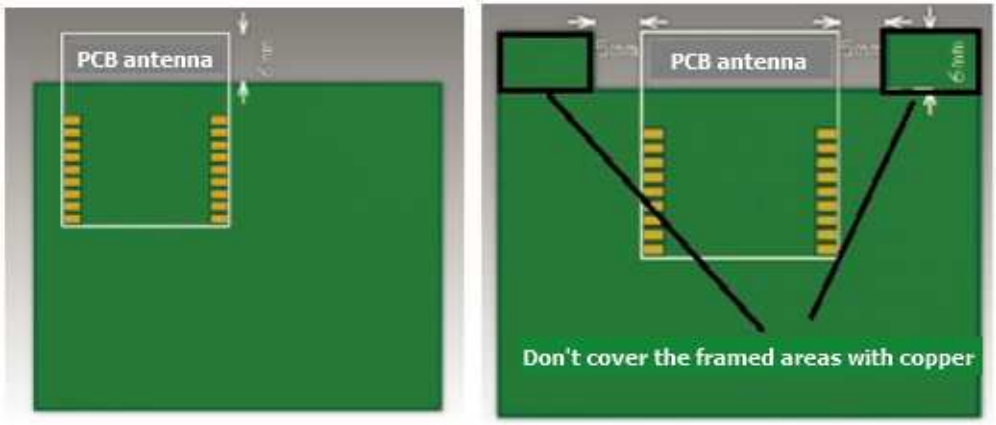
5 Antenna information

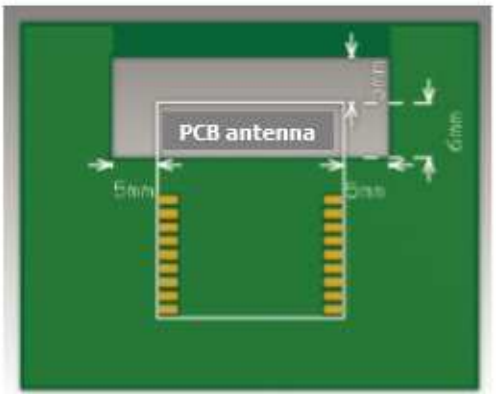
5.1 Antenna type

Onboard PCB antenna with a gain of 0.57 dBi

5.2 Antenna interference reduction

The distance between the antenna and other metal components should be at least 15 mm to provide the best radio performance. If metal materials wrap the surrounding of the antenna, the wireless signal will be greatly attenuated, thereby deteriorating the RF performance. Allow enough space to support the RF layout when designing your product.

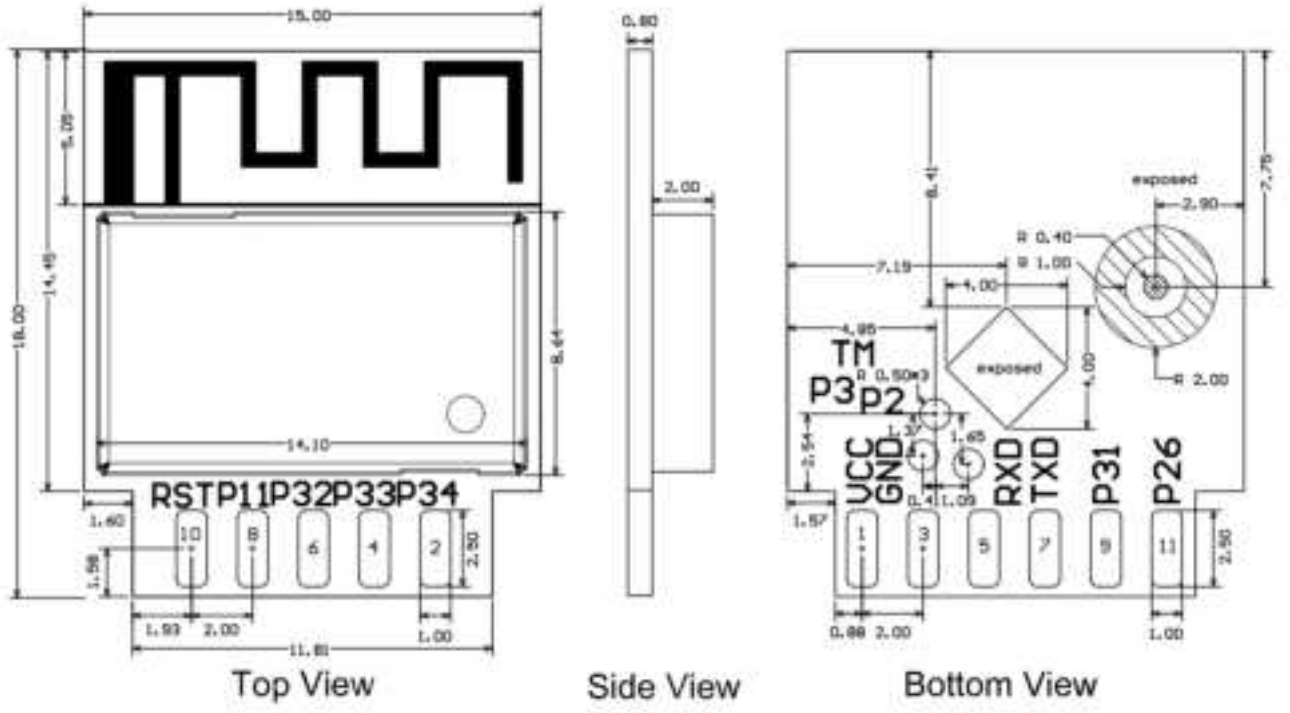




6 Packing and production instructions

6.1 Mechanical dimensions

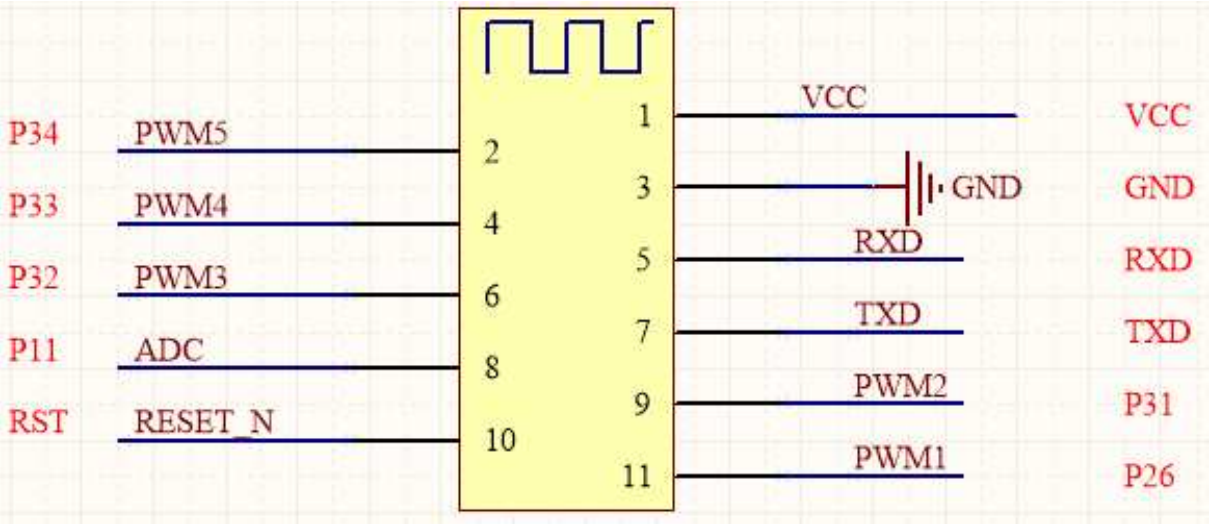
PCB dimensions: 15±0.35 mm (W) × 18±0.35 mm (L) × 0.8±0.1 mm (H). The figure below shows the mechanical dimensions of BP2S.



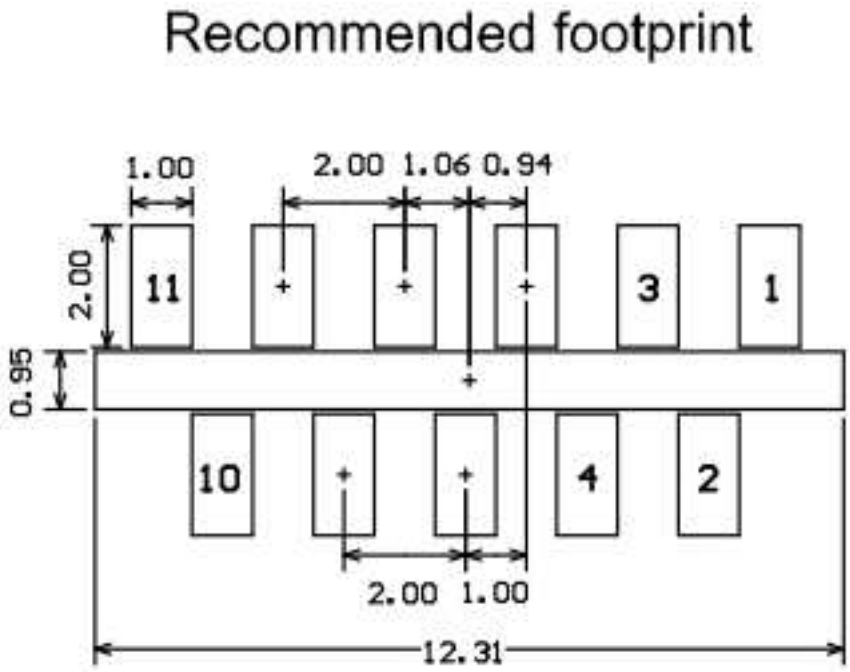
> The default tolerance of the dimensions is ±0.35 mm. If you have special requirements for key dimensions, specify them in the datasheet after consultations.

6.2 Recommended PCB footprint

The figure below shows the pins of the BP2S schematic diagram:



The figure below shows the PCB footprint of the BP2S module:



6.3 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. Complete soldering within 24 hours after the module is unpacked. Otherwise, we recommend that you place the module in a drying cupboard with a relative humidity level below 10%, or pack the module in vacuum again. Then, record the packing time and duration of exposure. The total exposure time cannot exceed 168 hours.

    - Instruments or devices required for the SMT process:
        - Surface mount system
        - SPI
        - Reflow soldering machine
        - Thermal profiler
        - AOI
    - Instruments or 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
    - Instruments or devices required for the baking process:
        - Cabinet oven
        - Electro-static discharge (ESD) protection and heat-resistant trays
        - ESD protection 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.
    - A humidity indicator card (HIC) is put in the sealed package.

Figure 1: HIC

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

   - The vacuum packaging bag is damaged before unpacking.
   - After unpacking, no HIC is found in the packaging bag.
   - After unpacking, the HIC indicates a humidity level of 10% or higher. In this case, 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: 40°C for reel packaging with relative humidity ≤ 5%. And 125°C for tray packaging with relative humidity ≤ 5% (use a heat-resistant tray, rather than plastic containers).
   - Baking time: 168 hours for reel packaging and 12 hours for tray packaging.
   - Temperature for triggering an alert: 50°C for reel packaging and 135°C for tray packaging.
   - Production can begin after a module has cooled down to below 36°C under natural conditions.
   - 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 after exposure for more than 168 hours, do not use 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, device failure or poor soldering performance might occur.

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

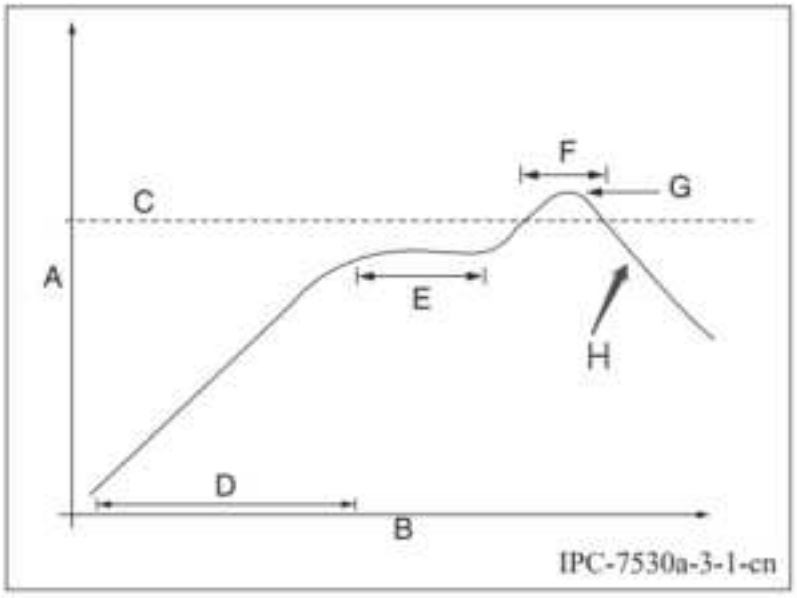
6. To guarantee the pass rate, we recommend that you use the SPI and AOI to monitor the quality of solder paste printing and mounting.

6.4 Recommended oven temperature curve

Select a proper soldering technique according to the process. For more information, refer to the recommended oven temperature curve of either reflow soldering or wave soldering. The set temperatures might deviate from the actual temperature measurements. All 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.



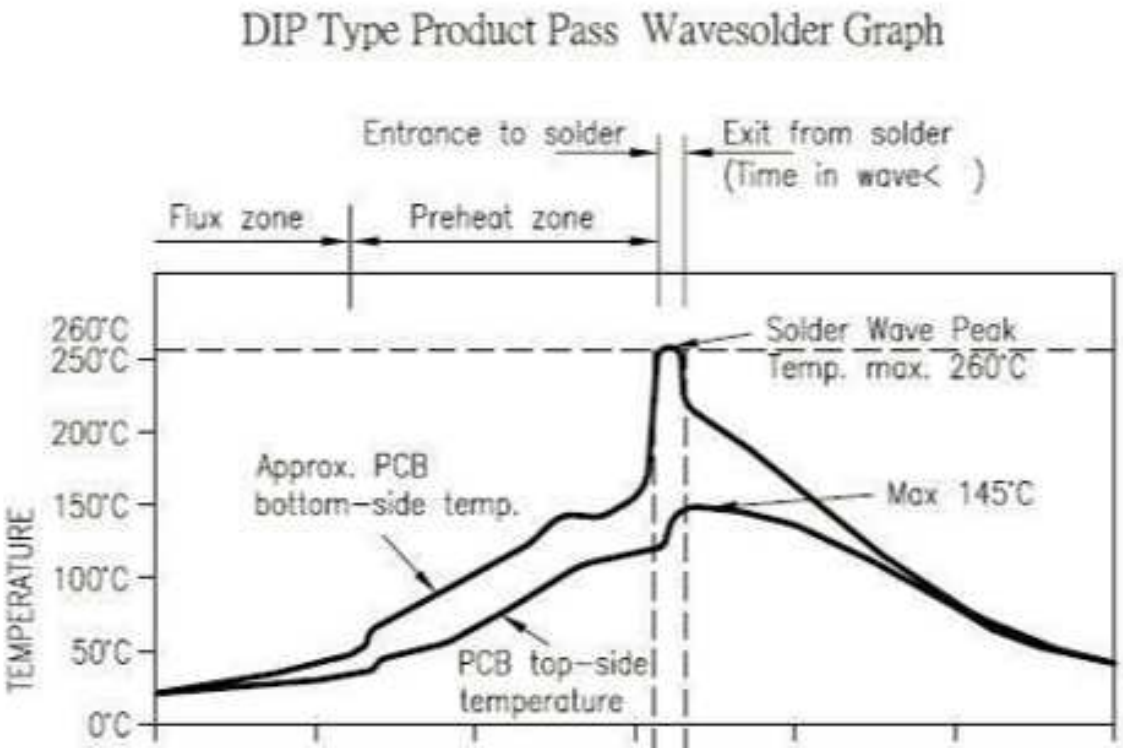
- A: temperature axis
- B: time axis
- C: alloy liquidus temperature from 217°C to 220°C
- D: ramp-up slope from 1°C/s to 3°C/s
- E: keep a constant temperature from 150°C to 200°C for a time period of 60s to 120s

- F: temperature above liquidus temperature for 50s to 70s
- G: peak temperature from 235°C to 245°C
- H: ramp-down slope from 1°C/s to 4°C/s

  :::info
  The curve above is based on solder paste SAC305. For more information about other solder pastes, see the recommended oven temperature curve in the specified 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 wave soldering		Suggestions on manual repair soldering	
Preheat temperature	80°C to 130°C	Soldering temperature	360°C ± 20°C
Preheat duration	75s to 100s	Soldering duration	Less than 3s/point
Contact duration at the peak	3s to 5s	N/A	N/A
Solder tank temperature	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

6.5 Storage conditions

7 MOQ and packaging information

Product model	MOQ (pcs)	Shipping packaging	Modules per reel	Reels per carton
BP2S	4,400	Tape and 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 20cm 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 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-BP2S. The end product must be labeled in a visible area with the following: “Contains Transmitter Module FCC ID: 2ANDL-BP2S”.

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.