BPU Module Datasheet

Version: 20211229

Online Version

Contents

1 Product overview **2**
1.1 Features . . . 2
1.2 Applications . . . 2
1.3 Change history . . . 2

2 Module interfaces **3**
2.1 Dimensions and footprint . . . 3
2.2 Pin definition . . . 6

3 Electrical parameters **11**
3.1 Absolute electrical parameters . . . 11
3.2 Operating conditions . . . 11
3.3 Power consumption in operating mode . . . 12

4 RF parameters **13**
4.1 Basic RF features . . . 13
4.2 RF output power . . . 13
4.3 RF receiving sensitivity . . . 13

5 Antenna information **15**
5.1 Antenna type . . . 15
5.2 Antenna interference reduction . . . 15

6 Packaging information and production instructions **18**
6.1 Mechanical dimensions and dimensions of the back of the pad . . . 18
6.2 Production instructions . . . 23
6.3 Recommended oven temperature curve . . . 25
6.4 Storage conditions . . . 28

7 MOQ and packaging information **29**

8 Appendix: Statement **30**

BPU is a low-power-consumption 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

BPU includes a low-power-consumption 32-bit MCU, a Bluetooth LE 5.1/2.4-G Radio, 128-KB to 8-MB flash memory, 64-KB SRAM, and 18 reusable I/O pins.

1.1 Features

- Embedded with a low-power 32-bit MCU, which can also function as an application processor.
- Working voltage: 1.8 to 3.6V
- Peripherals: 5 PWMs, 2 ADCs, 3 GPIOs, and 1 SPI
- Bluetooth RF features
  - Bluetooth LE 5.1
  - The RF data rate can be up to 1 Mbps.
  - TX power: +6 dBm
  - RX sensitivity: -97 dBm@ 1 Mbps
  - Embedded hardware meets the AES
  - Onboard antenna with a gain of 2.19 dBi
  - Operating temperature: -40℃ to +105℃

1.2 Applications

- Smart LED
- Smart home

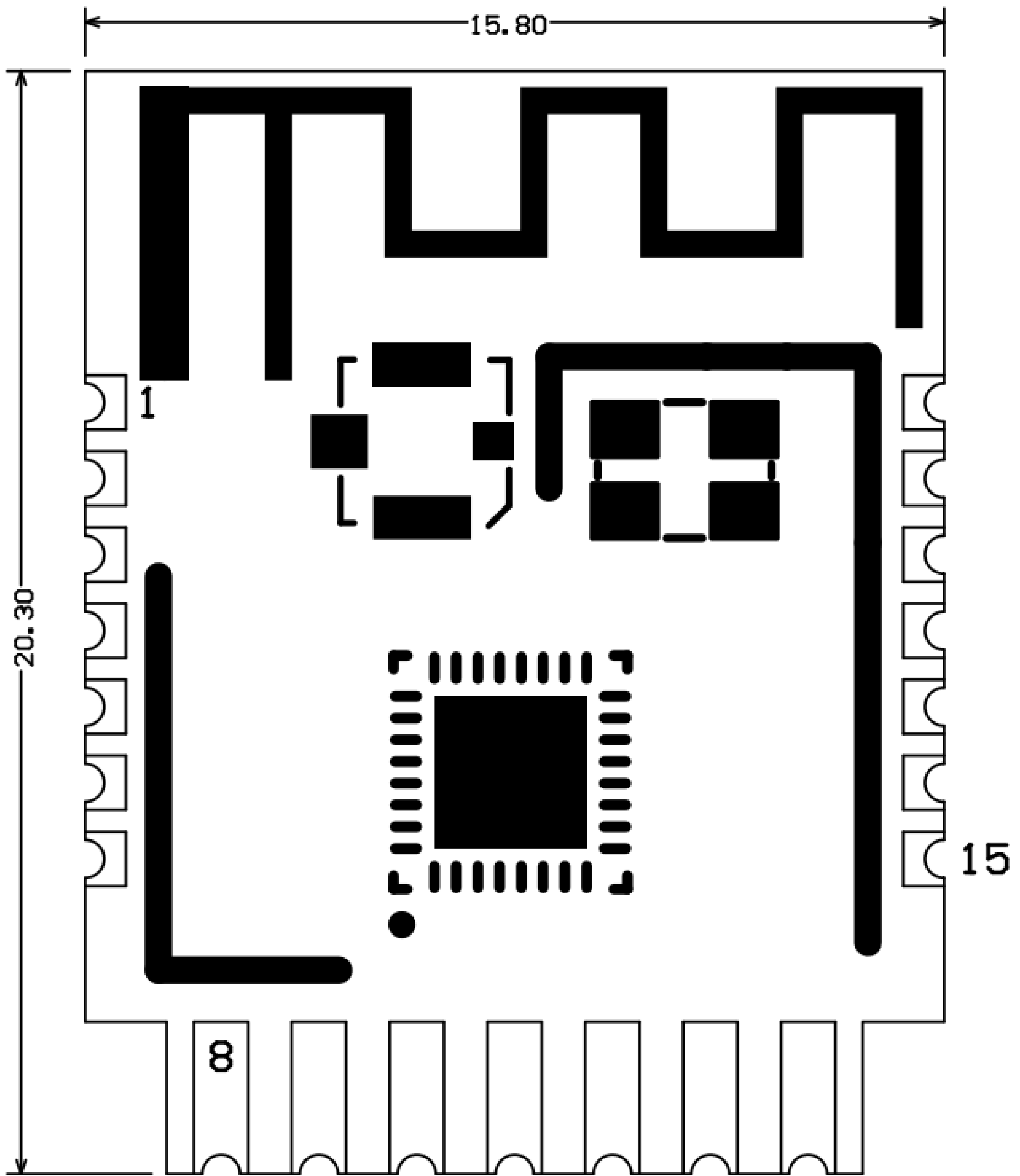
1.3 Change history

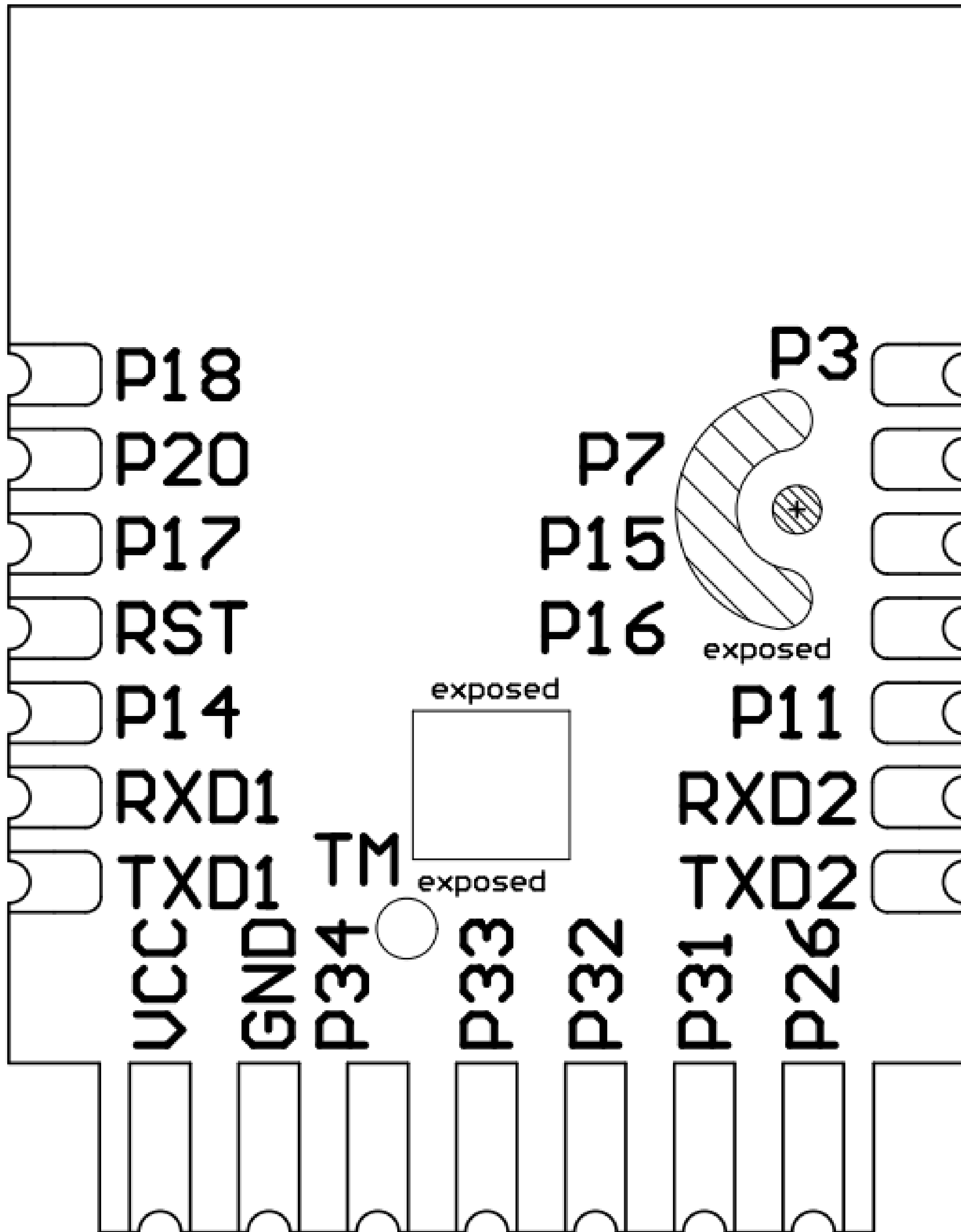
Update date	Updated content	Version after update
11/25/2021	This is the first release.	V1.0.0

2 Module interfaces

2.1 Dimensions and footprint

BPU has 3 lines, 21 pins in total. The spacing of pins at the two sides is 1.4±0.1 mm, and the spacing of pins at the bottom is 1.8±0.1 mm. The dimensions of BPU 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, which are shown below:


15.80
20.30
1
15
8
Top View


P18
P20
P17
RST
P14
RXD1
TXD1
P3
P7
P15
P16
exposed
exposed
P11
RXD2
TM
exposed
TXD2
VCC
GND
P34
P33
P32
P31
P26
Bottom View

2.2 Pin definition

The definitions of pins are shown in the following table:

Pin number	Symbol	Pin type	Function
1	P3	I/O	Common I/O interface, which can be used as SCK of the SPI interface and corresponds to P3 of the IC chip
2	P7	I/O	Common I/O pin, which can be used as MOSI of the SPI interface and corresponds to P7 of the IC
3	P15	I/O	Common I/O interface, which corresponds to P15 of the IC chip
4	P16	I/O	Common I/O interface, which corresponds to P16 of the IC chip
5	P11	I/O	ADC port, 12 bit/s, which can also be used as a common I/O pin and corresponds to P11 of the IC chip

Pin number	Symbol	Pin type	Function
6	RXD2	I/O	Serial port UART2_RX, which can also be used a common I/O pin and corresponds to P0 of the IC chip
7	TXD2	I/O	Serial port UART2_TX, which can also be used a common I/O pin and corresponds to P2 of the IC chip. It can used to output logs.
8	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 chip
9	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 chip

Pin number	Symbol	Pin type	Function
10	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 chip
11	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 chip
12	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 chip
13	GND	I/O	Common I/O interface, which can be used as PWM output of the LED drive and corresponds to P26 of the IC
14	VCC	P	Power supply pin (Typical value: 3.3V)

Pin number	Symbol	Pin type	Function
15	TXD1	I/O	UART1_TX, which can also be used a common I/O pin and corresponds to P9 of the IC chip
16	RXD1	I/O	UART1_RX, which can also be used a common I/O pin and corresponds to P10 of the IC chip
17	P14	I/O	ADC port, 12 bit/s, which can also be used as a common I/O interface and corresponds to P14 of the IC chip
18	RESET_N	I/O	Reset pin (low active), correspond to RESET_N of the IC chip.
19	P17	I/O	Common I/O interface, which corresponds to P17 of the IC chip
20	P20	I/O	Common I/O interface, which can be used as MISO of the SPI interface and corresponds to P20 of the IC chip

Pin number	Symbol	Pin type	Function
21	P18	I/O	Common I/O interface, which can be used as CS of the SPI interface and corresponds to P18 of the IC chip
Test pin	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 colour 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 Operating conditions

Parameter	Description	Minimum value	Typical value	Maximum value	Unit
Ta	Operating tempera-ture	-40	-	105	℃
VCC	Operating voltage	1.8	3.3	3.6	V
V_{IL}	Voltage input low	VSS	-	VCC*0.3	V
V_{IH}	Voltage input high	VCC*0.7	-	VCC	V
V_{OL}	Voltage output low	VSS	-	VCC*0.1	V

Parameter	Description	Minimum value	Typical value	Maximum value	Unit
V_{OH}	Voltage output high	VCC*0.9	-	VCC	V

3.3 Power consumption in operating mode

Symbol	Conditions	Maximum value (Typical value)	Unit
Itx	Constantly transmit with the output power of 6 dBm	10.9	mA
Irx	Constantly receive	5.0	mA
IDC	Average value in mesh networking state	9.4	mA
IDC	Peak value in mesh networking state	11.4	mA
Ideepsleep	Average value at common sleep mode	1	uA

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 Mbps
Antenna type	PCB antenna

4.2 RF output power

Parameter	Minimum value	Typical value	Maximum value	Unit
Average RF output power	-20	6	7	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

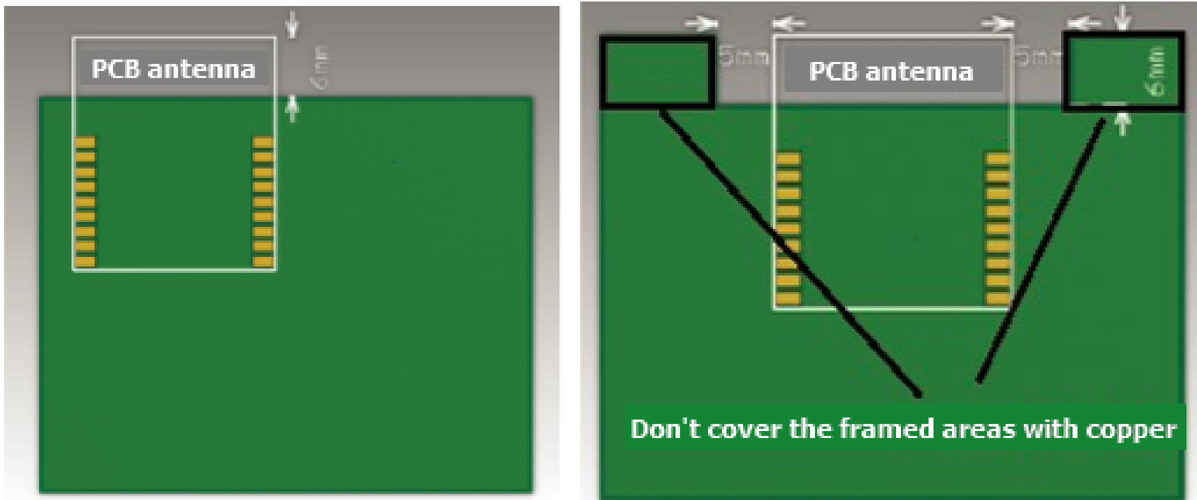
5 Antenna information

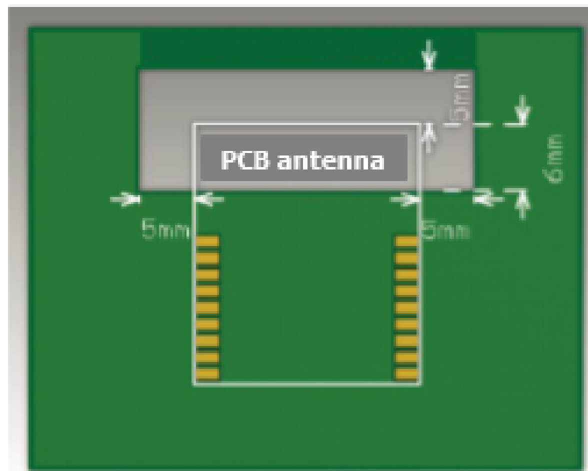
5.1 Antenna type

BPU uses the PCB antenna with a gain of 2.19 dBi.

5.2 Antenna interference reduction

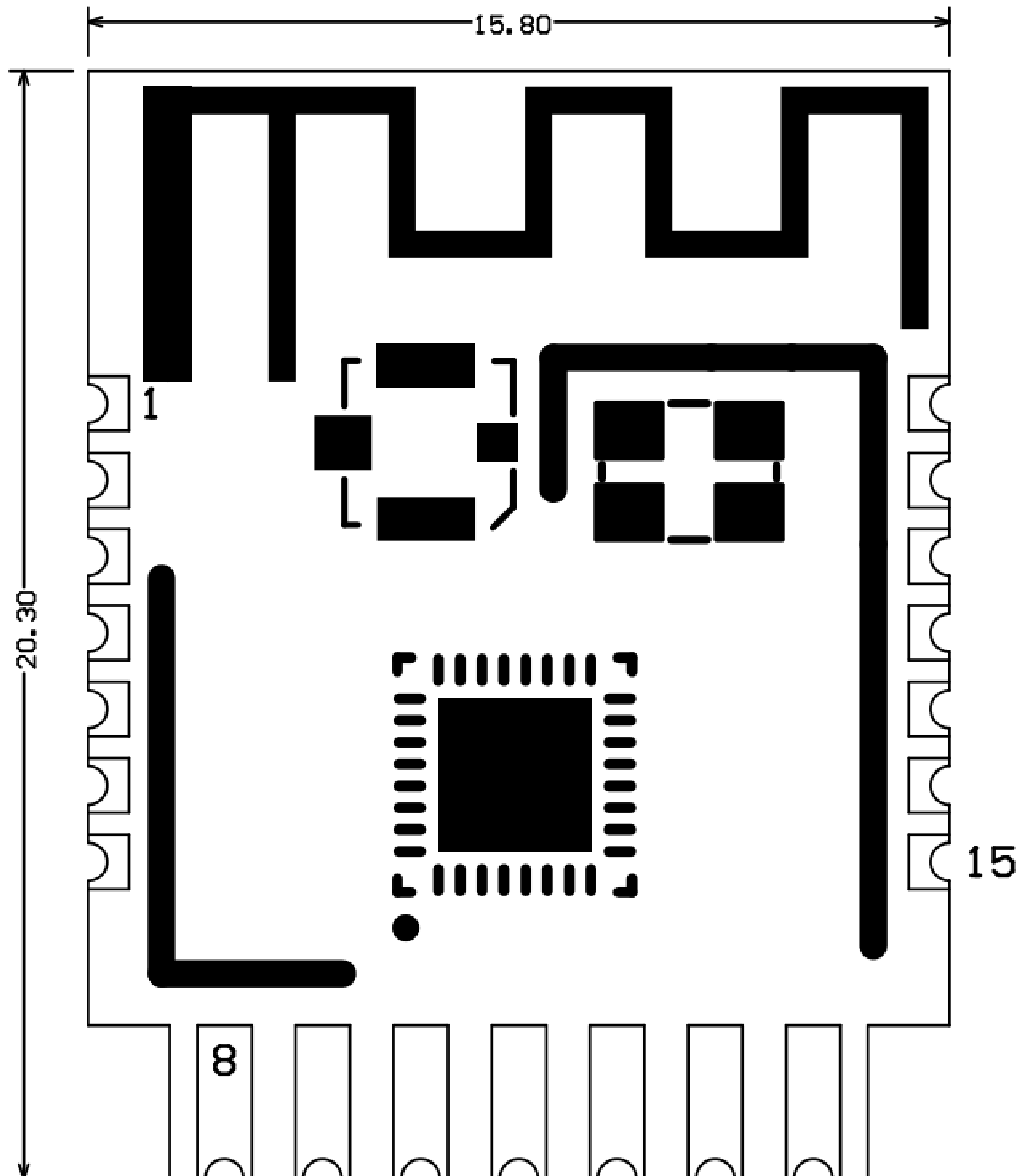
To ensure the best RF performance, it is recommended that the antenna be at least 15 mm away from other metal parts. If metal materials are wrapped around the antenna, the wireless signal will be greatly attenuated, thereby deteriorating the RF performance. When designing the finished product, please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

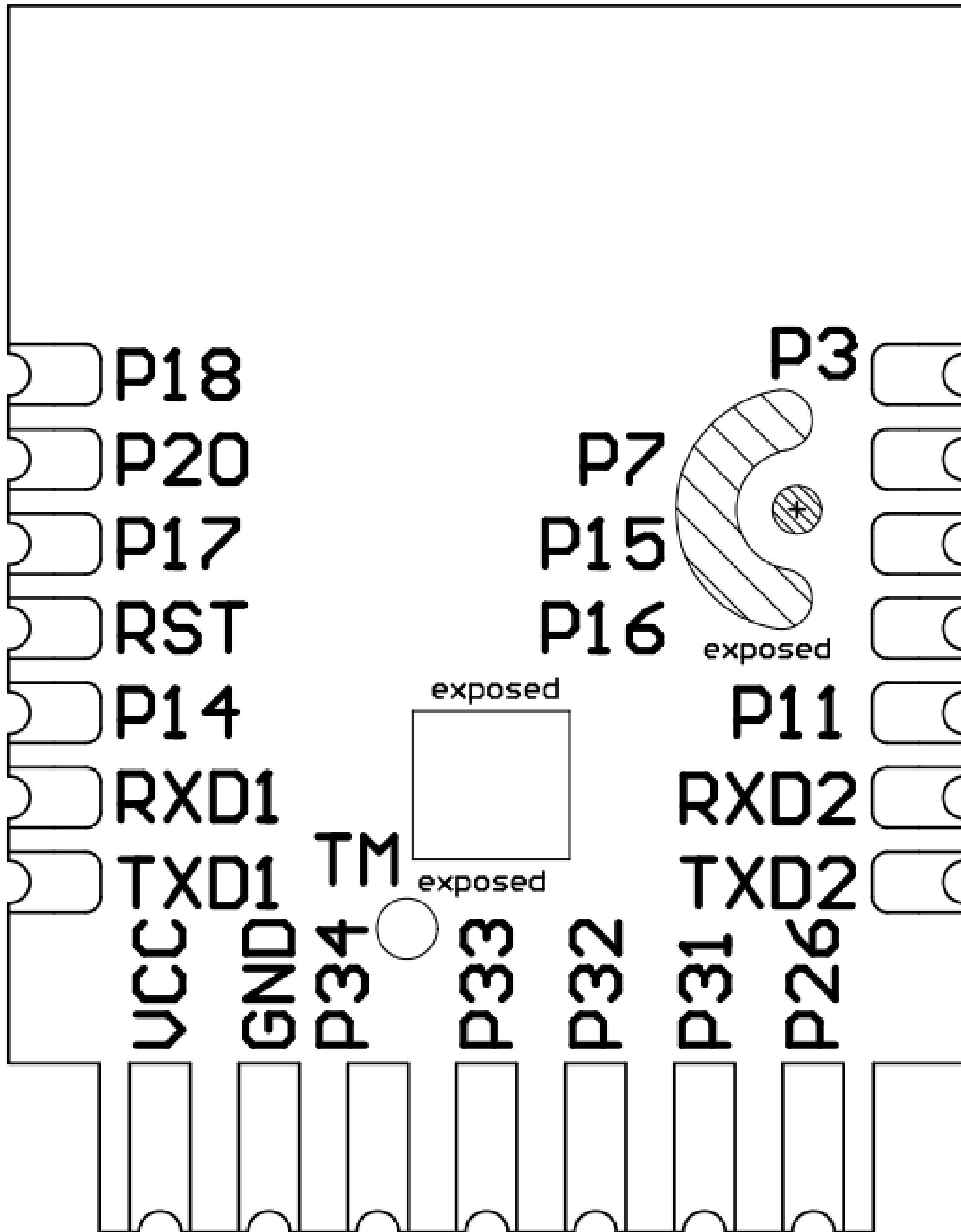

PCB antenna
6mm
5mm
5mm
PCB antenna
6mm
Don't cover the framed areas with copper

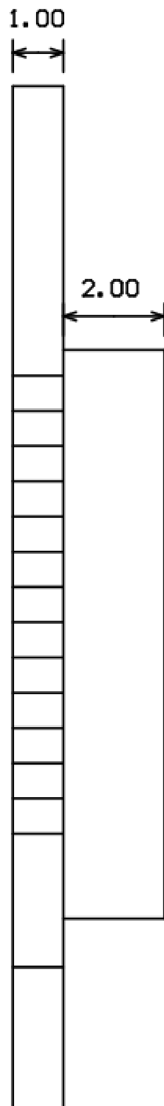

5mm
6mm
PCB antenna
5mm
5mm

6 Packaging information and production instructions

6.1 Mechanical dimensions and dimensions of the back of the pad




P18
P20
P17
RST
P14
RXD1
TXD1
TM
exposed
exposed
P3
P7
P15
P16
exposed
P11
RXD2
TXD2
VCC
GND
P34
P33
P32
P31
P26
Bottom View



Unit: mm

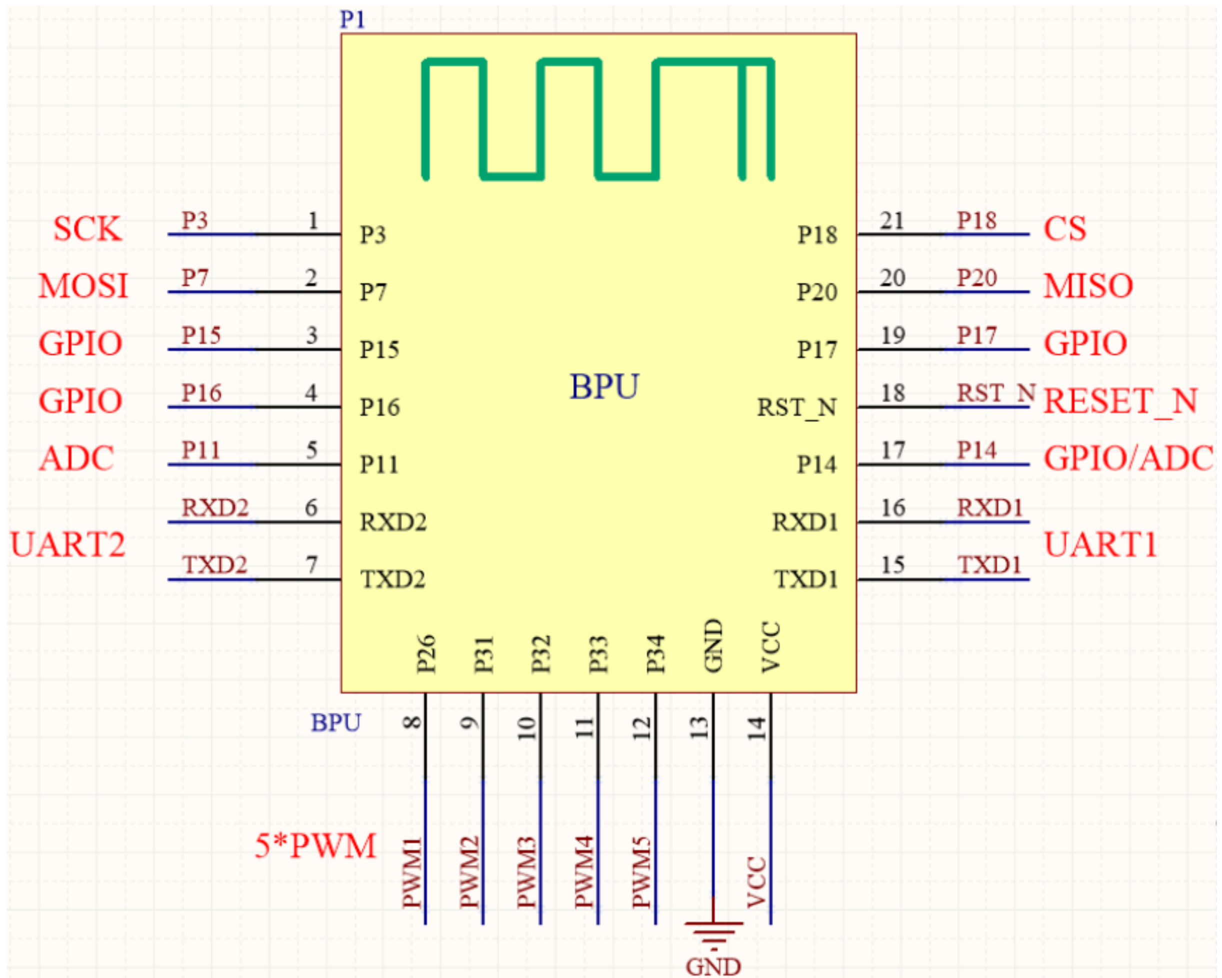
Module form factor tolerance: ± 0.35mm

PCB thickness tolerance: ±0.1mm

Shield cover height tolerance: ±0.05mm

Side View

The following figure is a schematic diagram of BPU:



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.

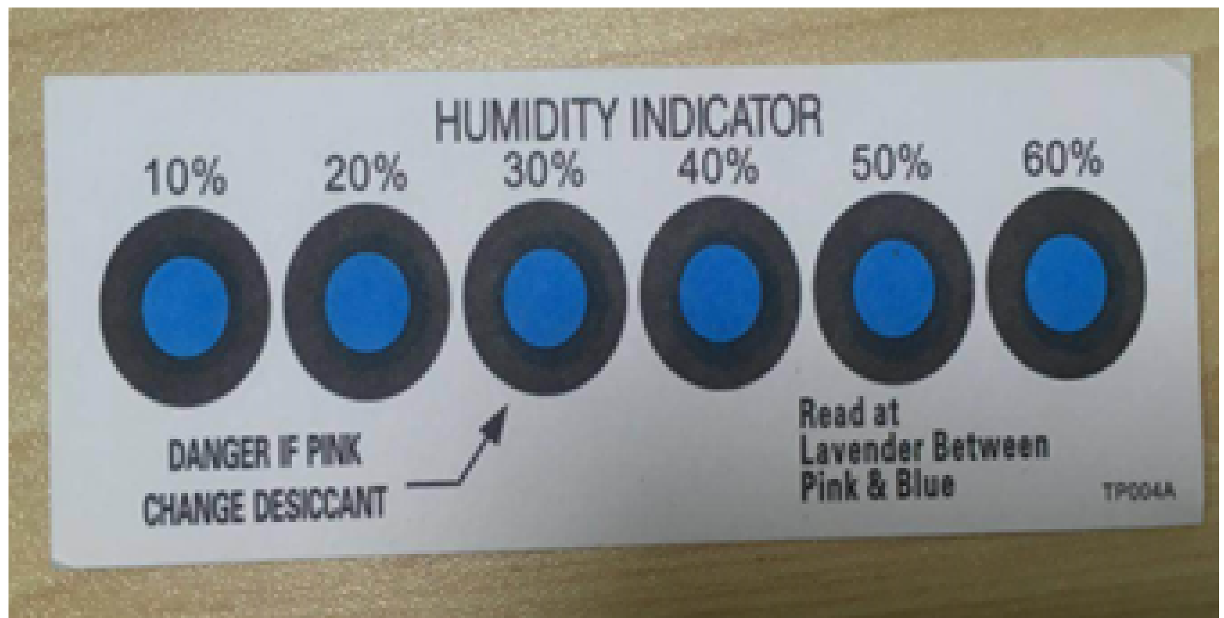
6.2 Production instructions

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

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

2. Storage conditions for a delivered module:

   - The moisture-proof bag must be placed in an environment in which 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.



3. 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 has passed since sealing of the bag.
4. 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 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.
5. In the whole production process, take electrostatic discharge (ESD) protective

measures.

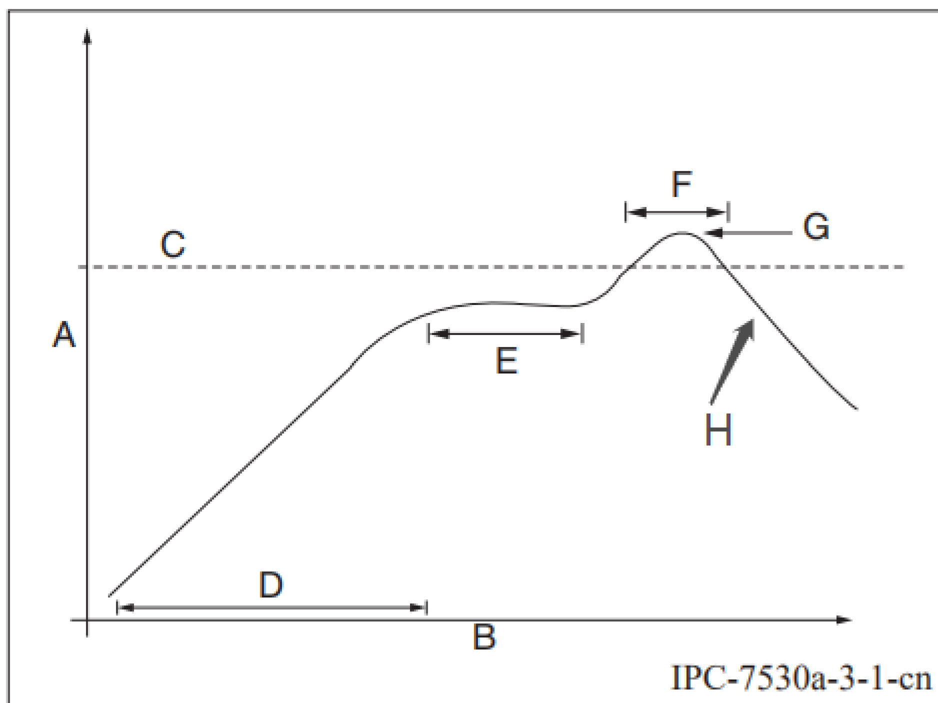
6. To guarantee the passing rate, it is recommended that you use the SPI and AOI to monitor the quality of solder paste printing and mounting.

6.3 Recommended oven temperature curve

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

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

Set oven temperatures according to the following curve.



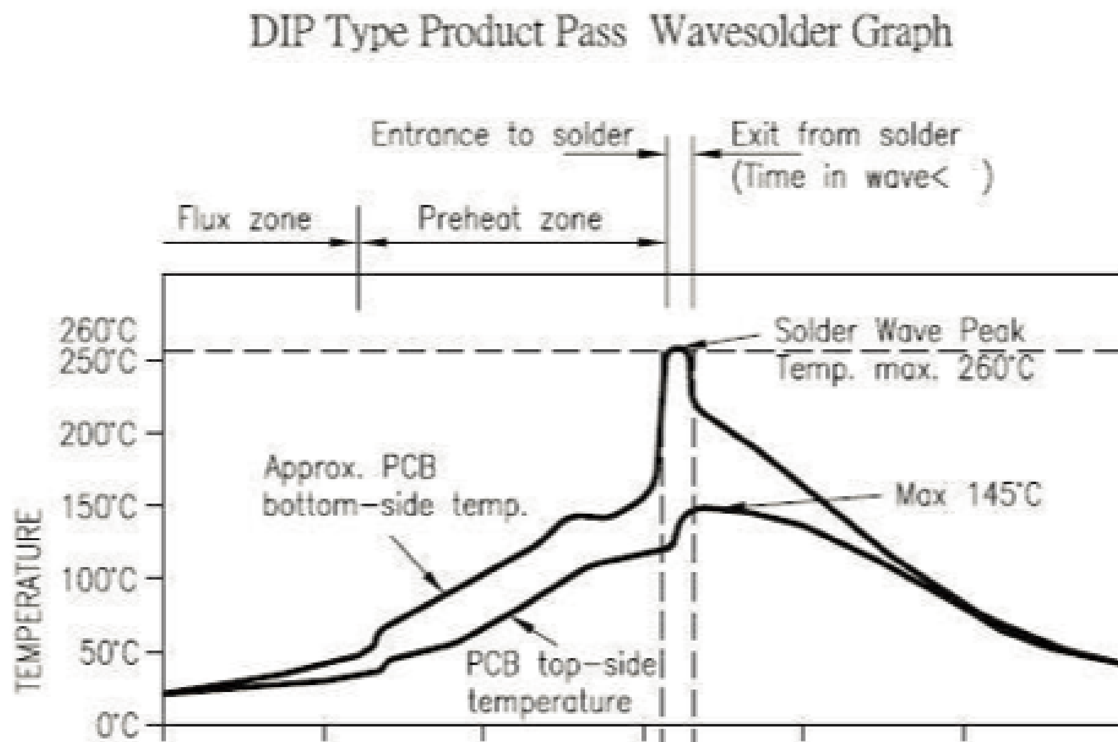
- A: Temperature axis
- B: Time axis
- C: Liquidus temperature: 217 to 220°C

- D: Ramp-up slope: 1 to 3°C/s
- E: Duration of constant temperature: 60 to 120s; the range of constant temperature: 150 to 200°C
- F: Duration above the liquidus: 50 to 70s
- G: Peak temperature: 235 to 245°C
- H: Ramp-down slope: 1 to 4°C/s

> **Note**: The above curve is just an example of the solder paste SAC305. For more details about other solder pastes, please refer to Recommended oven temperature curve in the solder paste specifications.

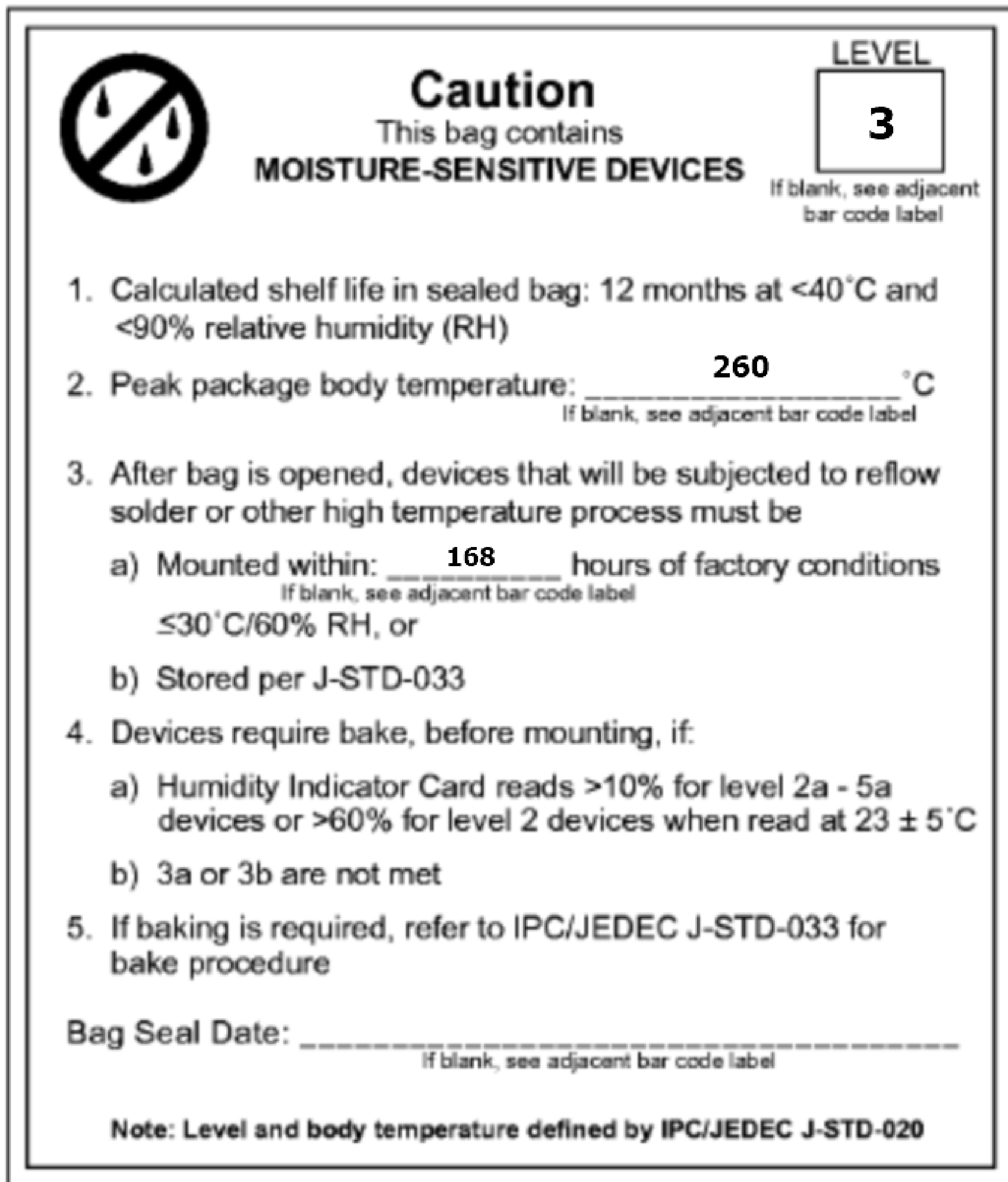
Manner 2: Wave soldering process (Oven temperature curve of wave soldering)

Set 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 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



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: ______________________________
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
BPU	4400	Tape reel	1100	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 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".

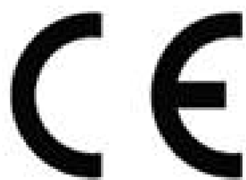
This device has got an FCC ID: 2ANDL-BPU. The end product must be labelled in a visible area with the following: "Contains Transmitter Module FCC ID: 2ANDL-BPU".

This device is intended only for OEM integrators under the following conditions:

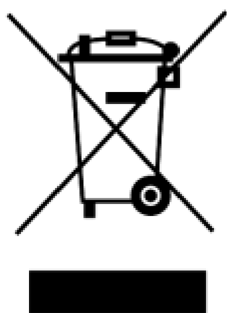
The antenna must be installed such that 20cm is maintained between the antenna and users, and the transmitter module may not be co-located with any other transmitter or antenna.

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 a municipal recycling collection point.

The device could be used with a separation distance of 20cm to the human body.