



# **BTU Module Datasheet**

Version: 20210525

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## Contents

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BTU is a low-power embedded Bluetooth module that Tuya has developed. It consists of a highly integrated Bluetooth chip (TLSR8250), a few peripheral circuits, an embedded Bluetooth network communication protocol stack, and rich library functions.

## I Product overview

BTU consists of a low-power 32-bit MCU, a Bluetooth LE 5.0/2.4G radio-frequency band, 4-Mbit/s flash memory, and 48-KB SRAM.

### I.1 Features

- Embedded with a low-power 32-bit MCU, which can also function as an application processor.
  - The clock rate: 48 MHz
- Working voltage: 1.8 to 3.6 V. If the voltage is between 1.8 and 2.7 V, the module can start, but the optimal RF performance cannot be ensured. If the voltage is between 2.8 and 3.6 V, the overall performance is normal.
- Peripherals: 15 GPIOs, 1 UART, and 2 ADCs
- Bluetooth LE RF features
  - Compatible with the Bluetooth LE4.2/5.0
  - The RF data rate can be up to 2 Mbps.
  - TX power: +10 dBm
  - RX sensitivity: -94.5 dBm@Bluetooth LE 1 Mbps
  - Embedded hardware AES encryption
  - Onboard PCB antenna with a gain of 1.1 dBi
  - Working temperature: -20°C to +85°C

### I.2 Applications

- Intelligent building
- Smart household and home appliances
- Smart socket and light
- Industrial wireless control
- Baby monitor
- Intelligent bus

### I.3 Change history

Update date	Updated content	Version after update
May 7, 2021	This is the first release.	V1.0.0

## 2 Module interfaces

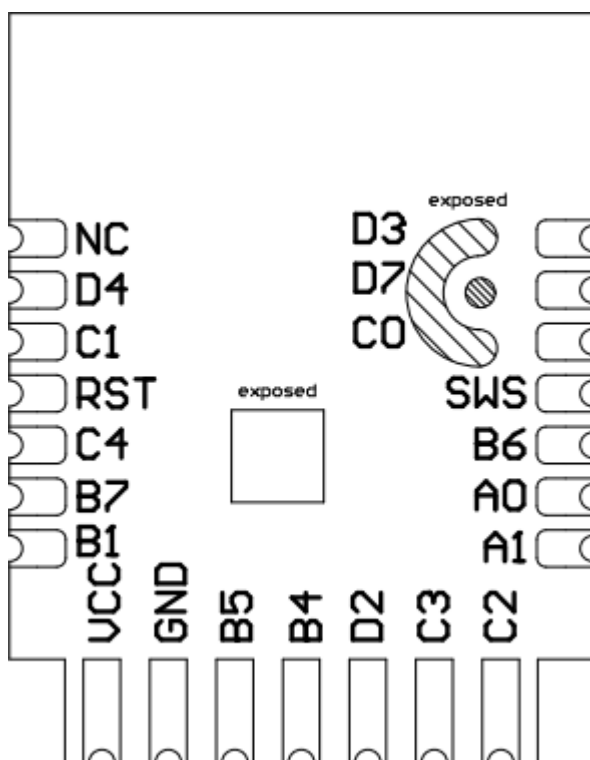
### 2.1 Dimensions and package

BTU has 3 rows of pins with the spacing of  $1.4 \pm 0.1$  mm.

The dimensions of the BTU are  $20.3 \pm 0.35$  mm (L)  $\times$   $15.8 \pm 0.35$  mm (W)  $\times$   $3.0 \pm 0.15$  mm (H).

The dimensions of BTU are as follows:

### 2.2 Pin definition



Pin number	Symbol	I/O type	Function
1	D3	I/O	Common I/O pin, which corresponds to D3 (Pin 32) on the internal IC
2	D7	I/O	Common I/O pin, which corresponds to D7 (Pin 2) on the internal IC
3	C0	I/O	Common I/O pin, which corresponds to C0 (Pin 20) on the internal IC
4	SWS	I/O	Burning pin, which corresponds to SWS (Pin 5) on the internal IC
5	B6	I	ADC pin, which corresponds to B6 (Pin 16) on the internal IC
6	A0	I/O	Common I/O pin, which corresponds to A0 (Pin 3) on the internal IC

Pin number	Symbol	I/O type	Function
7	A1	I/O	Common I/O pin, which corresponds to A1 (Pin 4) on the internal IC
8	C2	I/O	Support hardware PWM and correspond to C2 (Pin 22) on the internal IC
9	C3	I/O	Support hardware PWM and correspond to C3 (Pin 23) on the internal IC
10	D2	I/O	Support hardware PWM and correspond to D2 (Pin 31) on the internal IC
11	B4	I/O	Support hardware PWM and correspond to B4 (Pin 14) on the internal IC
12	B5	I/O	Support hardware PWM and correspond to B5 (Pin 15) on the internal IC
13	GND	P	Power supply reference ground

Pin number	Symbol	I/O type	Function
14	VCC	P	Power supply pin (3.3V)
15	B1	I/O	Uart_TXD, which corresponds to B1 (Pin 6) on the internal IC
16	B7	I/O	Uart_RXD, which corresponds to B7 (Pin 17) on the internal IC
17	C4	I/O	ADC pin, which corresponds to C4 (Pin 24) on the internal IC
18	RST	I/O	Reset pin, active low
19	C1	I/O	Common I/O pin, which corresponds to C1 (Pin 21) on the internal IC
20	D4	I/O	Common I/O pin, which corresponds to D4 (Pin 1) on the internal IC
21	NC	I/O	No connection

**Note:** P indicates a power supply pin and I/O indicates an input/output pin.



### 3 Electrical parameters

#### 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 discharge voltage (human body model)	TAMB-25°C	-	2	KV
Static electricity discharge voltage (machine model)	TAMB-25°C	-	0.5	KV

#### 3.2 Working conditions

Parameter	Description	Minimum value	Typical value	Maximum value	Unit
Ta	Working temperature	-40	-	85	°C
VCC	Working voltage	2.8	3.3	3.6	V

Parameter	Description	Minimum value	Typical value	Maximum value	Unit
$V_{IL}$	I/O low-level input	VSS	-	$VCC*0.3$	V
$V_{IH}$	I/O high-level input	$VCC*0.7$	-	VCC	V
$V_{OL}$	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
$I_{tx}$	Constantly transmit, the output power of 11.5 dBm	22.6	mA
$I_{rx}$	Constantly receive	6.5	mA
IDC	Average value in the mesh networking	6.59	mA
IDC	Peak value in the mesh networking	24.9	mA
$I_{Ideepsleep1}$	Deep sleep mode (reserve16-KB RAM)	1.2	$\mu A$

Symbol	Conditions	Maximum value (typical value)	Unit
$I_{\text{Ideepsleep2}}$	Deep sleep mode (not reserve RAM)	0.4	$\mu\text{A}$

## 4 RF parameters

### 4.1 Basic RF features

Parameter	Description
Working frequency	2400 – 2483.5 MHz
Wireless standard	Bluetooth LE 4.2/5.0
Data transmission rate	1 Mbps/2 Mbps
Antenna type	Onboard PCB antenna

### 4.2 RF output power

Parameter	Minimum value	Typical value	Maximum value	Unit
Average RF output power	-21	10	11.5	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	-	-94.5	-	dBm
Frequency offset error 1 Mbps	-250	-	+300	KHz
Co-channel interference suppression	-	-	-10	dB

## 5 Antenna information

### 5.1 Antenna type

BTU uses the onboard PCB antenna with a gain of 1.1 dBi.

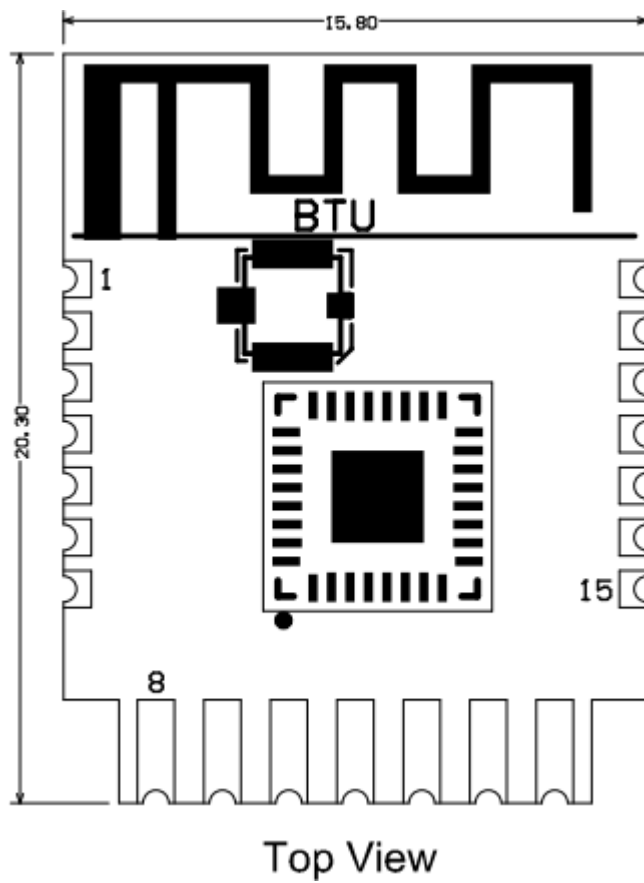
### 5.2 Antenna interference reduction

To ensure the RF performance, it is recommended that the antenna be at least 15 mm away from other metal parts. If metal materials wrap the surrounding of 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 area.

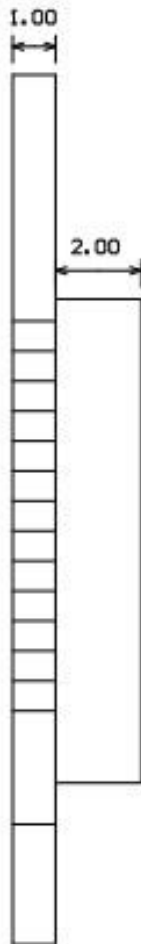
## 6 Packaging information and production instructions

### 6.1 Mechanical dimensions

The dimensions of the PCB are  $20.3 \pm 0.35$  mm (L)  $\times$   $15.8 \pm 0.35$  mm (W)  $\times$   $1.0 \pm 0.1$  mm (H).



## 6.2 Side view



Unit: mm

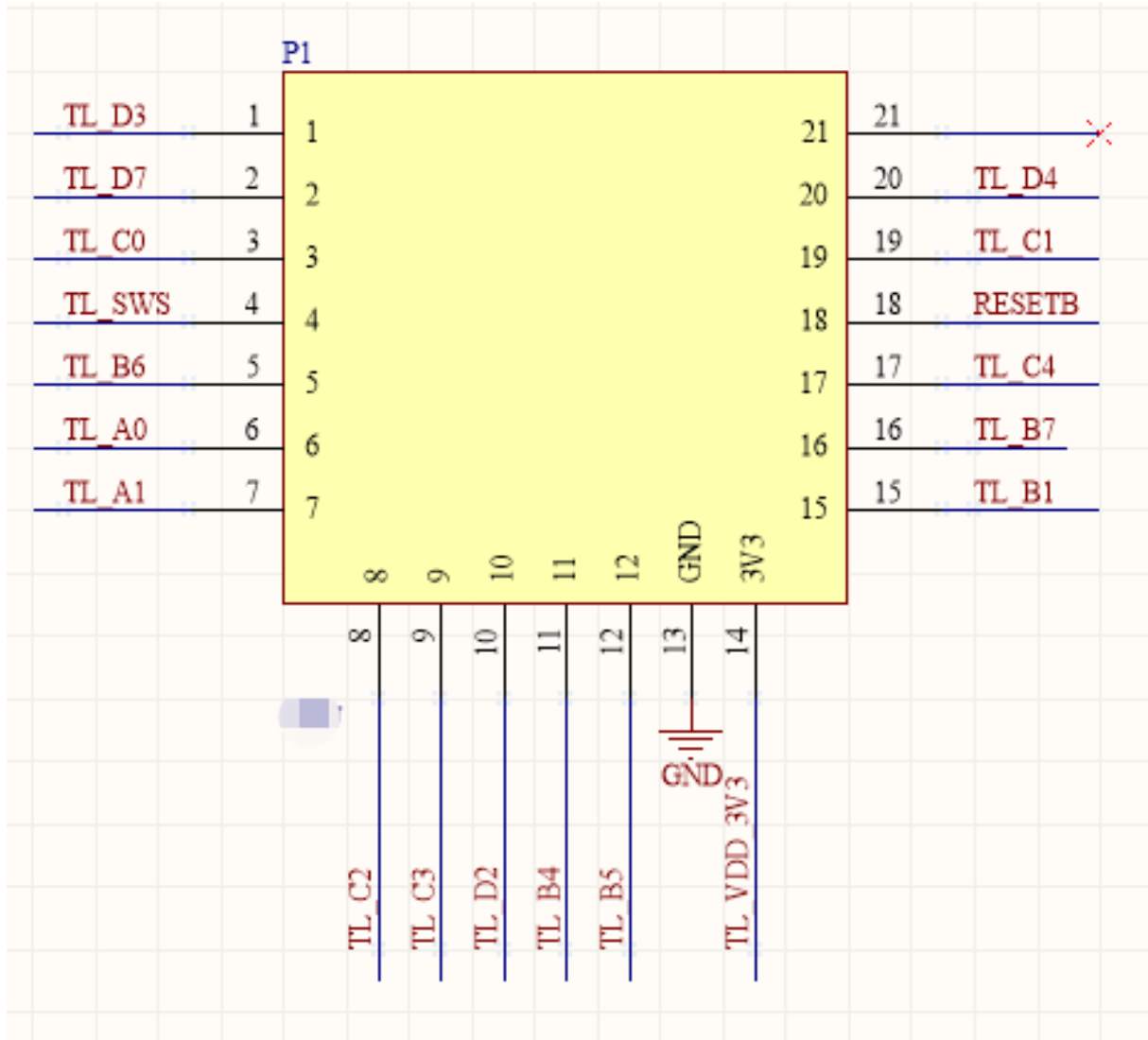
Module form factor tolerance:  $\pm 0.35\text{mm}$

PCB thickness tolerance:  $\pm 0.1\text{mm}$

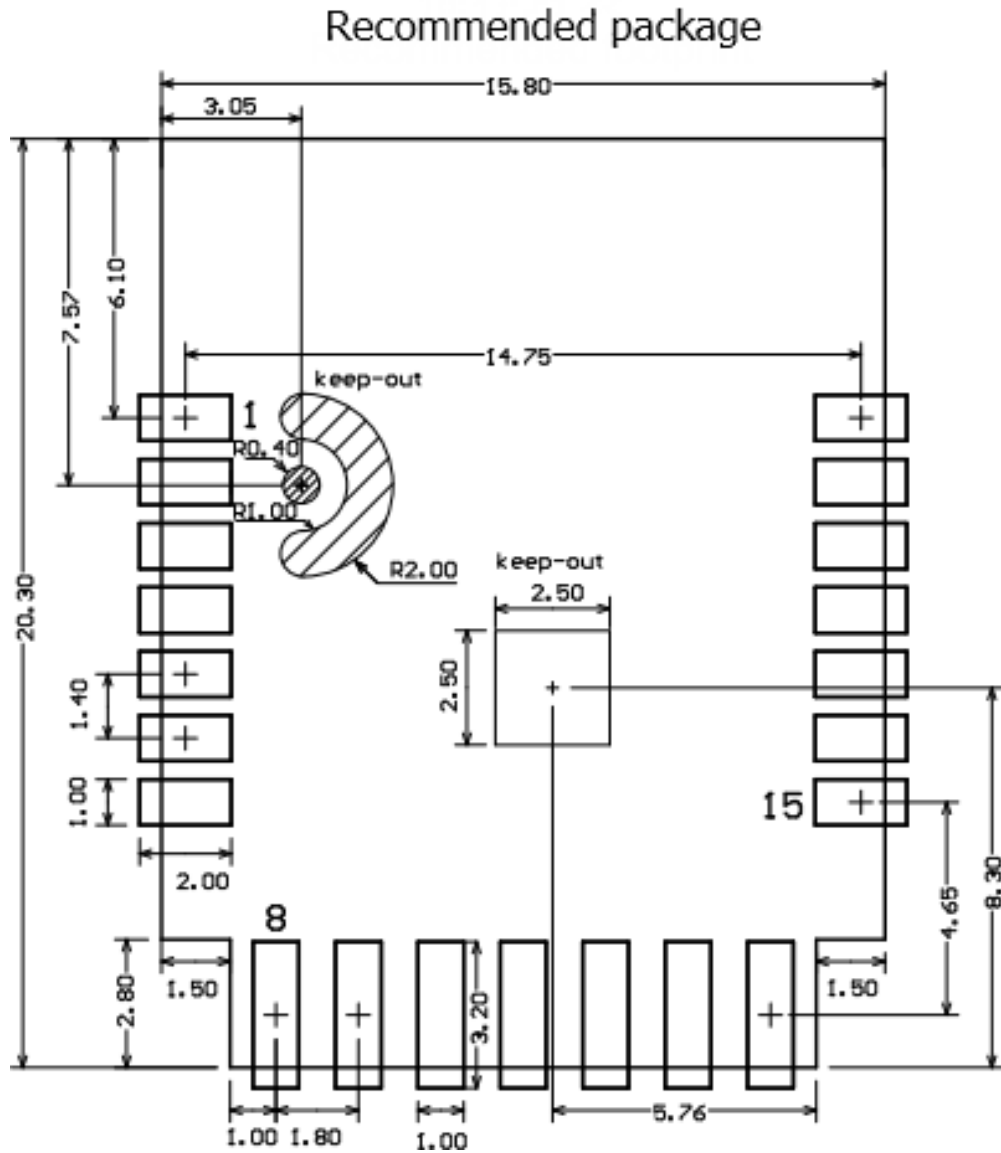
Shield cover height tolerance:  $\pm 0.05\text{mm}$

Side View

### 6.3 The schematic diagram of package



### 6.3.1 Diagram of PCB package-SMT



### 6.4 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

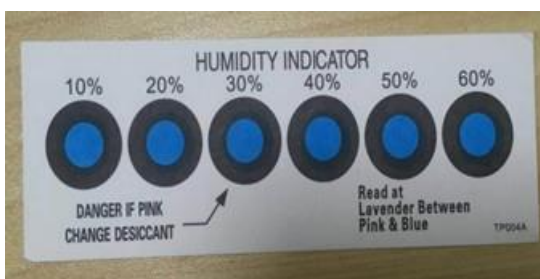


is designed to be in-line-packaged, package the module in an in-line way. After being unpacked, the module must be soldered within 24 hours. Otherwise, it needs to be put into the drying cupboard where the relative humidity is not greater than 10%; or it needs to be packaged again under vacuum and the 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  $\leq 5\%$  RH for reel package and 125°C and  $\leq 5\%$  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:  $< 36^\circ\text{C}$
- 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.

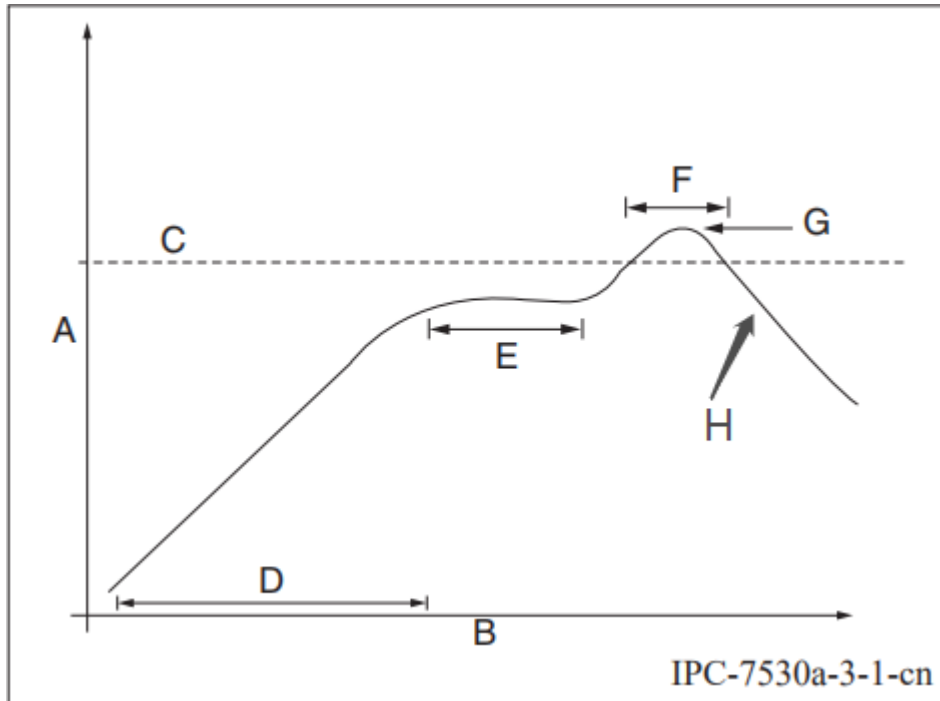
6. To guarantee the passing rate, it is recommended that you use the SPI and AOI to monitor the quality of solder paste printing and mounting.

### 6.5 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.



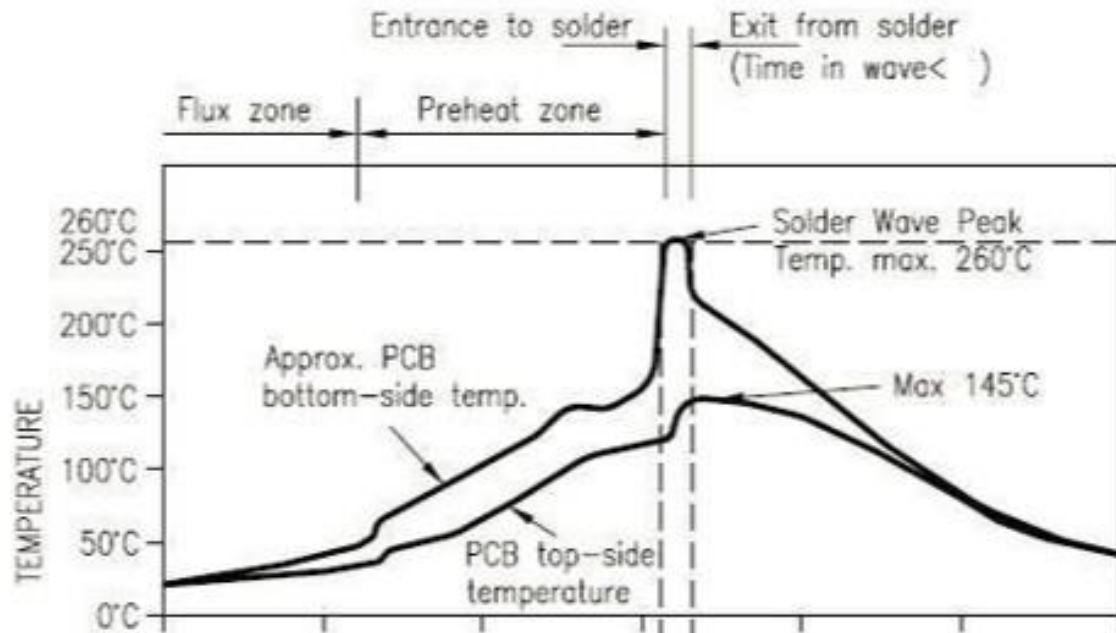
- A: Temperature axis
- B: Time axis
- C: Liquidus temperature: 217 to 220°C
- D: Ramp-up slope: 1 to 3°C/s
- E: Duration of constant temperature: 60 to 120s; the range of constant temperature: 150 to 200°C
- F: Duration above the liquidus: 50 to 70s
- G: Peak temperature: 235 to 245°C
- H: Ramp-down 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.

DIP Type Product Pass Wavesolder Graph




{width=100%}

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

### 6.6 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 <math><40^{\circ}\text{C}</math> and <math><90\%</math> relative humidity (RH)
2. Peak package body temperature: 260  $^{\circ}\text{C}$   
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  
 $\leq 30^{\circ}\text{C}/60\% \text{ RH}$ , 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  $23 \pm 5^{\circ}\text{C}$
  - 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 number	MOQ (pcs)	Shipping packaging method	The number of modules per reel	The number of reels per carton
BTU	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 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-BTU. The end product must be labeled in a visible area with the following: "Contains Transmitter Module FCC ID: 2ANDL-BTU".

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.