



# BT5S Module Datasheet

Device Development > Module > Bluetooth Module

Version: 20200316

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## 1 Product Overview

BT5S 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. BT5S also contains a low-power 32-bit microcontroller unit (MCU), BLE 5.0 or 2.4 GHz radio, 512 KB 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: one Inter-Integrated Circuit (I2C) bus, four pulse width modulation (PWM) pins, and one universal asynchronous receiver/transmitter (UART)
- BLE RF features - Compatible with BLE 5.0 - RF data rate: 1 Mbit/s or 2 Mbit/s - 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: -20°C to +85°C

### 1.2 Application Scenarios

- Smart households
- Smart low-power sensors

## 2 Change History

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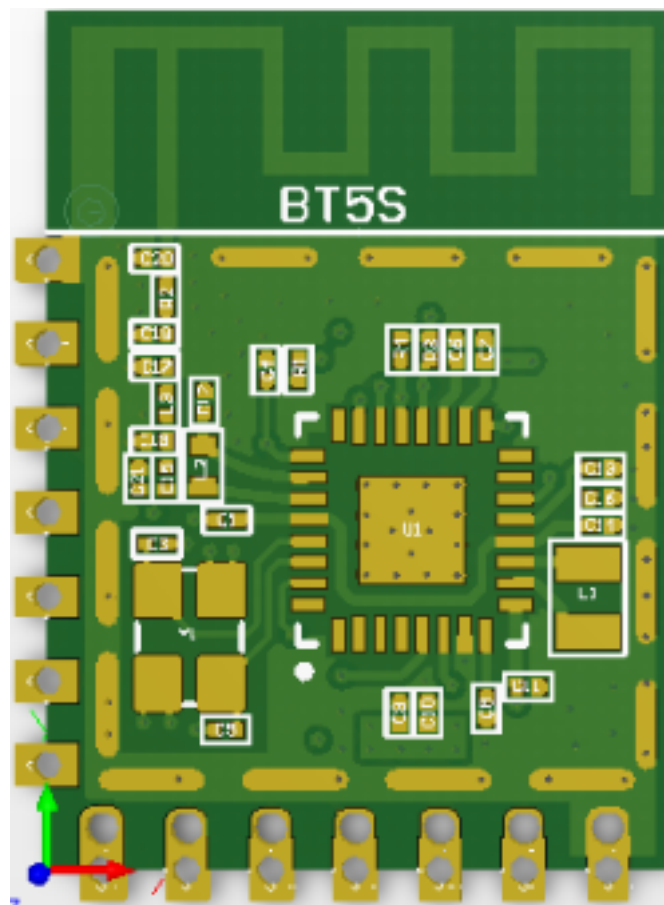
No.	Date	Change Description	Version After Change
1	2020-01-13	This is the first release.	1.0.0

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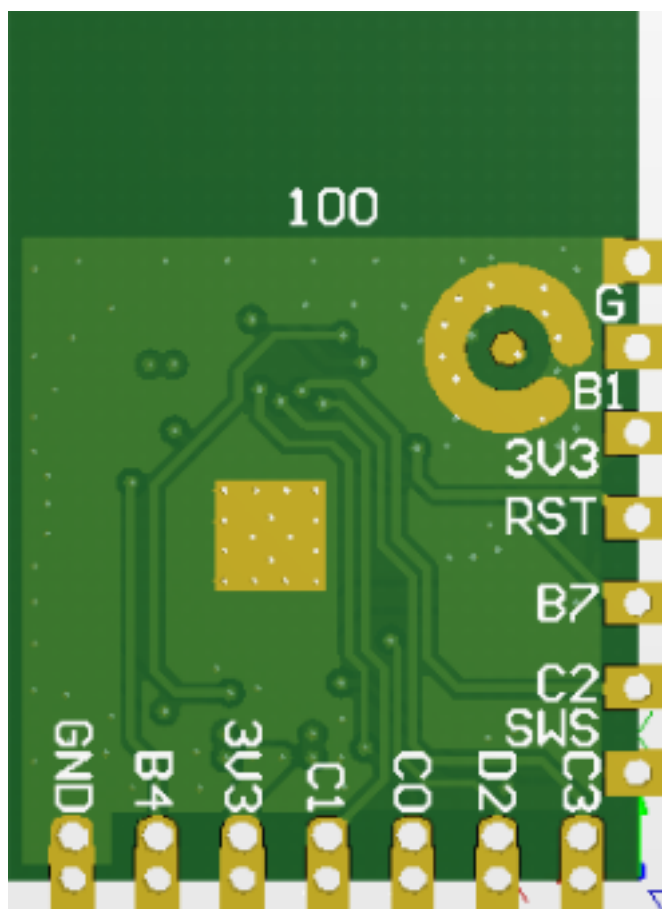
## 3 Module Interfaces

### 3.1 Dimensions and Footprint

BT5S has two rows of 14 pins on the front and rear sides with a 2 mm pin spacing. The BT5S dimensions (H x W x D) are  $2.0 \pm 0.15$  mm x 14.8 mm x 20.4 mm. The following figures show the front and rear views.



**Figure 1:** image.png



**Figure 2:** image.png

### 3.2 Interface Pin Definition

Pin No.	Symbol	I/O Type	Function
1	C3	I/O	Common I/O pin, which can be used as a PWM output of the LED drive and is connected to the PC3 pin on the internal IC
2	D2	I/O	Common I/O pin, which can be used as a PWM output of the LED drive and is connected to the PD2 pin on the internal IC
3	C0	I/O	I2C data cable pin, which can be used as a common I/O pin and is connected to the PC0 pin on the internal IC

Pin No.	Symbol	I/O Type	Function
4	C1	I/O	I2C clock cable pin, which can be used as a common I/O pin and is connected to the PC1 pin on the internal IC
5	3V3	P	Power supply pin
6	B4	I/O	Common I/O pin, which can be used as a PWM output of the LED drive and is connected to the PB4 pin on the internal IC
7	GND	P	Power supply reference ground pin
0	SWS	I/O	Bluetooth chip programming pin, which is connected to the SWS pin on the internal IC
00	C2	I/O	Common I/O pin, which can be used as a PWM output of the LED drive and is connected to the PC2 pin on the internal IC
8	B7	I/O	Serial RX pin, which can be used as a common I/O pin and is connected to the PB7 pin on the internal IC
9	RST	I	Reset pin, which is connected to the RESETB pin on the internal IC (The module is embedded with a pull-up resistor.)
10	3V3	P	Power supply pin
11	B1	I/O	Serial TX pin, which can be used as a common I/O pin and is connected to the PB1 pin on the internal IC
12	GND	P	Power supply reference ground pin

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

## 4 Electrical Parameters

### 4.1 Absolute Electrical Parameters

Parameter	Description	Minimum Value	Maximum Value	Unit
T <sub>s</sub>	Storage temperature	-65	150	°C
VCC	Power supply voltage	-0.3	3.9	V
Static electricity voltage (human body model)	T <sub>amb</sub> = 25°C	N/A	2	kV
Static electricity voltage (machine model)	T <sub>amb</sub> = 25°C	N/A	0.5	kV



## 4.2 Working Conditions

ParameterDescription		Minimum Value	Typical Value	Maximum Value	Unit
T <sub>a</sub>	Working temperature	-20	N/A	85	°C
V <sub>CC</sub>	Working voltage	1.8	3.3	3.6	V
V <sub>IL</sub>	I/O low-level input	V <sub>SS</sub>	N/A	V <sub>CC</sub> x 0.3	V
V <sub>IH</sub>	I/O high-level input	V <sub>CC</sub> x 0.7	N/A	V <sub>CC</sub>	V
V <sub>OL</sub>	I/O low-level output	V <sub>SS</sub>	N/A	V <sub>CC</sub> x 0.1	V
V <sub>OH</sub>	I/O high-level output	V <sub>CC</sub> x 0.9	N/A	V <sub>CC</sub>	V

### 4.3 Working Current

Symbol	Condition	Typical Value	Maximum Value	Unit
$I_{tx}$	Continuous TX, 10 dBm output power	16.8	18.4	mA
$I_{tx}$	Continuous TX, 0 dBm output power	6.3	8.8	mA
$I_{rx}$	Continuous RX	6.3	8.9	mA
$I_{DC}$	Network pairing	6.8	32	mA
$I_{DC}$	Connected	6.8	32	mA
$I_{sleep}$	Sleep mode	1.5	30	$\mu$ A

## 5 RF Features

### 5.1 Basic RF Features

Parameter	Description
Working frequency	2.4 GHz ISM band
Wireless standard	BLE 5.0
Data transmission rate	1 Mbit/s or 2 Mbit/s
Antenna type	Onboard PCB antenna

### 5.2 RF TX Power

Parameter	Minimum Value	Typical Value	Maximum Value	Unit
Average RF output power	-22	10	10.5	dBm
20 dB modulation signal bandwidth (1 Mbit/s)	N/A	2500	N/A	kHz
20 dB modulation signal bandwidth (2 Mbit/s)	N/A	2600	N/A	kHz

### 5.3 RF RX Sensitivity

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

## 6 Antenna Information

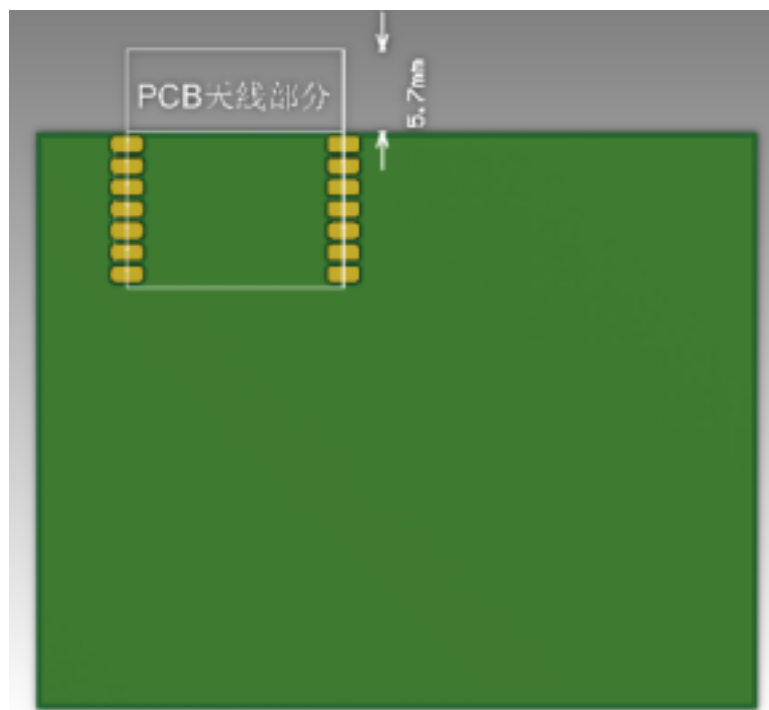
### 6.1 Antenna Type

BT5S uses an onboard PCB antenna.

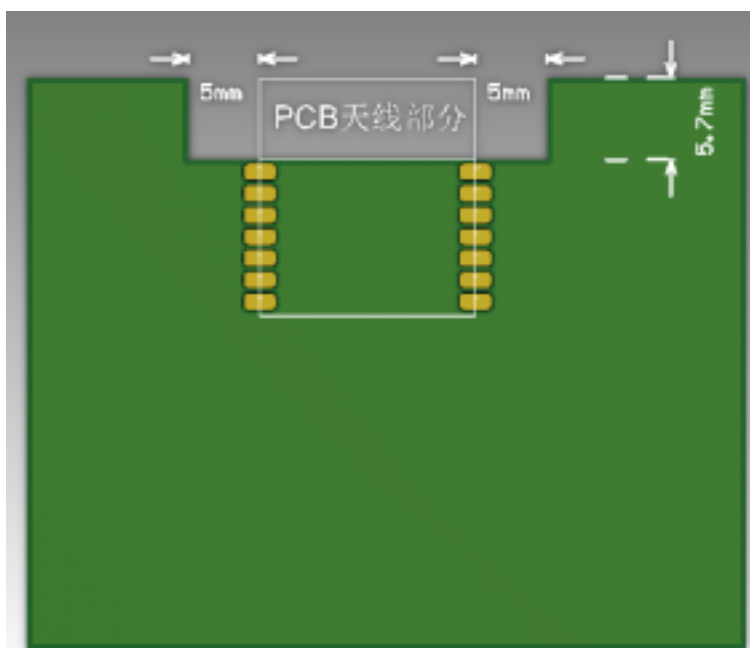
### 6.2 Antenna Interference Reduction

To ensure optimal RF performance, it is recommended that the antenna be at least 15 mm away from other metal parts.

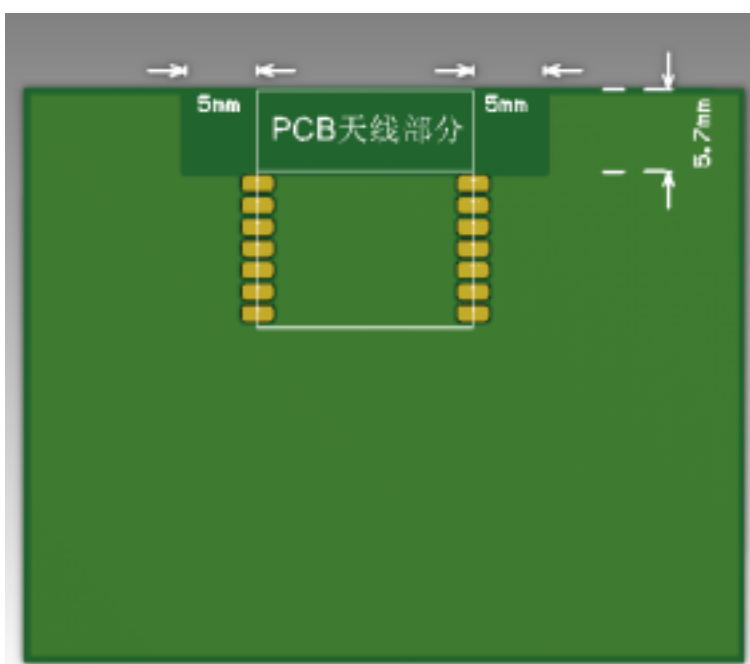
To prevent adverse impact on the antenna radiation performance, avoid copper or traces along the antenna area on the PCB. Ensure that there are no substrate media above or below the antenna and that copper is at a certain distance away from the antenna to maximize the antenna radiation performance.



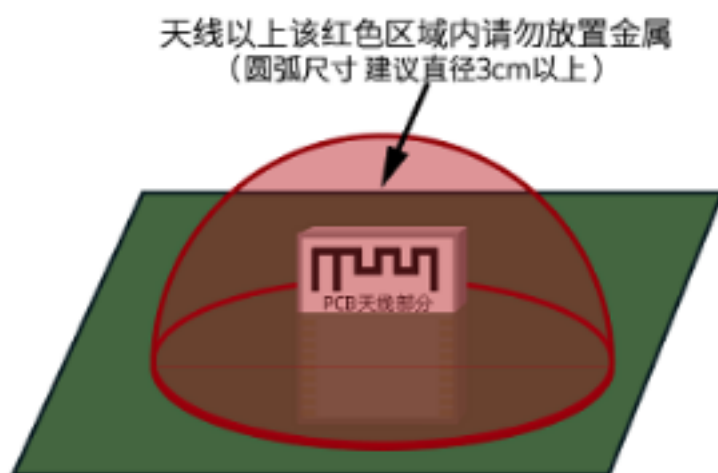
**Figure 3:** image.png



**Figure 4:** image.png



**Figure 5:** image.png



**Figure 6:** image.png

## 7.1 Mechanical Dimensions and Rear Solder Pad Dimensions



Note: The default dimensional tolerance is  $\pm 0.35$  mm, and the tolerance for some measurements is  $\pm 0.1$  mm. If a customer has other requirements, clearly specify them in the datasheet after communication.

## 7.2 Production Instructions

1. Use an SMT placement machine to mount the stamp hole module that Tuya produces onto the PCB within 24 hours after the module is unpacked and the firmware is burned. If not, vacuum pack the module again. Bake the module before mounting it onto the PCB.

### (1) SMT placement equipment

- i. Reflow soldering machine
- ii. Automated optical inspection (AOI) equipment
- iii. Nozzle with a 6 mm to 8 mm diameter

### (2) Baking equipment

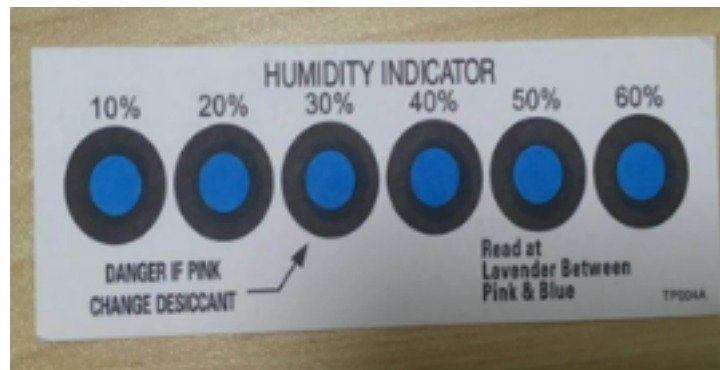
- i. Cabinet oven
- ii. Anti-static heat-resistant trays
- iii. Anti-static heat-resistant gloves

2. 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 humidity indicator card (HIC).



**Figure 8:** image.png

3. Bake a module based on HIC status as follows when you unpack the module package:

- (1) If the 30%, 40%, and 50% circles are blue, bake the module for 2 consecutive hours.
- (2) If the 30% circle is pink, bake the module for 4 consecutive hours.
- (3) If the 30% and 40% circles are pink, bake the module for 6 consecutive hours.
- (4) If the 30%, 40%, and 50% circles are pink, bake the module for 12 consecutive hours.

4. Baking settings:

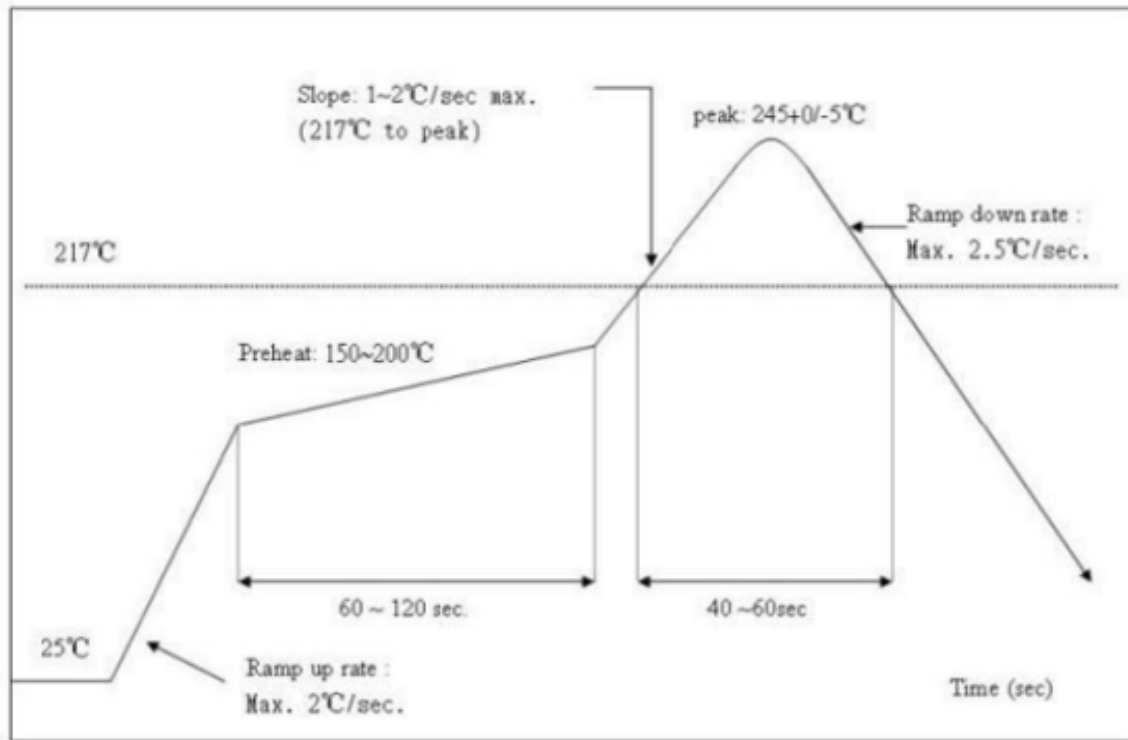
- (1) Baking temperature:  $125 \pm 5^{\circ}\text{C}$
- (2) Alarm temperature:  $130^{\circ}\text{C}$
- (3) SMT placement ready temperature after natural cooling:  $< 36^{\circ}\text{C}$

- (4) Number of drying times: 1
- (5) Rebaking condition: The module is not soldered within 12 hours after baking.
- 5. Do not use SMT to process 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.
- 6. Before SMT placement, take electrostatic discharge (ESD) protective measures.
- 7. To reduce the reflow defect rate, draw 10% of the products for visual inspection and AOI before first SMT placement to determine a proper oven temperature and component placement method. Draw 5 to 10 modules every hour from subsequent batches for visual inspection and AOI.

### **7.3 Recommended Oven Temperature Curve**

Perform SMT placement based on the following reflow oven temperature curve. The highest temperature is 245°C.

Based on the IPC/JEDEC standard, perform reflow soldering on a module at most twice.



**Figure 9:** image.png

## 7.4 Storage Conditions

	<b>CAUTION</b> <b>This bag contains</b> <b>MOISTURE-SENSITIVE DEVICES</b>	<b>LEVEL</b> <b>3</b> <small>If Blank, see adjacent bar code label</small>
<p>1. Calculated shelf life in sealed bag: 12 months at <math>&lt; 40^{\circ}\text{C}</math> and <math>&lt; 90\%</math> relative humidity (RH)</p>		
<p>2. Peak package body temperature: <u>260</u> <math>^{\circ}\text{C}</math> <small>If Blank, see adjacent bar code label</small></p>		
<p>3. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must</p>		
<p>a) Mounted within: <u>168</u> hrs. of factory conditions <small>If Blank, see adjacent bar code label</small></p>		
<p><math>\leq 30^{\circ}\text{C}/60\%\text{RH}</math>, OR</p>		
<p>b) Stored at <math>&lt;10\%</math> RH</p>		
<p>4. Devices require bake, before mounting, if:</p>		
<p>a) Humidity Indicator Card is <math>&gt; 10\%</math> when read at <math>23 \pm 5^{\circ}\text{C}</math></p>		
<p>b) 3a or 3b not met.</p>		
<p>5. If baking is required, devices may be baked for 48 hrs. at <math>125 \pm 5^{\circ}\text{C}</math></p>		
<p>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</p>		
<p>Bag Seal Date: _____ <small>If Blank, see adjacent bar code label</small></p>		
<p>Note: Level and body temperature defined by IPC/JEDEC J-STD-020</p>		

Figure 10: image.png

## 8 MOQ and Packing Information

Product Model	Packing MOQ Method	Number of Modules in Each Reel Pack	Number of Reel Packs in Each Box
BT5S	3600 Carrier tape and reel packing	900	4

## 9 Appendix: Statement

### 9.1 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.

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.

### 9.2 Radiation Exposure Statement

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.

### 9.3 Important Note

This radio module must not be installed to co-locate and operate simultaneously with other radios in host system except in accordance with FCC multi-transmitter product procedures. Additional testing and equipment authorization may be required to operating simultaneously with other radio.

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 host product manufacturer is responsible for compliance to 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/warning 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 gotten an FCC ID: 2ANDL-BT5S. The final end product must be labeled in a visible area with the following:

“Contains Transmitter Module FCC ID: 2ANDL-BT5S”

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

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

As long as two conditions above are met, further transmitter test 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.

#### 9.4 Declaration of Conformity European Notice



**Figure 11:** image.png

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>.



**Figure 12:** image.png

This product must not be disposed of as normal household waste, in accordance with 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 20 cm to the human body.