Product Manual	**Tuya BT7L-IPEX BLE Module**
	Version: 1.0.0 Date: 2019-10-14 No.: 0000000001

1 Product Overview

BT7L-IPEX is an embedded Bluetooth low energy (BLE) module that Tuya has developed. It consists of a highly integrated Bluetooth chip (TLSR8250F512ET32) and several peripheral components, with an embedded Bluetooth network protocol stack and robust library functions. BT7L-IPEX also contains a low-power 32-bit multipoint control unit (MCU), BLE 5.0 component, 2.4 GHz radio component, 4 MB flash memory, 48 KB static random-access memory (SRAM), and nine multiplexing I/O interfaces.

1.1 Features

✧ Embedded low-power 32-bit MCU, which can also function as an application processor

- Dominant frequency: 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: nine pulse width modulation (PWM) interfaces

✧ BLE RF features

- Compatible with BLE 5.0

- Up to 1 Mbit/s RF data rate

- TX power: +10 dBm

- RX sensitivity: –94.5 dBm at BLE 1 Mbit/s

- Embedded advanced encryption standard (AES) hardware encryption

- External IPEX antenna with 2.5 dBi gain

- Working temperature: –20°C to +85°C

1.2 Applications

✧Smart LED lights

✧Smart households

✧Smart low-power sensors

Change History

No.	Date	Change Description	Version After Change
1	2019-10-14	This is the first release.	1.0.0

Contents

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2 Module Interfaces

2.1 Dimensions and Footprint

BT7L-IPEX has two rows of pins with a 2 mm pin spacing.

The BT7L-IPEX dimensions are 15mm±0.35 (W)×16.5mm±0.35 (L)×2.85mm(H). The PCB thickness is 0.8±0.1 mm. Figure 2-1 shows the BT7L-IPEX pins.
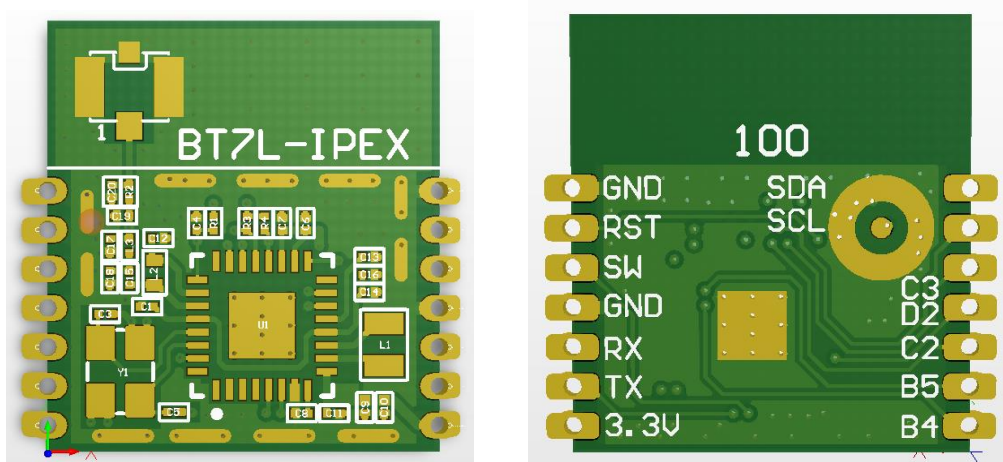

Figure 2-1 BT7L-IPEX pins

2.2 Interface Pin Definition

Table 2-1 BT7L-IPEX interface pins

Pin No.	Symbol	I/O Type	Function
1	SDC	I/O	I2C SDC,can be used as a common I/O
2	SCL	I/O	I2C SCL,can be used as a common I/O
3	C3	I/O	Common I/O, which can be used as a PWM output of the LED drive and is connected to pin 23 on the IC
4	D2	I/O	Common I/O, which can be used as a PWM output of the LED drive and is connected to pin 31 on the IC
5	C2	I/O	Common I/O, which can be used as a PWM output of the LED drive and is connected to pin 22 on the IC
6	B5	I/O	Common I/O, which can be used as a PWM output of the LED drive and is connected to pin 15 on the IC
7	B4	I/O	Common I/O, which can be used as a PWM output of the LED drive and is connected to pin 14 on the IC
8	3.3V	P	Power supply pin (3.3 V)
9	TX	I/O	Serial interface transmission pin (UART TX), which is connected to pin 6 on the IC
10	RX	I/O	Serial interface receiving pin (UART RX), which is connected to pin 17 on the IC

Pin No.	Symbol	I/O Type	Function
11	GND	P	Power supply reference ground pin
12	SWS	Input	Programming pin, which is connected to pin 5 on the IC
13	RST	I/O	Hardware reset pin, which is active at a low level and is connected to pin 25 on the IC
14	GND	P	Power supply reference ground pin

Note:

1. **P** indicates power supply pins, **I/O** indicates input/output pins, and **AI** indicates analog input pins.

2. If you have special requirements for light colors controlled by PWM outputs, contact Tuya business personnel.

3 Electrical Parameters

3.1 Absolute Electrical Parameters

Table 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 voltage (human body model)	Tamb = 25°C	N/A	2	kV
Static electricity voltage (machine model)	Tamb = 25°C	N/A	0.5	kV

3.2 Electrical Conditions

Table 3-2 Normal electrical conditions

Parameter	Description	Minimum Value	Typical Value	Maximum Value	Unit
Ta	Working temperature	−20	N/A	85	°C
VCC	Working voltage	2.8	3.3	3.6	V
V_{IH}	I/O	VCC x 0.7	N/A	VCC	V

Parameter	Description	Minimum Value	Typical Value	Maximum Value	Unit
	high-level input				
V_{OL}	I/O low-level output	VSS	N/A	VCC x 0.1	V
V_{OH}	I/O high-level output	VCC x 0.9	N/A	VCC	V

3.3 Working Current

Table 3-3 Current during constant transmission and receiving

Symbol	Description	Typical Value	Unit
I_{tx}	Constant transmission, 0 dBm output power	6.7	mA
I_{rx}	Constant receiving	6.3	mA
I_{DC}	Connected to a mesh network	7.4	mA
$I_{deepsleep1}$	Deep sleep mode 1 (16 KB RAM is reserved.)	1.2	µA
$I_{deepsleep2}$	Deep sleep mode 2 (No RAM is reserved.)	0.4	µA

4 RF Features

4.1 Basic RF Features

Table 4-1 Basic RF features

Parameter	Description
Frequency band	2.4 GHz ISM band
Wireless standard	BLE 5.0
Data transmission rate	1 Mbit/s
Antenna type	external IPEX antenna

4.2 RF Output Power

Table 4-2 Power during constant transmission

Parameter	Minimum Value	Typical Value	Maximum Value	Unit
Average RF output power	–22	9	10	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	1400	N/A	kHz

4.3 RF RX Sensitivity

Table 4-3 RX sensitivity

Parameter		Minimum Value	Typical Value	Maximum Value	Unit
RX sensitivity	1 Mbit/s	N/A	−94.5	N/A	dBm
Frequency offset	1 Mbit/s	−250	N/A	+300	kHz
Co-channel interference suppression	N/A	N/A	−10	N/A	dB

5 Antenna Information

5.1 Antenna Type

BT7L-IPEX uses an external IPEX antenna.

Standard antenna：

Manufacturer	UANT
Product model	UB01C130F3D923A
Frequency Range(MHz)	2400~2500
Impedance(Ω)	50
Peak Gain(dBi)	2.5
VSWR	≤2.5
Polarization	Linear
Connector Type	IPEX connector

5.2 Antenna Interference Reduction

To ensure optimal RF performance, it is recommended that the antenna be at least 15 mm away from other metal parts. If metal materials are wrapped around the antenna, the wireless signals will be reduced greatly, deteriorating the RF performance. Because BT7L-IPEX is inserted to the PCB, sufficient space needs to be reserved for the antenna.

6 Packaging Information and Production Instructions
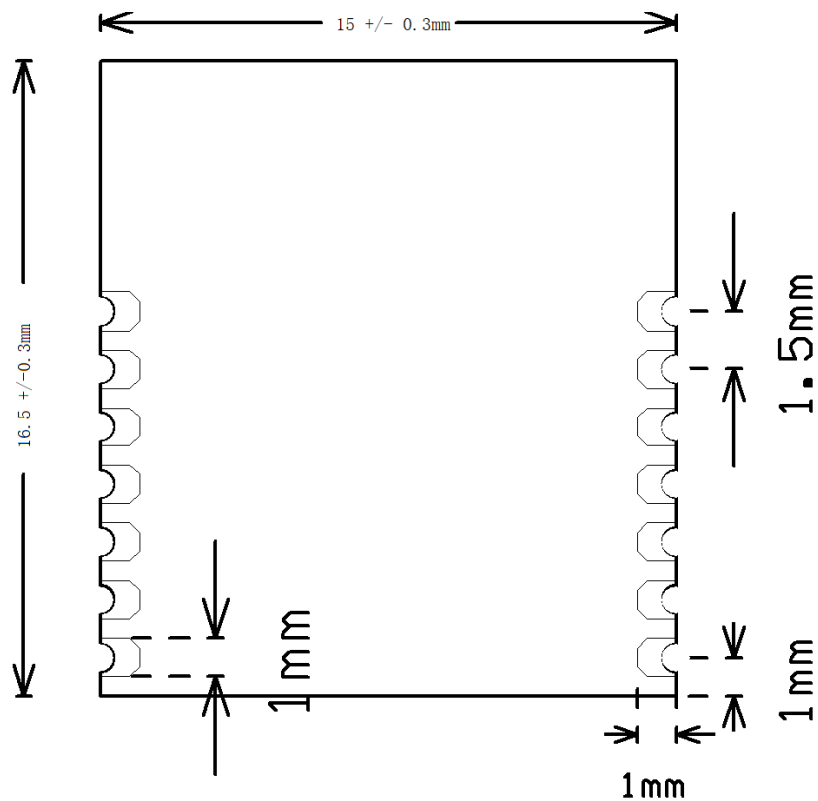
6.1 Mechanical Dimensions

Figure 6-1 BT7L-IPEX mechanical dimensions

Note:

The default dimensional tolerance is ±0.35 mm, and the tolerance for some

measurements is ±0.1 mm. If a customer has other requirements, clearly specify them in the datasheet after communication.

6.2 Production Instructions

1. Use an SMT placement machine to mount components to the stamp hole module that Tuya produces 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 components to the module.

   (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).
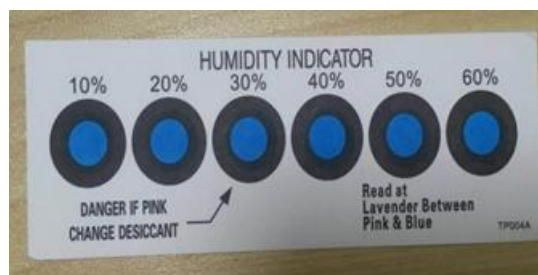
Figure 6-2 HIC for BT7L-IPEX

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±5°C

    (2) Alarm temperature: 130°C

    (3) SMT placement ready temperature after natural cooling: < 36°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 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.

6.3 Recommended Oven Temperature Curve

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

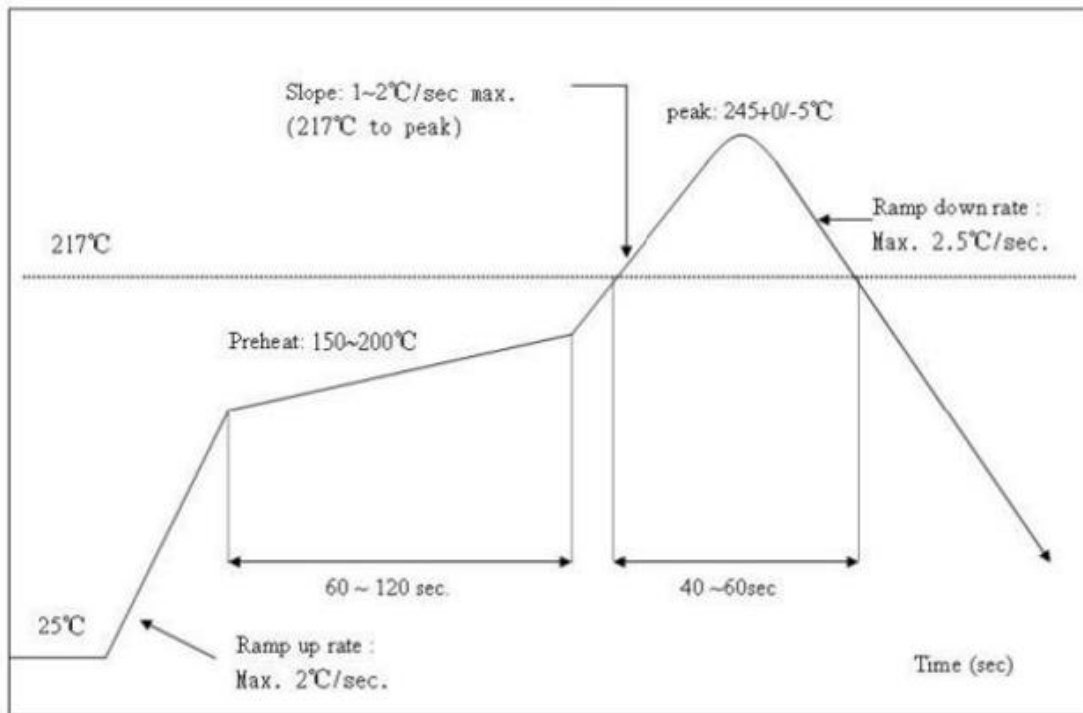Based on the IPC/JEDEC standard, perform reflow soldering on a module at most twice.

Figure 6-3 Oven temperature curve

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
   a) Mounted within:_____168_____hrs. of factory conditions
      If Blank, see adjacent bar code label
      ≤ 30°C/60%RH, OR
   b) Stored at <10% RH

4. Devices require bake, before mounting, if:
   a) Humidity Indicator Card is > 10% when read at 23 ± 5°C
   b) 3a or 3b not met.

5. If baking is required, devices may be baked for 48 hrs. at 125 ± 5°C

   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

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 Packing Information

MOQ and Packing Information				
Product Model	**MOQ (PCS)**	**Packing Method**	**Number of Modules in Each Reel Pack**	**Number of Reel Packs in Each Box**
BT7L-IPEX	3600	Carrier tape and reel packing	900	4

8 Appendix: Statement

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.

Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled rolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.

Important Note

This radio module must not installed to co-locate and operating 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 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 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 have got a FCC ID:2ANDL-BT7L-IPEX. The final end product must be labeled in a visible area with the following:

 "Contains Transmitter Module FCC ID:2ANDL-BT7L-IPEX"

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

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

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 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.