ZSU-IPEX Module Datasheet

Version: 20211115

Contents

ZSU-IPEX is a Zigbee module that Tuya has developed. It consists of a highly integrated RF processing chip (EFR32MG21A020F1024IM32-B), a few peripherals, a built-in 802.15.4 PHY/MAC Zigbee network protocol stack and rich library functions.

1 Product overview

ZSU-IPEX is embedded with a low-power 32-bit ARM Cortex-M33 core, 1024-KB flash program memory, 96-KB RAM and abundant peripheral resources. It integrates all function libraries of the Zigbee MAC and TCP/IP. You can develop embedded Zigbee products as required.

1.1 Features

- Embedded ARM Cortex-M 33 processor having a low-power 32-bit CPU and having DSP instructions and uping-point units, which can also function as an application processor
- Clock rate: 80 MHz
- Wide working voltage: 2.0 to 3.8 V
- Peripherals: 9 GPIOs, 1 UART, 2 ADCs, and 5 PWMs
- Zigbee connectivity

    - Support 802.15.4 MAC/PHY
    - Working channels 11 to 26 @2.400 to 2.483 GHz, air interface rate: 250 Kbps
    - Up to +20dBm output power
    - 60 uA/MHz power consumption during running; 5-uA sleep current
    - Ipex antenna with a gain of 3.1 dBi
    - Working temperature: -40℃ to 105℃
    - Support hardware encryption and AES 128/256

1.2 Applications

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

1.3 Change history

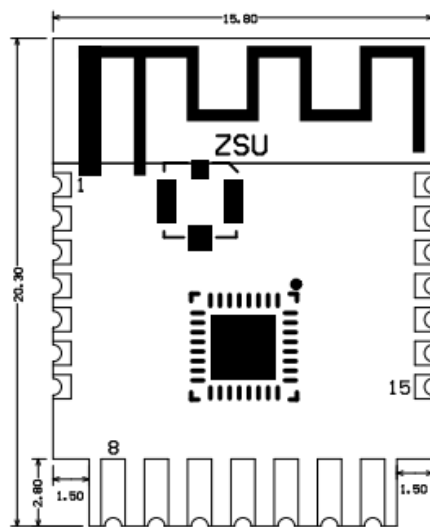| Update date	Updated content	Version after update
06/30/2021	This is the first release.	V1.0.0

2 Module interfaces

2.1 Dimensions and footprint

ZSU-IPEX has 3 lines of pins. 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 ZSU-IPEX are 20.3±0.35 mm (L)×15.8±0.35 mm (W) ×3.0±0.15 mm (H).

The dimensions of ZSU-IPEX are as follows:

Top View
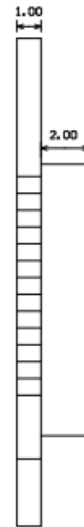
Side View

Unit: mm
Module form factor tolerance: ± 0.35mm
PCB thickness tolerance: ±0.1mm
Shield cover height tolerance: ±0.05mm

Bottom View

Recommended footprint
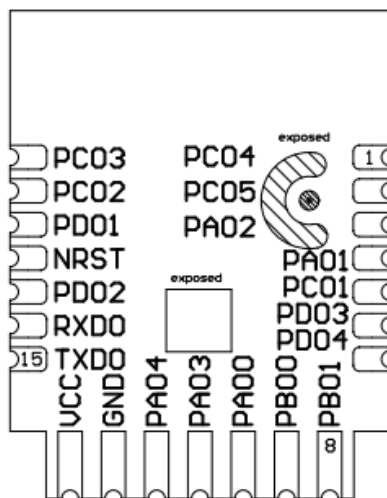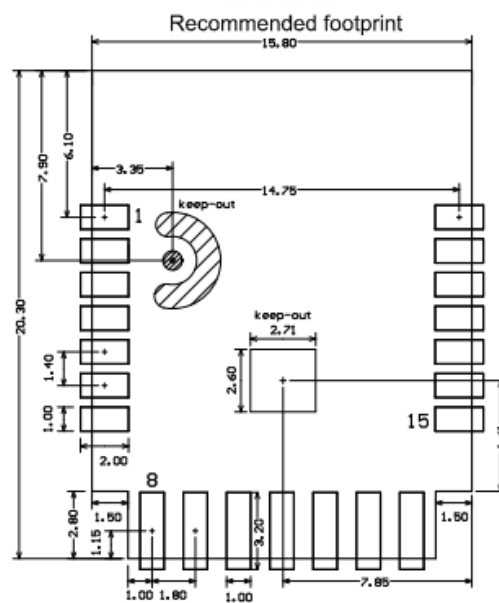
2.2 Pin definition
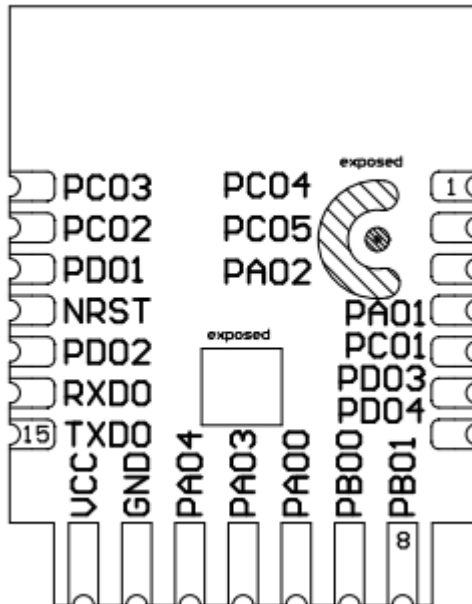
Pin number	Symbol	Type	Function
1	PC04	I/O	Common I/O pin, which corresponds to PC04 (Pin 5) on the internal IC
2	PC05	I/O	Common I/O pin, which corresponds to PC05 (Pin 6) on the internal IC
3	PA02	I/O	Burning pin, SWDIO, which corresponds to PA02 (Pin 19) on the internal IC
4	PA01	I/O	Burning pin, SWCLK, which corresponds to PA01 (Pin 18) on the internal IC

Pin number	Symbol	Type	Function
5	PC01	I	ADC pin, which corresponds to PC01 (Pin 2) on the internal IC
6	PD03	I/O	Common I/O pin, which corresponds to PD03 (Pin 29) on the internal IC
7	PD04	I/O	Common I/O pin, which corresponds to PD04 (Pin 28) on the internal IC
8	PB01	I/O	Support hardware PWM and correspond to PB01 (Pin 15) on the internal IC
9	PB00	I/O	Support hardware PWM and correspond to PB00 (Pin 16) on the internal IC
10	PA00	I/O	Support hardware PWM and correspond to PA00 (Pin 17) on the internal IC
11	PA03	I/O	Support hardware PWM and correspond to PA03 (Pin 20) on the internal IC

Pin number	Symbol	Type	Function
12	PA04	I/O	Support hardware PWM and correspond to PA04 (Pin 21) on the internal IC
13	GND	P	Power supply reference ground
14	VCC	P	Power supply pin (3.3V)
15	TXD0	I/O	UART_TXD0, burning authorization pin, correspond to PA05 (Pin 22) on the internal IC
16	RXD0	I/O	UART_RXD0, burning authorization pin, correspond to PA06 (Pin 23) on the internal IC
17	PD02	I	ADC pin, which corresponds to PD02 (Pin 30) on the internal IC
18	NRST	I/O	Reset pin, low active, correspond to RESETn (Pin 9) on the internal IC
19	PD01	I/O	Common I/O pin, which corresponds to PD01 (Pin 31) on the internal IC

Pin number	Symbol	Type	Function
20	PC02	I/O	Common I/O pin, which corresponds to PC02 (Pin 3) on the internal IC
21	PC03	I/O	Common I/O pin, which corresponds to PC03 (Pin 4) on the internal IC

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

- Pin 3, 4, 13, 14, and 18 are burning pins, which are not exposed by default. During routing, customers should bypass them.

3 Electrical parameters

3.1 Absolute electrical parameters

Parameter	Description	Minimum value	Maximum value	Unit
Ts	Storage temperature	-50	150	℃
VBAT	Power supply voltage	2.0	3.8	V
ESD voltage (human body model)	TAMB-25℃	-	2	KV
ESD voltage (machine model)	TAMB-25℃	-	0.5	KV

3.2 Normal working conditions

Parameter	Description	Minimum value	Typical value	Maximum value	Unit
Ta	Working temperature	-40	-	105	℃
VCC	Working voltage	2.0	3.3	3.8	V
VIL	I/O low level input	-	-	VDD*0.3	V
VIH	I/O high level input	VDD*0.7	-	-	V
VOL	I/O low level output	-	-	VDD*0.2	V

Parameter	Description	Minimum value	Typical value	Maximum value	Unit
VOH	I/O high level output	VDD*0.8	-	-	V

3.3 TX and RX power consumption

Working status	Mode	Rate	Transmit power/re-ceive	Average value	Peak value (Typical value)	Unit
Transmit	-	250Kbps	+20dBm	200	211	mA
Transmit	-	250 Kbps	+10 dBm	62	65	mA
Transmit	-	250 Kbps	+0 dBm	27	29	mA
Receive	-	250Kbps	Constantly receive	11	15	mA

3.4 Working current

Working mode	Working status, Ta = 25°C	Average value	Maximum value (Typical value)	Unit
EZ mode	The module is in fast network connection state.	12	38	mA
Connected and busy	The module is connected to the network and in running state.	13	70	mA

Working mode	Working status, Ta = 25°C	Average value	Maximum value (Typical value)	Unit
Connected and idle	The module is connected to the network and in idle state.	12	14	mA
Deep sleep mode	Deep sleep mode, 64-KB flash memory reserved	5	-	uA

4 RF parameters

4.1 Basic RF features

Parameter	Description
Working frequency	2.405 to 2.480 GHz
Zigbee standard	IEEE 802.15.4
Data transmission rate	250 Kbps
Antenna type	IPEX antenna with a gain of 3.1 dBi

4.2 TX performance

TX performance

Parameter	Minimum value	Typical value	Maximum value	Unit
Output power (250Kbps)	-30	15	20	dBm
Output power adjustment stepping	-	0.5	1	dBm
Output spectrum adjacent channel suppression	-	-31	-	dBc
Frequency error	-15	-	15	ppm

4.3 RX performance

RX sensitivity

Parameter	Minimum value	Typical value	Maximum value	Unit
PER<8%, RX sensitivity (250 Kbps)	-102	-101	-99	dBm

5 Antenna information

5.1 Antenna type

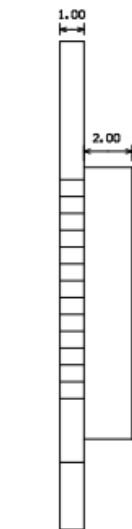The ZSU-IPEX uses a new generation of IPEX antenna bases. Its structure is shown below:
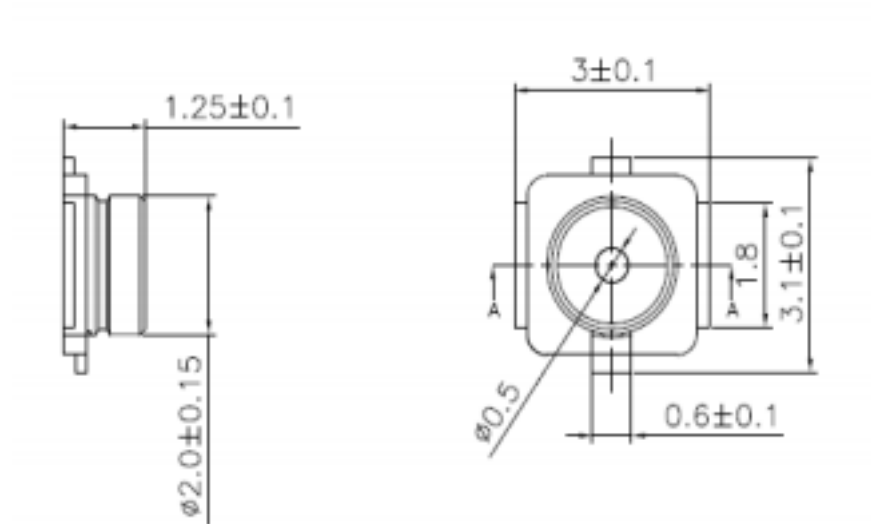
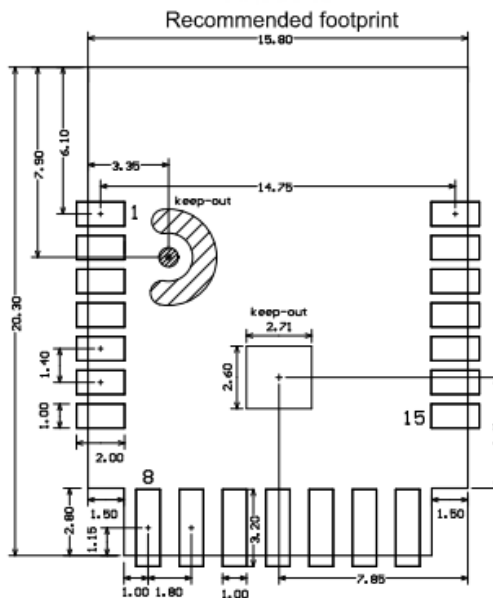

5.2 Antenna interference reduction

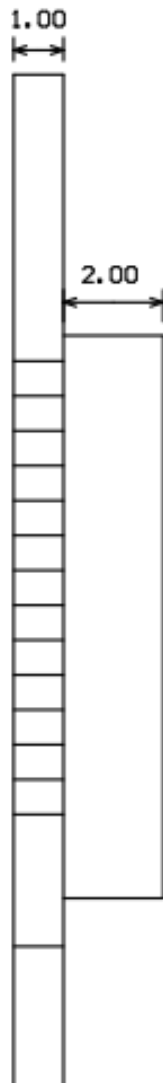It is recommended that the antenna be at least 15 mm away from other metal parts.

6 Packaging information and production instructions

6.1 Mechanical dimensions

The PCB dimensions are 20.3±0.35 mm (W)×15.8±0.35 mm (L) ×1.0±0.1 mm (H).

Unit: mm
Module form factor tolerance: ± 0.35mm
PCB thickness tolerance: ±0.1mm
Shield cover height tolerance: ±0.05mm

Top View

Side View

PC03 PC04
PC02 PC05
PD01 PA02
NRST PA01
PD02 PC01
RXD0 PD03
TXD0 PD04

VCC GND PA04 PA03 PA00 PB00 PB01

Bottom View

Recommended footprint

6.2 Side view

Unit：mm

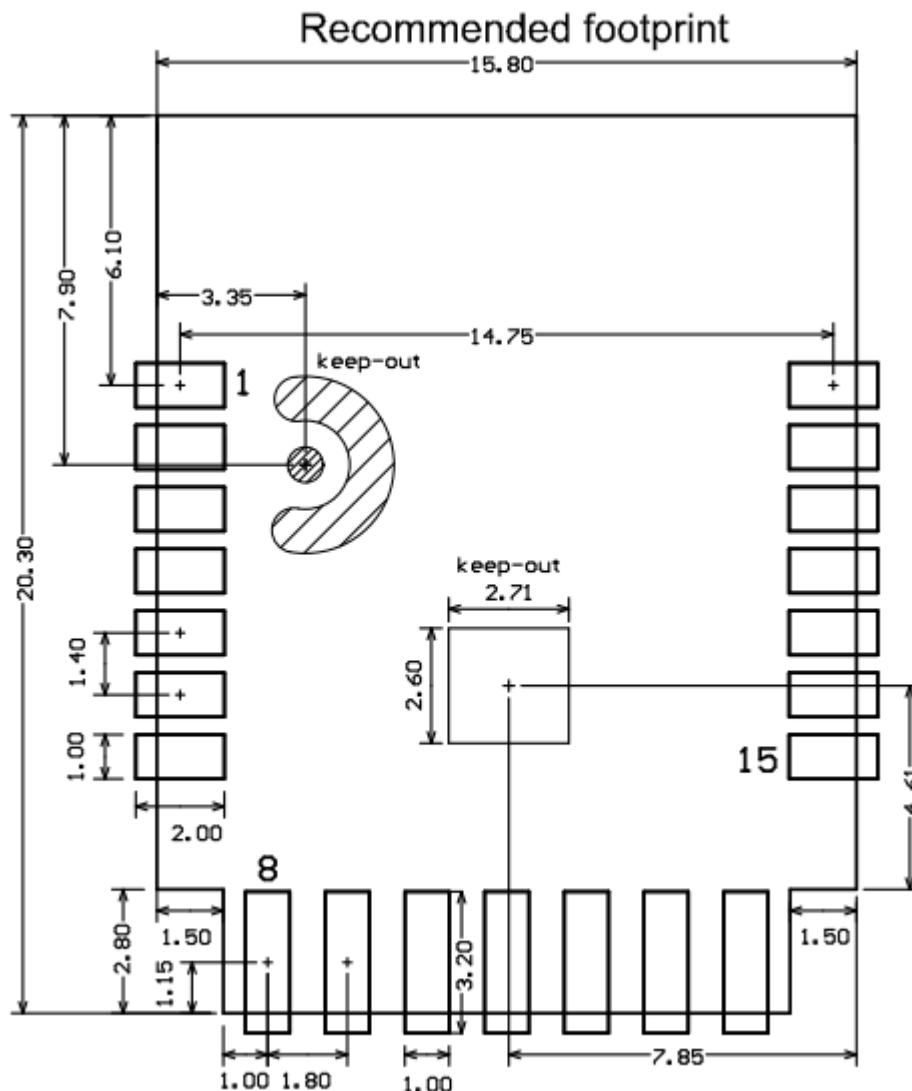Module form factor tolerance: ± 0.35mm

PCB thickness tolerance: ±0.1mm

Shield cover height tolerance: ±0.05mm

Side View

6.3 The schematic diagram of footprint
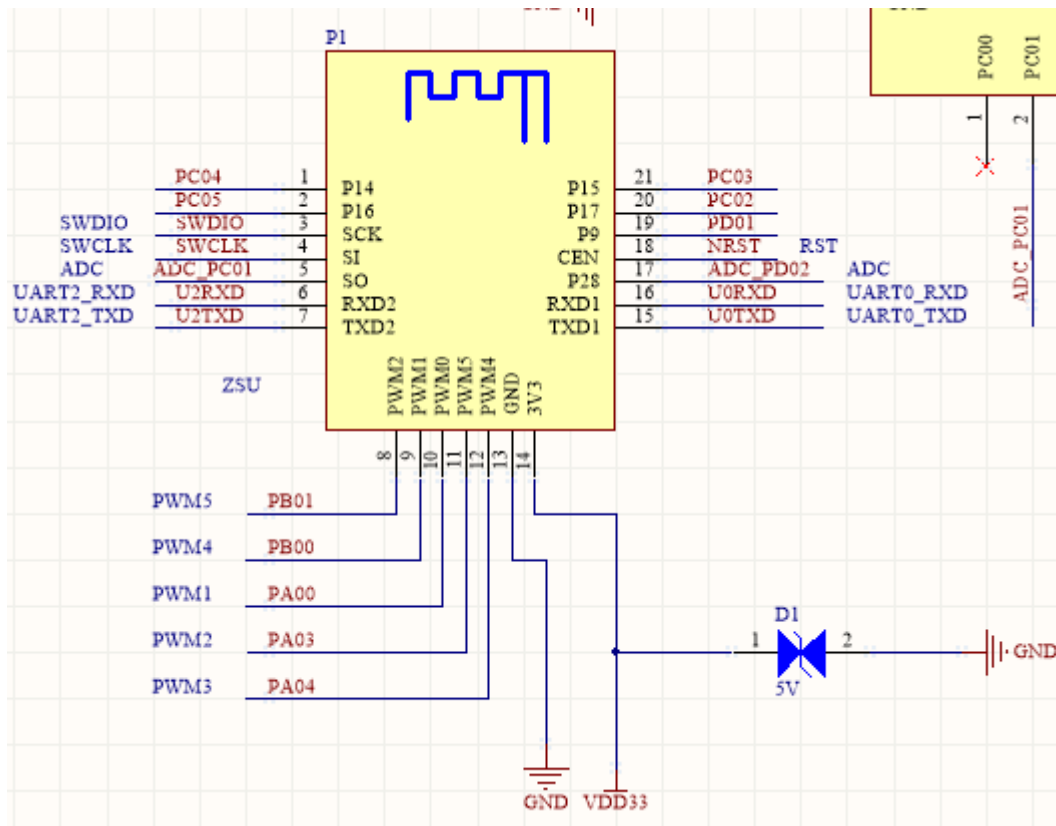
6.4 Recommended footprint

6.5 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.

```
1   ![HIC-SMT and in-line module.png](https://airtake-public-data-12541
2   53901.cos.ap-shanghai.myqcloud.com/goat/20210410/2c61fd34d2a6464d8cb
3   ee05f63689786.png)
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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.

6.6 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.

IPC-7530a-3-1-cn
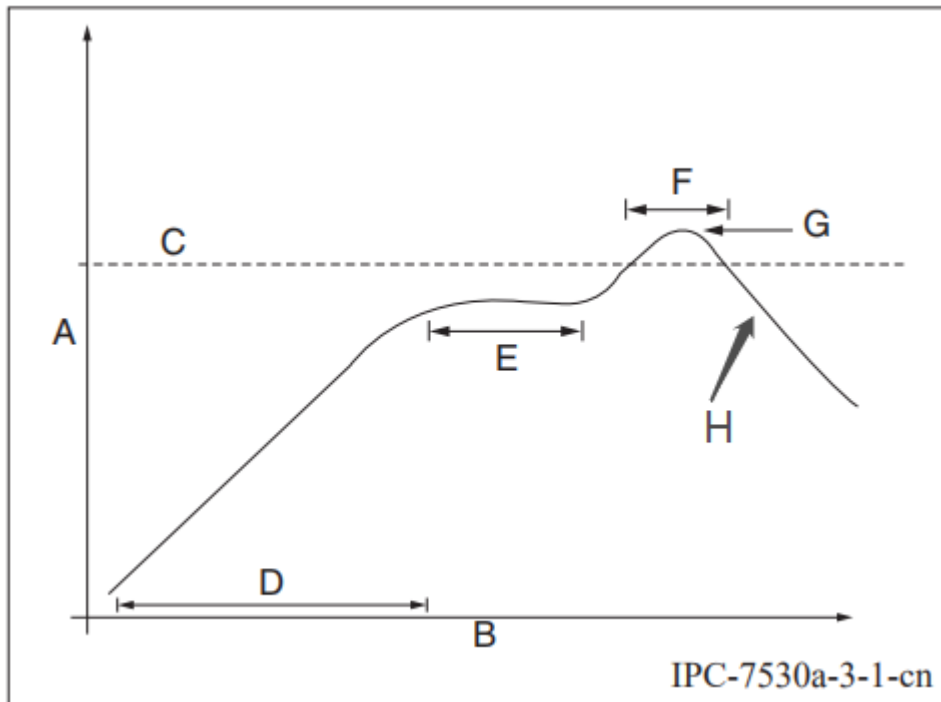
- A: Temperature axis

- 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
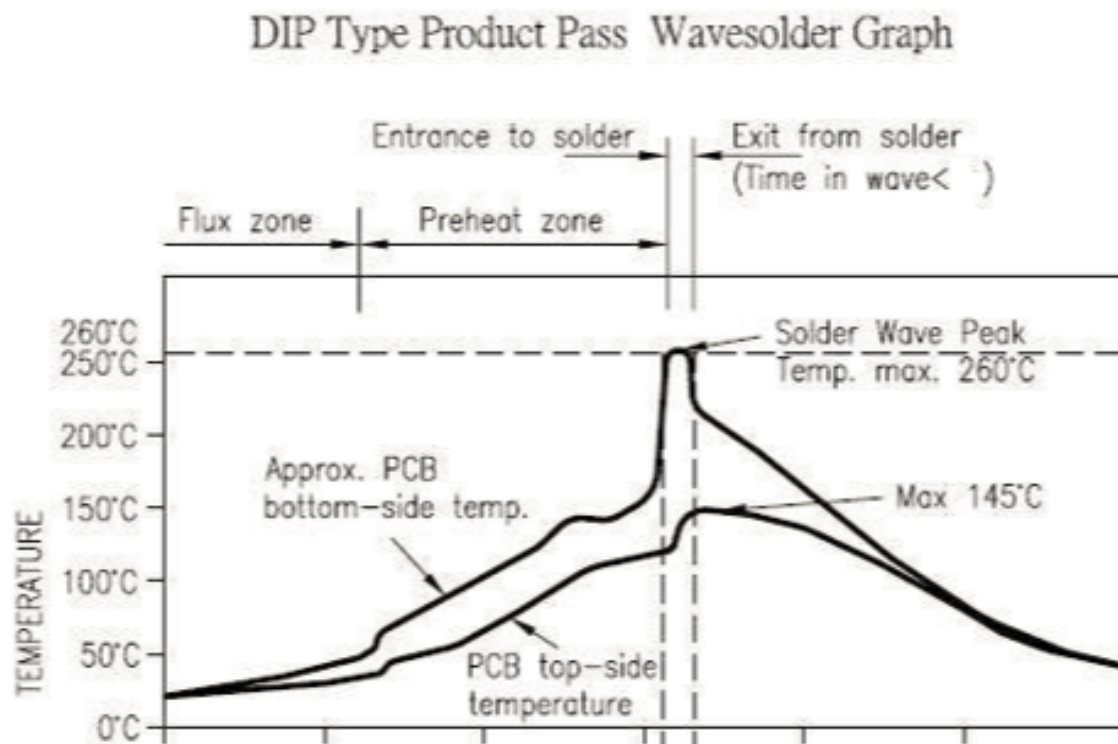
Suggestions on oven temperature curve of wave soldering		Suggestions on manual soldering temperature	
Preheat temperature	80 to 130 °C	Soldering temperature	360±20°C
Preheat time	75 to 100s	Soldering time	< 3s/point
Peak contact time	3 to 5s	NA	NA
Temperature of tin cylinder	260±5°C	NA	NA
Ramp-up slope	≤2°C/s	NA	NA
Ramp-down slope	≤6°C/s	NA	NA

6.7 Storage conditions

7 MOQ and packaging information

Product model	MOQ (pcs)	Packing method	Modules per reel	Reels per carton
ZSU-IPEX	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-ZSU-IPEX. The end product must be labelled in a visible area with the following: "Contains Transmitter Module FCC ID: 2ANDL-ZSU-IPEX".

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.