



# **ZS4S-IPEX Module Datasheet**

Version: 20210818

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ZS4S-IPEX is a Zigbee module that Tuya has developed. It consists of a highly integrated RF processing chip (EFR32MG13P732F512GM48), a few peripherals, a 802.15.4 PHY/MAC Zigbee network protocol stack, and rich library functions.

## 1 Product overview

ZS4S-IPEX is embedded with a low-power 32-bit ARM Cortex-M4 core, 512-KB flash program memory, 64-KB RAM, and rich peripherals. It integrates all function libraries of the Zigbee MAC and TCP/IP. You can develop embedded Zigbee products as required.

### 1.1 Features

- Embedded with a low-power 32-bit CPU having a Cortex-M4 processor, DSP instructions, and uping-point units, which can also function as an application processor
- Clock rate: 40 MHz
- Wide operating voltage: 2.4 to 3.8 V
- Peripherals: 9 GPIOs and 1 UART
- Zigbee connectivity
  - Support 802.15.4 MAC/PHY
  - Channels 11 to [26@2.400](#) to 2.483 GHz Air interface rate: 250 Kbps
  - Built-in DC-DC circuit, which improves the power efficiency to the greatest extent
  - Up to +18dBm output power and dynamic output power > 35 dB
  - 60 uA/MHz power consumption during running, 3.5uA sleep current
  - The terminal device connects to the network actively.
  
  - The Ipex connector can be used with an external antenna with a gain of 3.3dBi.
  - Operating temperature: -20°C to 85°C
  - 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

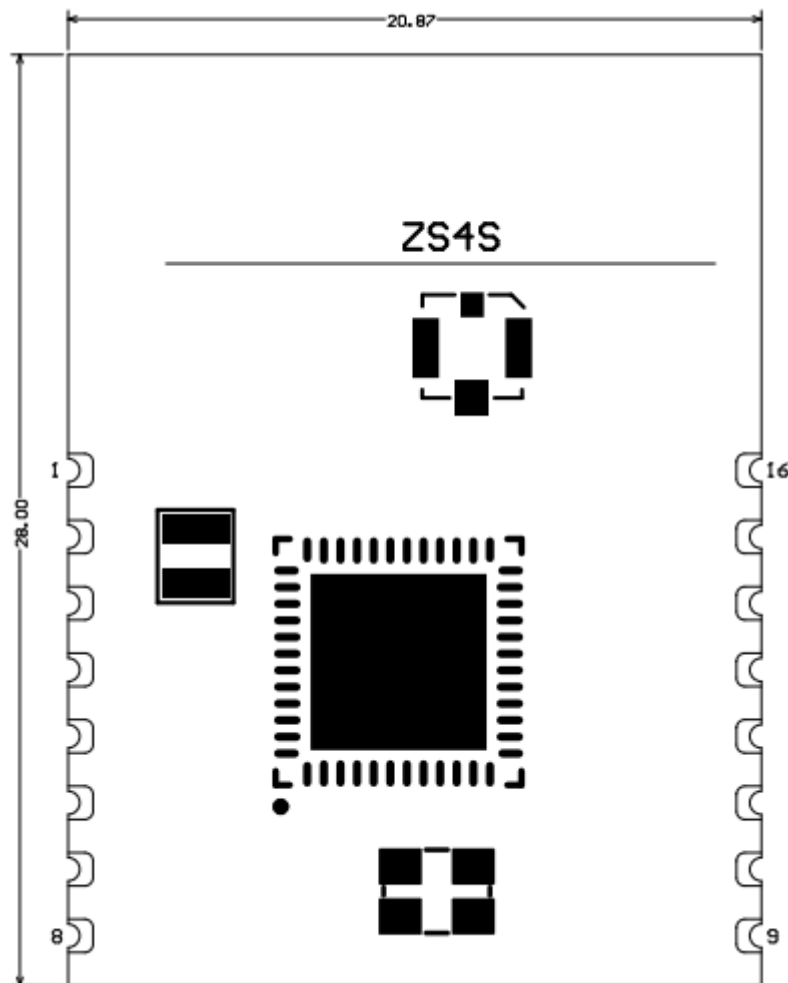
### 1.3 Change history

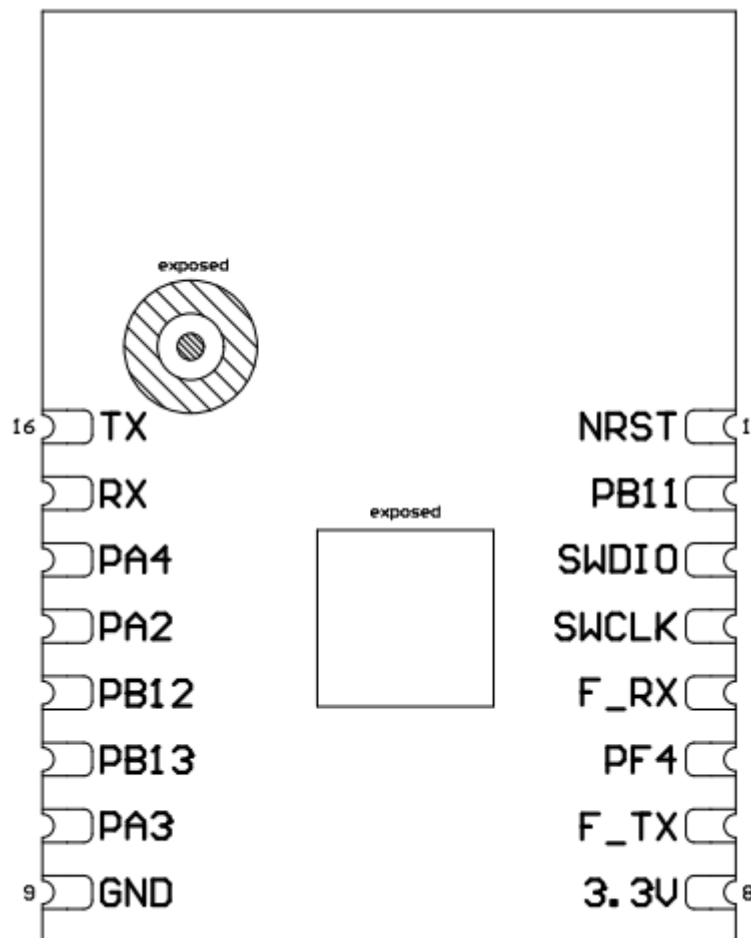
| Update date    | Updated content            | Version after update |
|----------------|----------------------------|----------------------|
| June 4th, 2021 | This is the first release. | V1.0.0               |

## 2 Module interfaces

### 2.1 Dimensions and footprint

The ZS4S-IPEX dimensions are  $20.9 \pm 0.35$  mm (W)  $\times$   $28.0 \pm 0.35$  mm (L)  $\times$   $3.5 \pm 0.15$  mm (H), which are shown below:





## 2.2 Pin definition

| Pin number | Symbol | Type | Function                                                                                                                                              |
|------------|--------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1          | nRST   | I    | Reset pin The chip is reset at low level. The module has its own power-on reset pin, so users may not use this pin according to the actual situation. |

| Pin number | Symbol | Type | Function                                                                                                                        |
|------------|--------|------|---------------------------------------------------------------------------------------------------------------------------------|
| 2          | PB11   | I/O  | Port for debugging the PTI (Packet trace interface), which corresponds to Pin 31                                                |
| 3          | SWDIO  | I/O  | Communication interface for JLINK burning, which can be configured as a GPIO in the application, and corresponds to PF1 (Pin 2) |
| 4          | SWCLK  | I/O  | Clock signal of JLINK burning, which can be configured as GPIO in the application, and corresponds to PF0 (Pin 1)               |
| 5          | F_RX   | I/O  | Receiving port of production, which corresponds to PF2 (Pin 3)                                                                  |
| 6          | PF4    | I/O  | Used as GPIO and correspond to PF4 (Pin 5)                                                                                      |
| 7          | F_TX   | I/O  | Transmitting port of production, which corresponds to PF5 (Pin 6)                                                               |

| Pin number | Symbol | Type | Function                                                                                                             |
|------------|--------|------|----------------------------------------------------------------------------------------------------------------------|
| 8          | 3.3V   | P    | Power supply pin of the module (The typical power supply voltage is 3.3V)                                            |
| 9          | GND    | P    | Power supply reference ground                                                                                        |
| 10         | PA3    | I/O  | Reserved full-interface UART RTS signal, which can also be used as GPIO in the application and corresponds to Pin 28 |
| 11         | PB13   | I/O  | PTI debugging port, FRC_DFRAME. Target packet trace interface Frame signal. Correspond to Pin 33.                    |
| 12         | PB12   | I/O  | PTI debugging port, FRC_DOUT, PTI data signal, corresponding to Pin 32                                               |
| 13         | PA2    | I/O  | Reserved PWM output, which can also be used as GPIO, and corresponds to Pin 27)                                      |

| Pin number | Symbol | Type | Function                                                                                                                        |
|------------|--------|------|---------------------------------------------------------------------------------------------------------------------------------|
| 14         | PA4    | I/O  | Reserved full-interface UART CTS signal, which corresponds to Pin 29                                                            |
| 15         | RX     | I/O  | UART0_RXD, receiving interface, which is connected to UART_TX of the external host computer and corresponds to PA 1 (Pin 26)    |
| 16         | TX     | I/O  | UART0_TXD, transmitting interface, which is connected to UART_RX of the external host computer and corresponds to PA 0 (Pin 25) |

**Note:**

- P indicates a power supply pin and I/O indicates an input/output pin.
- nRST is only a reset pin of the module and cannot be used for clearing Zigbee networking information.

### 3 Electrical parameters

#### 3.1 Absolute electrical parameters

| Parameter                      | Description          | Minimum value | Maximum value | Unit |
|--------------------------------|----------------------|---------------|---------------|------|
| Ts                             | Storage temperature  | -50           | 150           | °C   |
| VCC                            | Power supply voltage | -0.3          | 3.8           | V    |
| ESD voltage (human body model) | TAMB-25°C            | -             | 2.5           | KV   |
| ESD 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      | 2.4           | 3.3           | 3.8           | V    |
| V <sub>IL</sub> | I/O low level input  | -0.3          | -             | VCC*0.25      | V    |
| V <sub>IH</sub> | I/O high-level input | VCC*0.75      | -             | VCC           | V    |

| Parameter        | Description           | Minimum value | Typical value | Maximum value | Unit |
|------------------|-----------------------|---------------|---------------|---------------|------|
| VOL              | I/O low level output  | -             | -             | VCC 0.1       | V    |
| V <sub>OH</sub>  | I/O high-level output | VCC*0.8       | -             | VCC           | V    |
| I <sub>max</sub> | I/O drive current     | -             | -             | 12            | mA   |

### 3.3 Zigbee TX power consumption

| Symbol | Rate    | Transmit power | Typical value | Unit |
|--------|---------|----------------|---------------|------|
| IRF    | 250Kbps | +18dBm         | 140           | mA   |
| IRF    | 250Kbps | +13dBm         | 55            | mA   |
| IRF    | 250Kbps | +10dBm         | 41.5          | mA   |
| IRF    | 250Kbps | +0dBm          | 21            | mA   |

**Note:** When the above data are tested, constant transmission is required, that is, duty cycle=100%.

### 3.4 Zigbee RX power consumption

| Symbol | Rate    | Typical value | Unit |
|--------|---------|---------------|------|
| IRF    | 250Kbps | 8             | mA   |

**Note:** When the UART is in active state, the receiving current is 14mA.

### 3.5 Power consumption in working mode

| Working mode    | Working status, Ta = 25°C                          | Average value | Maximum value | Unit |
|-----------------|----------------------------------------------------|---------------|---------------|------|
| Fast connection | The module is in the fast network connection state | 10            | 40            | mA   |
| Connected       | The module is connected to the network             | 3             | 5             | mA   |
| Deep sleep mode | Deep sleep mode, reserve 64KB RAM                  | 3             | 6             | uA   |

### 3.6 RF features

#### 3.7 Basic RF features

| Parameter                   | Description        |
|-----------------------------|--------------------|
| Working frequency           | 2.400 to 2.484 GHz |
| Standards of physical layer | IEEE 802.15.4      |
| Data transmission rate      | 250 Kbps           |
| Antenna type                | FPC antenna        |
| LOS propagation distance    | > 120m             |

### 3.8 Zigbee output performance

| Parameter                                    | Minimum value | Typical value | Maximum value | Unit |
|----------------------------------------------|---------------|---------------|---------------|------|
| Maximum output power                         | -             | +18           | -             | dBm  |
| Minimum output power                         | -             | -30           | -             | dBm  |
| Output power adjustment stepping             | -             | 0.5           | 1             | dB   |
| Frequency error                              | -15           | -             | +15           | ppm  |
| Output spectrum adjacent channel suppression | -             | -31           | -             | dBc  |

**Note:** The maximum output power can be +18dBm. Generally, the power output may be adjusted and the large power can be used for transmission in the extremely complicated environment, for example, gateway-level indoor.

### 3.9 Zigbee RX sensitivity

| Parameter                             | Minimum value | Typical value | Maximum value | Unit |
|---------------------------------------|---------------|---------------|---------------|------|
| PER<10%, RX sensitivity, 250Kbps@OQPS | -102          | -101          | -100          | dBm  |

## **4 Antenna information**

### **4.1 Antenna type**

ZS4S-IPEX adopts the external FPC antenna.

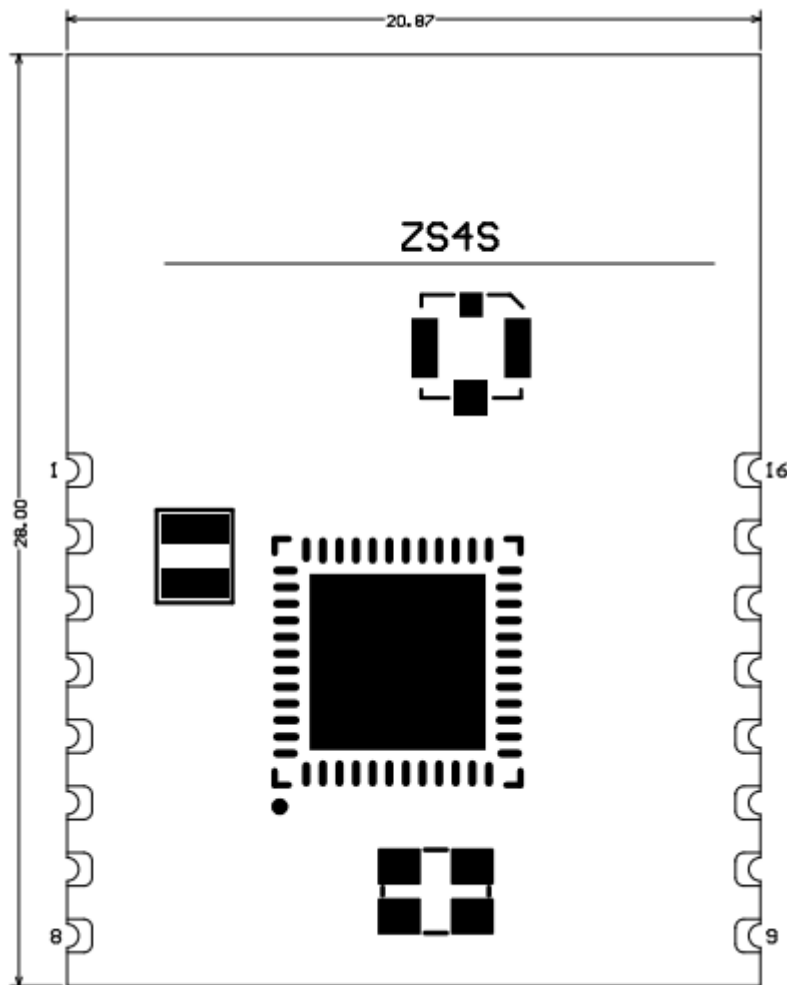
### **4.2 Antenna interference reduction**

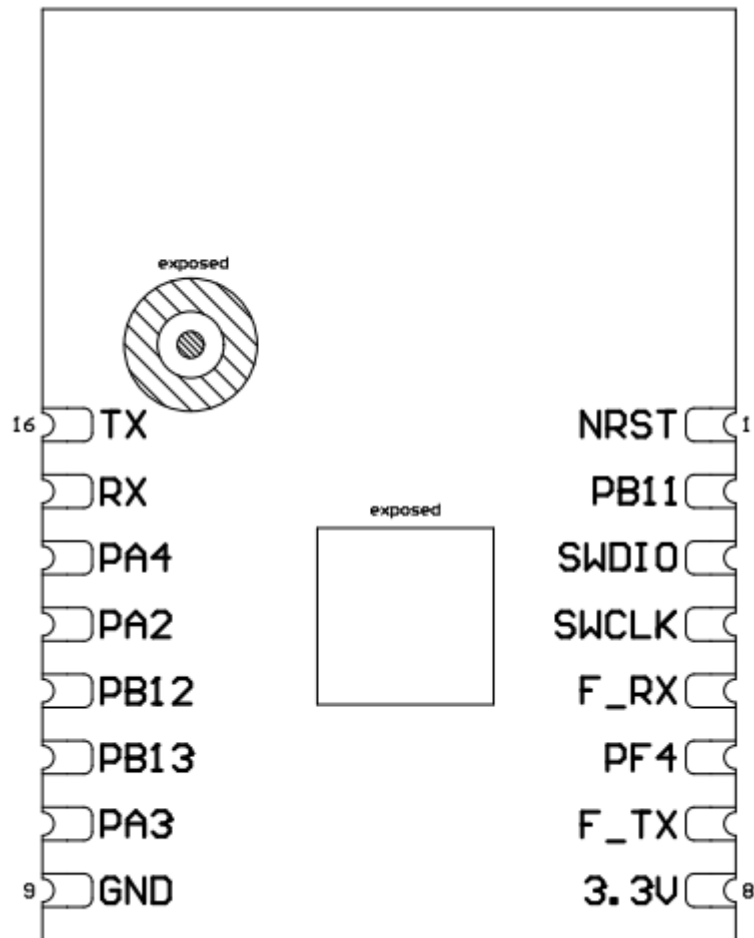
To ensure wireless performance, do not place wires or copper around the antenna on the PCB. It is recommended that the antenna be at least 15 mm away from other metal parts.

## 5 Packaging information and production instructions

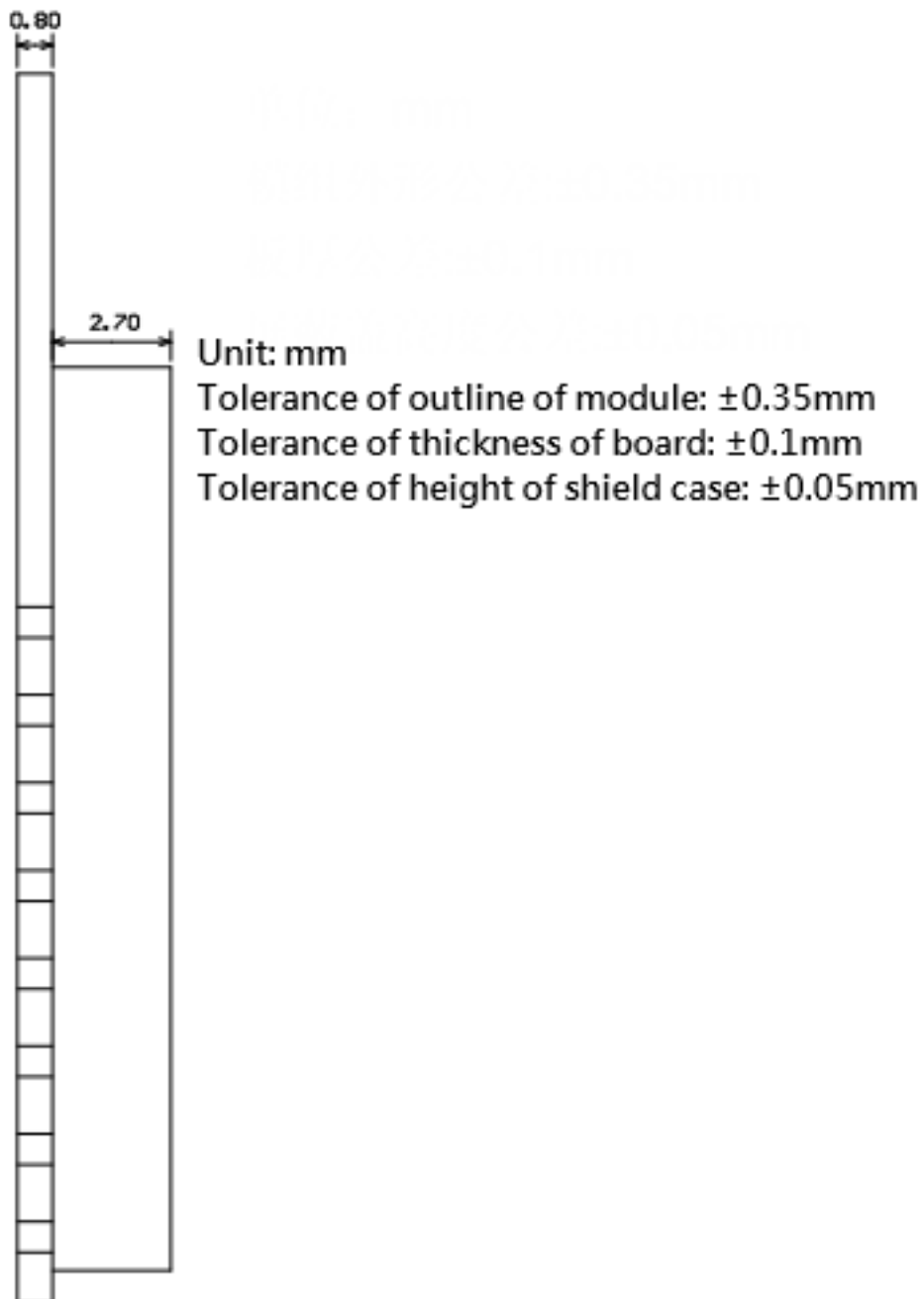
### 5.1 Mechanical dimensions

The PCB dimensions are  $20.9 \pm 0.35$  mm (W)  $\times$   $28.0 \pm 0.35$  mm (L)  $\times$   $0.8 \pm 0.1$  mm (H).





## 5.2 Side view



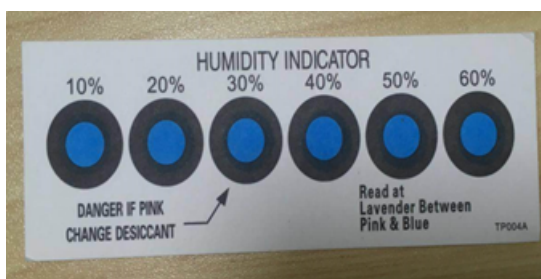
### 5.3 Production instructions

1. The Tuya SMT module should be mounted by the SMT device. After being unpacked, it should be soldered within 24 hours. Otherwise, it should be put into the drying cupboard where the RH is not greater than 10%; or it needs to be packaged under vacuum again and the exposure time needs to be recorded (the total exposure time cannot exceed 168 hours).

- SMT devices:
  - Mounter
  - SPI
  - Reflow soldering machine
  - Thermal profiler
  - Automated optical inspection (AOI) equipment
- 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 where 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 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 the sealing of the bag.

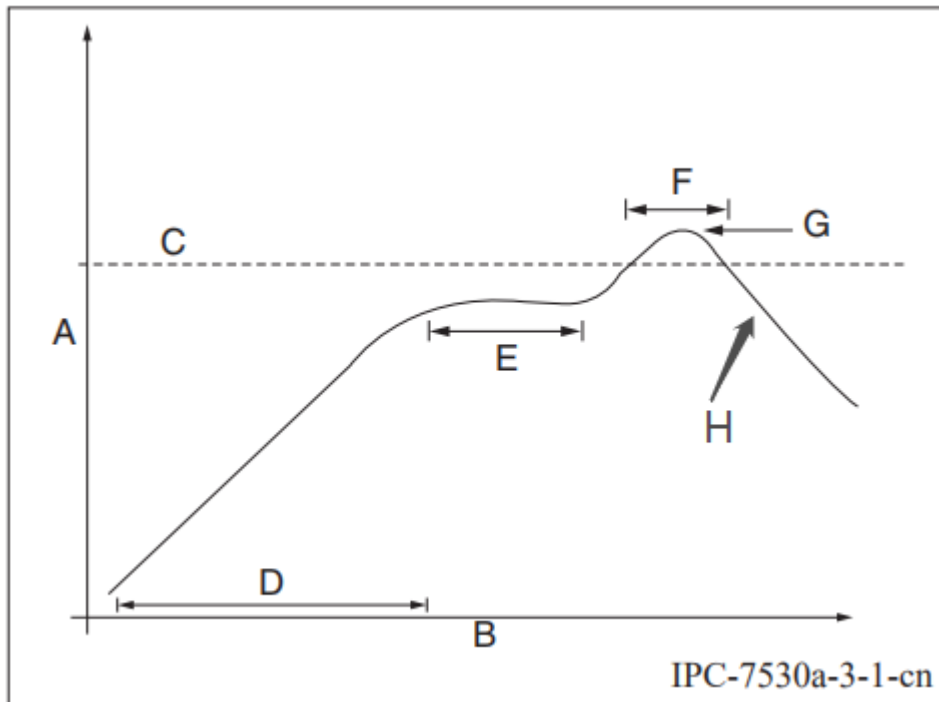
4. Baking settings:

- 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 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.

#### 5.4 Recommended oven temperature curve

Set oven temperatures according to the following temperature curve of reflow soldering. The peak temperature is 245°C.



- 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.

## 5.5 Storage conditions

|                                                                                                                                                                                         |                                                                          |                                                                                                                                                                    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                        | <b>Caution</b><br>This bag contains<br><b>MOISTURE-SENSITIVE DEVICES</b> | <div style="border: 1px solid black; padding: 5px; display: inline-block;"><b>LEVEL</b><br/><b>3</b></div><br><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><br/><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 be</p>                                                                |                                                                          |                                                                                                                                                                    |
| <p>a) Mounted within: <u>168</u> hours of factory conditions<br/><small>If blank, see adjacent bar code label</small><br/><math>\leq 30^{\circ}\text{C}/60\% \text{ RH}</math>, or</p>  |                                                                          |                                                                                                                                                                    |
| <p>b) Stored per J-STD-033</p>                                                                                                                                                          |                                                                          |                                                                                                                                                                    |
| <p>4. Devices require bake, before mounting, if:</p>                                                                                                                                    |                                                                          |                                                                                                                                                                    |
| <p>a) Humidity Indicator Card reads <math>&gt;10\%</math> for level 2a - 5a devices or <math>&gt;60\%</math> for level 2 devices when read at <math>23 \pm 5^{\circ}\text{C}</math></p> |                                                                          |                                                                                                                                                                    |
| <p>b) 3a or 3b are not met</p>                                                                                                                                                          |                                                                          |                                                                                                                                                                    |
| <p>5. If baking is required, refer to IPC/JEDEC J-STD-033 for bake procedure</p>                                                                                                        |                                                                          |                                                                                                                                                                    |
| <p style="text-align: center;"><b>See Production Date</b></p>                                                                                                                           |                                                                          |                                                                                                                                                                    |
| <p>Bag Seal Date: _____<br/><small>If blank, see adjacent bar code label</small></p>                                                                                                    |                                                                          |                                                                                                                                                                    |
| <p><b>Note: Level and body temperature defined by IPC/JEDEC J-STD-020</b></p>                                                                                                           |                                                                          |                                                                                                                                                                    |

## 6 MOQ and packaging information

| Product model | MOQ (pcs) | Packing method | The number of modules per reel | The number of reels per carton |
|---------------|-----------|----------------|--------------------------------|--------------------------------|
| ZS4S-IPEX     | 3600      | Tape reel      | 900                            | 4                              |

## 7 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 rule that applies 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-ZS4S-IPEX. The end product must be labeled in a visible area with the following: “Contains Transmitter Module FCC ID: 2ANDL-ZS4S-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 2) 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 a waste electrical and electronic device (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.