ZS4S-IPEX Module Datasheet

Version: 20210818

Contents

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℃ to 85℃
  - 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±0.35 mm (W)×28.0±0.35 mm (L) ×3.5±0.15 mm (H), which are shown below:
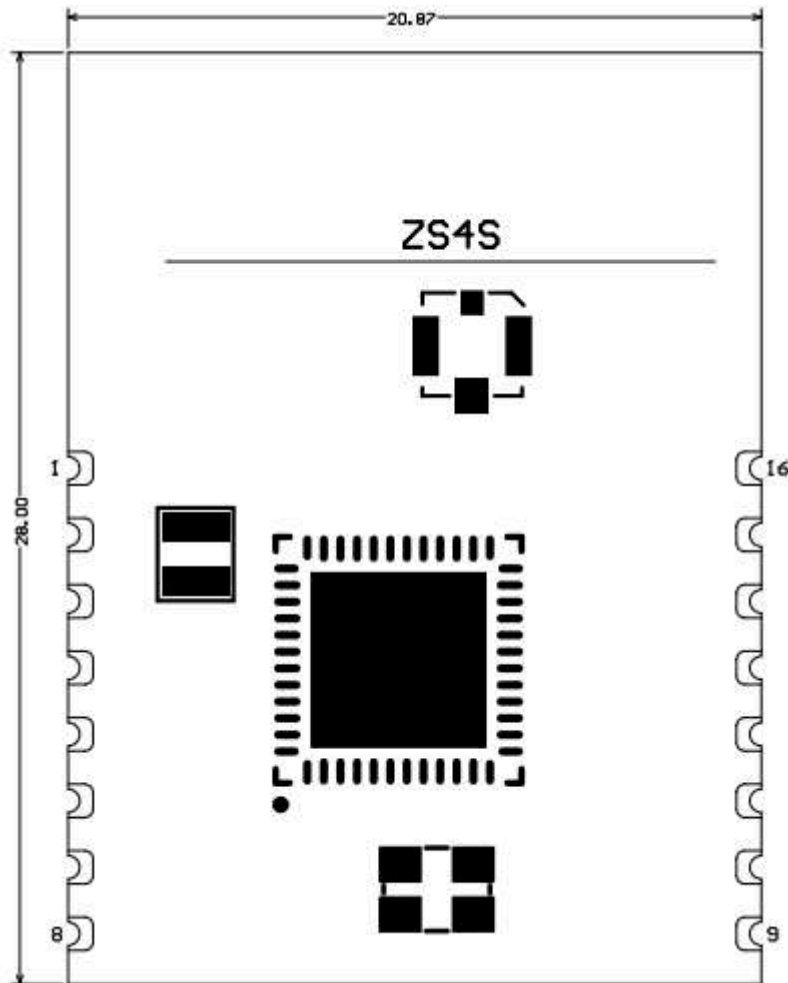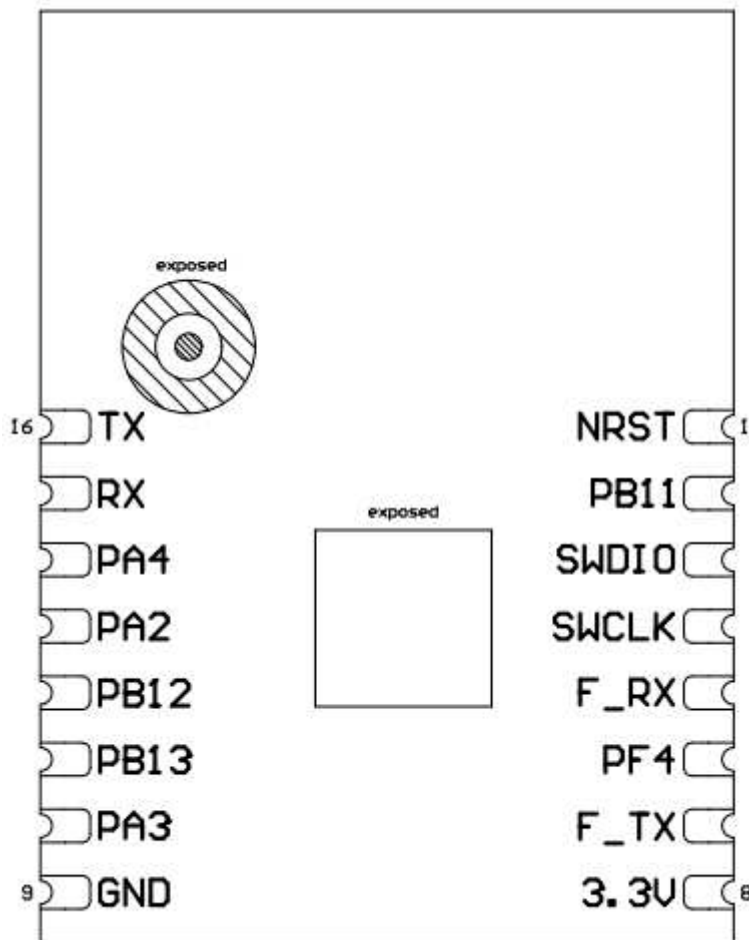
2.2 Pin definition

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	℃
VCC	Power supply voltage	-0.3	3.8	V
ESD voltage (human body model)	TAMB-25℃	-	2.5	KV
ESD voltage (machine model)	TAMB-25℃	-	0.5	KV

3.2 Working conditions

Parameter	Description	Minimum value	Typical value	Maximum value	Unit
Ta	Working temperature	-40	-	85	℃
VCC	Working voltage	2.4	3.3	3.8	V
V_{IL}	I/O low level input	-0.3	-	VCC*0.25	V
V_{IH}	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_{OH}	I/O high-level output	VCC*0.8	-	VCC	V
Imax	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

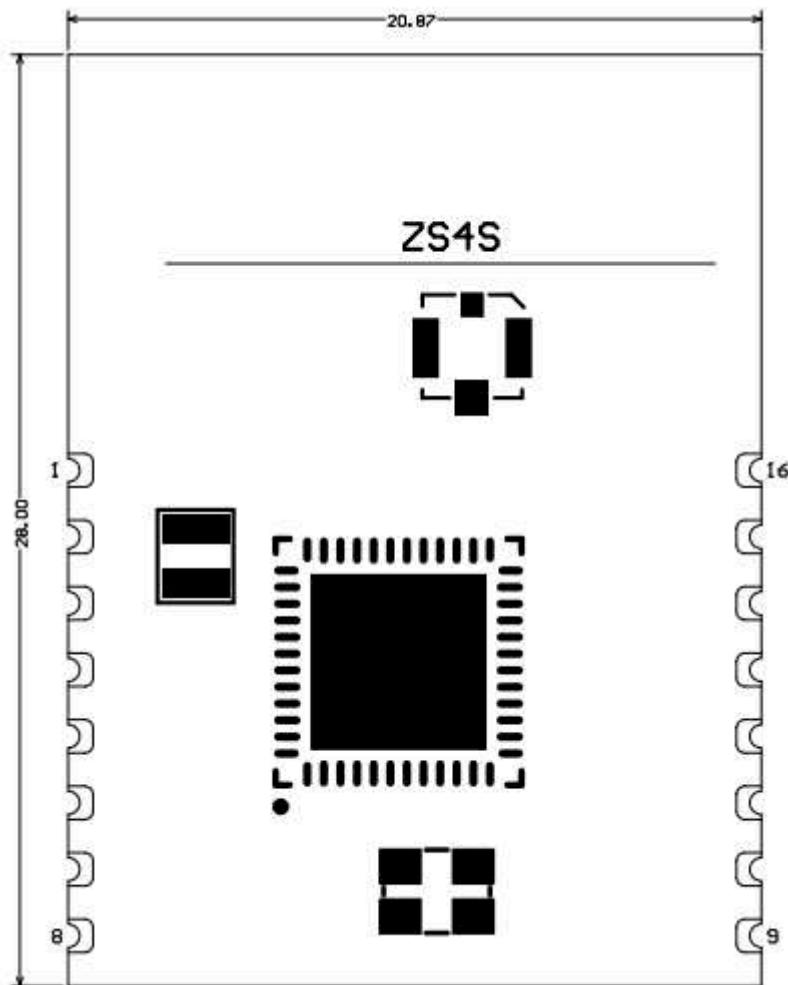## 4.1 Antenna type

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.
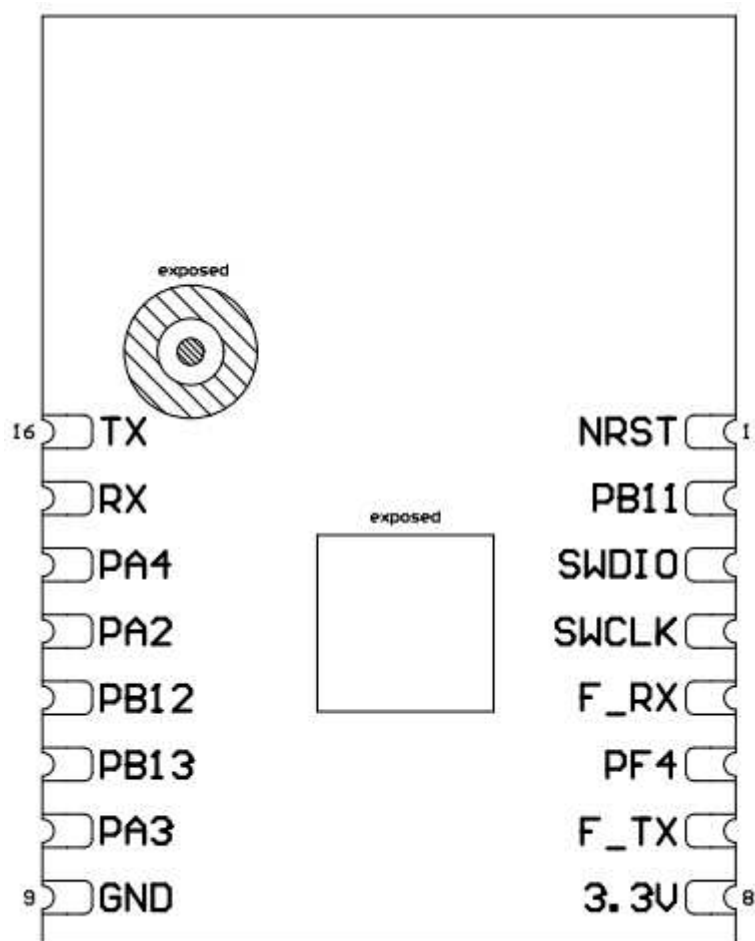
5 Packaging information and production instructions

5.1 Mechanical dimensions
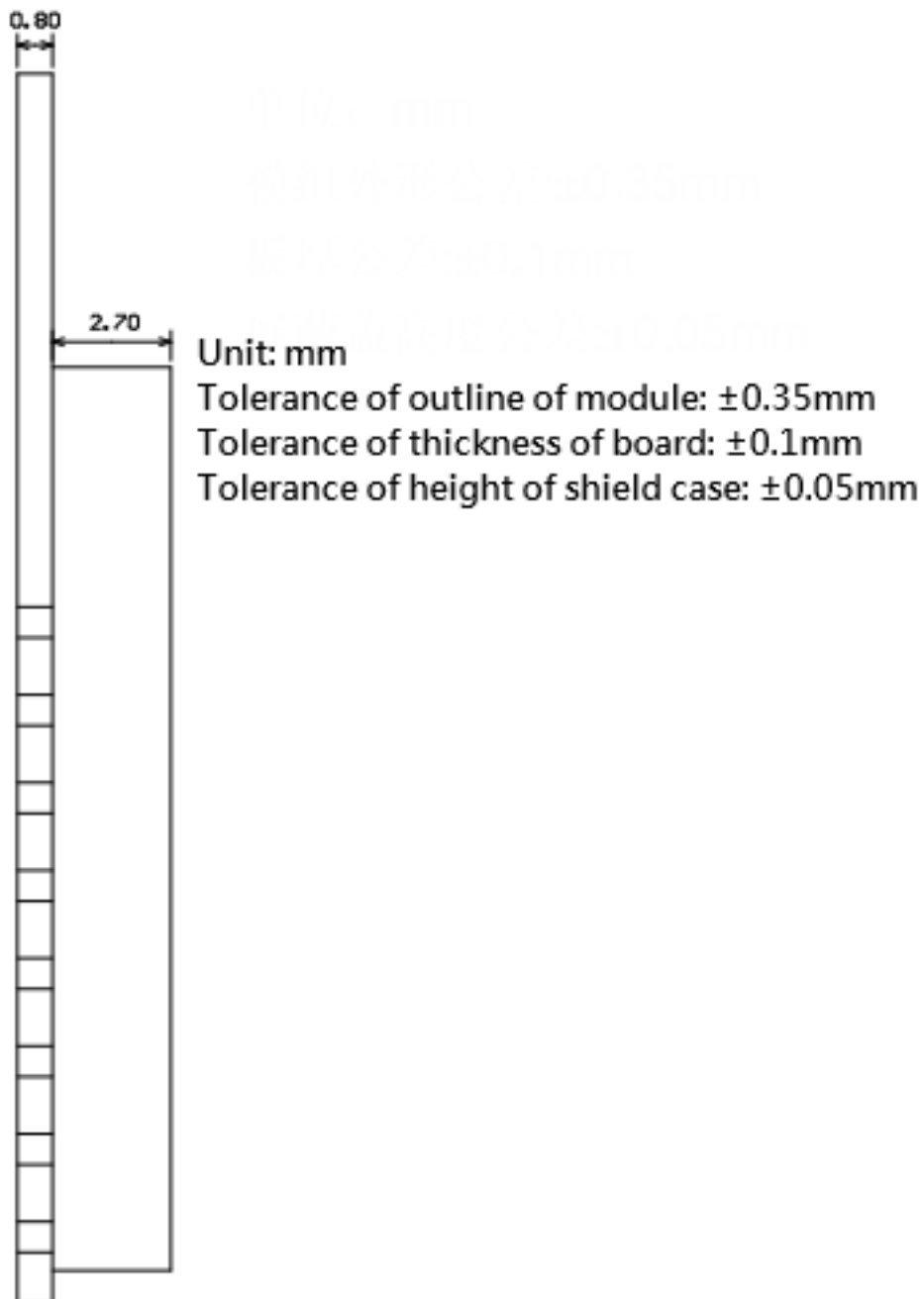
The PCB dimensions are 20.9±0.35 mm (W)×28.0±0.35 mm (L) ×0.8±0.1 mm (H).

5.2 Side view

Unit: mm
Tolerance of outline of module: ±0.35mm
Tolerance of thickness of board: ±0.1mm
Tolerance of height of shield case: ±0.05mm

5.3 Production instructions

1. The Tuya SMT module should be mounted by the SMT device. After being un-
   packed, 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 tem-
     perature 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 ≤ 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 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.

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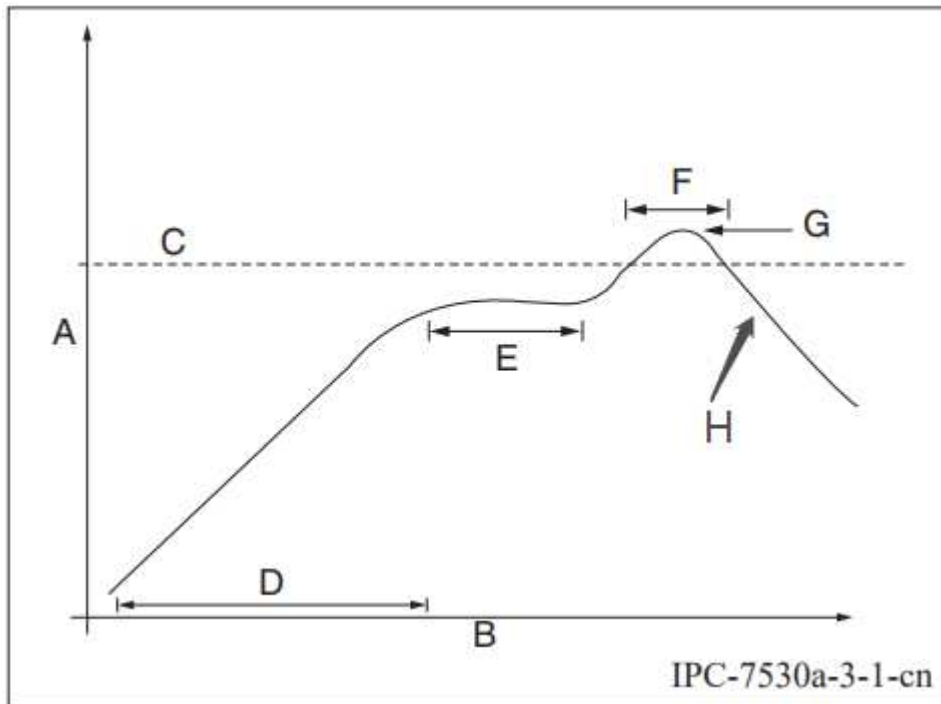
- A: Temperature axis

- 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.

5.5 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 be

   a) Mounted within: _____**168**_____ hours of factory conditions
   If blank, see adjacent bar code label
   ≤30˚C/60% 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 ± 5˚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: _____**See Production Date**_____
If blank, see adjacent bar code label

Note: Level and body temperature defined by IPC/JEDEC J-STD-020

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.