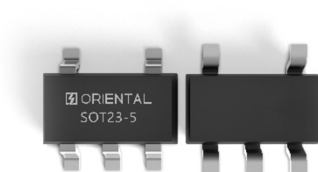
## SOT23-5

SOT23-3 和 SOT23-5 是电子硬件设计中最经典、应用最广泛的表面贴装（SMT）封装之一。它们在小体积与功能密度之间取得了极佳的平衡，特别是在 LDO（低压差线性稳压器）和 OPA（运算放大器）等产品中扮演着重要角色。
SOT23-3 and SOT23-5 are among the most classic and widely used surface-mount (SMT) packages in electronic hardware design. They deliver an excellent balance between compact size and functional density, and are particularly vital for components such as LDOs (Low-Dropout Linear Regulators) and OPAs (Operational Amplifiers).




**封装介绍与结构特点**
**Package Introduction & Structural Features**
**SOT** 的全称是“Small Outline Transistor”（小外形晶体管）。SOT23-3 和 SOT23-5 均属于该家族，具有极高的市场普及度。
SOT stands for Small Outline Transistor. Both SOT23-3 and SOT23-5 belong to this package family and enjoy extremely high market popularity.

- 物理尺寸与外观：
  Physical Dimensions & Appearance:
    - SOT23-3：是最基础的 3 引脚版本，典型封装体尺寸约为 2.9mm × 1.3mm。
      SOT23-3: The basic 3-pin version, with typical body dimensions of approximately 2.9mm × 1.3mm.
    - SOT23-5：在 SOT23-3 的基础上衍生而来，为了容纳更多引脚，其宽度略有增加，典型尺寸为 2.9mm × 1.6mm。
      SOT23-5: Derived from SOT23-3. Its width is slightly increased to accommodate more pins, with typical dimensions of approximately 2.9mm × 1.6mm.
    - 两者的高度通常都在 1.0mm - 1.1mm 左右，整体形如一颗微小的“芝麻粒”，非常适合高密度 PCB 布局。
      Both packages have a typical height of 1.0mm to 1.1mm. Featuring a tiny grain-like shape, they are well-suited for high-density PCB layout.
- 引脚结构：
  Lead Structure:
    - 均采用 “鸥翼”（Gull Wing） 引脚设计，引脚向外弯曲。这种结构不仅便于自动化贴片机的精准拾取和回流焊，还能有效吸收热应力，避免焊点开裂。
      Both adopt gull-wing lead design with outward-bent pins. This structure not only

enables accurate pick-and-place by automatic mounters and smooth reflow soldering, but also effectively relieves thermal stress and prevents solder joint cracking.

- 标准的引脚间距（Pitch）通常为 0.95mm，手工焊接和返修也相对容易。
  The standard lead pitch is typically 0.95 mm, making manual soldering and rework relatively easy.

**在 LDO / OPA 产品中的封装优势**

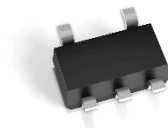
**Package Advantages for LDO / OPA**

对于电源管理芯片（如 LDO）和模拟信号链芯片（如 OPA）来说，SOT23-5 相比传统的 SOT23-3 具有明显的功能性优势，实现了从“分立元件”到“小型集成电路”的跨越：

For power management chips such as LDOs and analog signal chain chips like OPAs, SOT23-5 offers distinct functional advantages over traditional SOT23-3, marking an upgrade from discrete components to compact integrated circuits.

1. 功能的极大扩展（不仅仅是多了两个脚）：
   Significant functional expansion (far more than just two extra pins):
   - SOT23-3：通常只能实现最基础的功能，例如 LDO 的输入（Vin）、输出（Vout）和地（GND），或者 OPA 的正负输入与输出。它缺乏控制逻辑，上电即工作，无法灵活干预。
     SOT23-3 generally only supports basic functions. For LDOs, it covers Vin, Vout and GND; for OPAs, it includes positive input, negative input and output. Without control logic, it operates automatically after power-on with no flexible adjustment.
   - SOT23-5：多出的引脚为芯片带来了质的飞跃。
     The extra pins bring substantial functional improvements to the chip.
     - 在 LDO 中：第 5 脚通常被定义为 使能端（Enable/CE） 或 可编程端（Prog/FB）。工程师可以通过 Enable 脚由 MCU 控制电源的通断以降低系统待机功耗；也可以通过 Prog 脚外接电阻来精确设定输出电流或电压，极大地提升了设计的灵活性。
       For LDOs: The fifth pin is usually defined as Enable/CE or Prog/FB. Engineers can use the Enable pin to switch the power on and off via MCU, cutting down system standby power consumption. An external resistor connected to the Prog pin can also set the output current or voltage precisely, greatly boosting design flexibility.

        - 在 OPA 中：5 脚封装可以容纳单路运放并引出调零端或关断控制端，增强了模拟电路的可控性。
          For OPAs: The 5-pin package can house a single operational amplifier with offset null or shutdown control pins, enhancing the controllability of analog circuits.
2. 优异的散热与功耗表现：
   Excellent heat dissipation and power consumption performance:
    - 虽然体积微小，但 SOT23-5 通过 PCB 铜箔散热的能力较强。对于大多数低功耗 LDO 而言，它通常能处理 0.3W 到 0.5W 的功耗，足以满足便携式设备的供电需求。
      Despite its tiny size, SOT23-5 dissipates heat efficiently through PCB copper foils. For most low-power LDOs, it can handle power dissipation ranging from 0.3W to 0.5W, which fully meets the power supply demands of portable devices.
3. 低成本与高兼容性：
   Low cost and high compatibility:
    - 相比 DFN/QFN 等更先进的封装，SOT23-5 不需要 PCB 底部设计复杂的散热焊盘或钻孔，普通的双层板工艺配合标准回流焊即可轻松生产，显著降低了研发和生产成本。
      Compared with advanced packages such as DFN and QFN, SOT23-5 requires no complex thermal pads or vias on the PCB bottom. It can be easily manufactured with standard double-layer PCB processes and conventional reflow soldering, greatly cutting R&D and production costs.



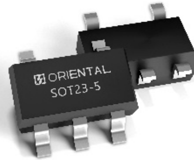
**主要应用领域**
**Main Application Fields**

凭借其紧凑的尺寸和成熟的工艺，SOT23-3/5 广泛应用于对空间和成本敏感的领域：
Thanks to its compact size and mature manufacturing process, SOT23-3 and SOT23-5 are widely used in space- and cost-sensitive applications.

- 消费电子与便携设备：智能手机、TWS 蓝牙耳机、智能手环、平板电脑等（用于电源管理和信号放大）。
  Consumer electronics and portable devices: Smartphones, TWS Bluetooth earbuds, smart bracelets, tablets, etc. (for power management and signal amplification).
- 物联网（IoT）与传感器节点：各类无线传感模块，要求极低的静态功耗和微型化体积。
  IoT and sensor nodes: Various wireless sensing modules that require ultra-low quiescent power and miniaturized size.
- 汽车电子：用于车载传感器接口、信号切换及低压稳压（需符合 AEC-Q101 车规级标准）。

Automotive electronics: Applied to vehicle sensor interfaces, signal switching and low-voltage voltage regulation (compliant with AEC-Q101 automotive standards).

- 工业控制与医疗设备：便携式诊断工具、继电器驱动及自动化设备中的低功耗控制电路。
  Industrial control and medical devices: Portable diagnostic tools, relay drive circuits and low-power control circuits in automation equipment.




**优劣势分析总结**

| 维度 | 优势（Pros) | 劣势（Cons) |
|---|---|---|
| 空间与成本 | 极致节省 PCB 面积，物料成本低，供应链极其成熟。 | 相比最新的 DFN/WSON 封装，在极限轻薄的应用中仍有一定厚度。 |
| 电气性能 | 引脚短，寄生电感低，适合高频小信号处理；SOT23-5 提供了丰富的控制接口。 | 不适合大功率应用，持续载流能力有限（通常在几百毫安到 1-2A 之间）。 |
| 热性能 | 依靠 PCB 铺铜可有效散发 0.3W-0.5W 的热量，满足常规需求。 | 自身热阻相对较高（约 200~300°C/W），在高环境温度或高压差工况下散热面临挑战。 |
| 工程应用 | “鸥翼”引脚便于目检和手工焊接调试，开发门槛低。 | 引脚间距较小（0.95mm），若 PCB 焊盘设计不当或印刷锡膏过多，存在连锡短路风险。 |

**Summary of Advantages and Disadvantages**

| Dimensions | Pros | Cons |
|---|---|---|
| Space & Cost | Ultra-compact PCB footprint, low material cost, and a highly mature supply chain. | Compared with state-of-the-art DFN/WSON packages, it has a larger overall thickness for ultra-thin and ultra-slim applications. |
| Electrical Performance | Short leads result in low parasitic inductance, making it suitable for high-frequency small signal processing. SOT23-5 is equipped with abundant control interfaces. | It is not suitable for high-power applications with limited continuous current carrying capacity (typically ranging from several hundred milliamps to 1-2 amps). |
| Thermal Performance | Heat dissipation of 0.3W to 0.5W can be achieved effectively via PCB copper plating, meeting general application requirements. | It features relatively high thermal resistance (approximately 200~300°C/W), leading to heat dissipation challenges under high ambient temperature or large voltage difference conditions. |

| | | |
|---|---|---|
| Engineering Applications | Gull-wing leads facilitate visual inspection and manual soldering & debugging, lowering the development barrier. | 引脚间距较小（0.95mm），若 PCB 焊盘设计不当或印刷锡膏过多，存在连锡短路风险。 |