

SOP No.: 90-193

SOP Title: Customer ESD Guide 客户 ESD 指南

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1. Purpose 目的

To give customers general guidance for ESD safe environment, to reduce risk of ESD damage for Bandwidth10's products which are significantly ESD sensitive.

为客户提供有关 ESD 安全环境的一般指导，以降低-ESD 对 Bandwidth10 高敏感度产品造成损坏的风险。

2. Scope 适用范围

To emphasize rules for ESD safe lab/facility setup and behavior of personnel, derived from experience and general ESD specifications like IEC, ANSI etc.

强调 ESD 安全实验室/设施的建设规范和人员行为准则，这些规则基于实践经验和 IEC、ANSI 等通用 ESD 标准制定。

3. Reference Documents 参考文献

3.1. IEC 61340 standards series IEC 61340 标准系列 e.g. 61340-5-1 General Requirements

3.2. ANSI/ESD standards series ANSI/ESD 标准系列 e.g. ANSI/ESD S20.20 ESD Control Program

3.3. JEDEC standards series JEDEC 标准系列 e.g. JESD625C Handling of ESD Sensitive Devices

These standards give rules for ESD safe setup, the ESD control program, materials, processes, and testing/verification of ESD protection.

These standards can be purchased e.g. from web shops. If any question, please reach out to Bandwidth10 for more detailed information regarding these standards!

这些标准可以通过网店等渠道购买。如有任何疑问，请联系 Bandwidth10 获取更多有关这些标准的详细信息！

4. Process and/or Procedure Steps 流程和/或操作步骤

4.1. Summary 概括

Summary of details laid out in the following sections 摘要（详情见以下章节）

- ESD discharge phenomena, ESD protection
- Facility / EPA electrostatic protected area 设施/EPA 静电保护区
 - Room Humidity above 40% 室内湿度高于 40%
 - Avoid insulative, non-ESD safe materials 避免使用非 ESD 材料
 - Floor grounding 地板接地
 - Workstation desk, Work surface grounding 办公桌、工作台面接地
 - Carts, Shelves grounding 推车、搁板接地
 - Chairs grounding 椅子接地
 - Soldering tool grounding 焊接工具接地
 - Ionizers for charge removal 用于消除电荷的离子发生器
- Personal protective gear 个人防护装备
 - Wrist straps 腕带
 - ESD footwear ESD 鞋
 - Clothing / ESD smock 服装/ESD 工作服
 - ESD gloves ESD 手套
- Part handling /packing material for 零件搬运/包装材料，用于
 - Internal handling / moving parts 内部搬运/移动零件
 - Storing 储存
 - Shipping 运输

4.2. ESD Discharge Phenomena ESD 保护

ESD discharge phenomena are predominantly responsible for many product damage cases. Discharge occurs when two isolated items with different potentials meet. Rapid discharge can destroy parts by the extremely high energy density, especially in the small semiconductor structures.

ESD 放电现象是造成许多产品损坏的原因。当两个带有不同电荷/电位的物体相接触时，就会发生放电。快速放电会因微小半导体结构中集中极高的能量密度而损坏器件。

4.3. ESD Protection ESD 保護

4.3.1. ESD protection aims at two aspects ESD 防护主要针对两个方面：

- 4.3.1.1. Avoiding Charge Buildup (on product, equipment in vicinity, person)
避免电荷积聚（在产品、周围设备、人员身上）
- 4.3.1.2. Removing Charge safely (from product, equipment in vicinity, person) that might
had built up despite any precautions
安全地释放在采取预防措施后仍然积聚的电荷（在产品、周围设备、人员
身上）

4.3.2. **Redundancy:** For sound ESD protection apply redundant means! Same principle as “Belt and Suspenders”. If one of the means fails, then there will be backup.
冗余设计：为了实现可靠的 ESD 防护，请采用冗余措施！原理与“安全带和背带”相同。如果其中一种措施失效，还有备用措施。

4.4. Product Handling 产品处理

4.4.1. Take out products from their protective package in Electrostatic Protected Area (EPA) only! Never take out or touch products in unprotected area, like typically office.

只能在静电防护区 (EPA) 从保护包装中取出产品！切勿在无防护区域（例如普通办公室）取出或接触产品。

4.4.2. For **Shipping**, always use original product packaging and pack products properly.

运输时，请务必使用原包装并妥善包装产品。

4.4.3. For **Storing**, original product package is recommended as well. Only acceptable alternative would be dedicated qualified ESD safe containers.

储存时，也建议使用原包装。唯一可接受的替代方案是使用专用的合格防静电安全容器。

4.5. ESD Protected Facilities (EPA) ESD 防护设施 (EPA)

4.5.1. **Room humidity** shall be always above 40%RH, the higher the better!

房间湿度必须始终保持在 40%RH 以上，越高越好！

4.5.2. **Workstation/desk** metal mainframe shall be grounded, and provide grounding points to connect protective equipment (e.g. table mat and wristbands, with defined ground resistance). Best practice is the use of table mats, connected to ground with defined resistance. Keep in mind that painted surfaces are not conductive.

工作站/办公桌的金属主机应接地，并提供接地点以连接防护设备（例如桌垫和腕带，并设定接地电阻）。最佳做法是使用桌垫，并以设定的电阻连接到地线。请注意，油漆表面不导电。工位桌应为金属结构，并连接至建筑物主接地系统。

4.5.2.1. Ground connection should be by direct line connection to central building/room ground.

接地应通过直接线路连接至中央建筑物/房间地面。

4.5.2.2. Less recommended grounding option is to employing mains ground from nearby power connector – thereby observe precautions against electrical hazard!)

不太推荐的接地选项是采用附近电源连接器的主接地——从而遵守防范电气危险的措施！)

4.5.3. Workstations equipped with **Wrist Strap connectors** sockets respective Continuous monitors.

工位桌配备腕带连接器插座和相应的连续监测设备。

4.5.4. **Work surfaces** equipped with dissipative mats, connected to workstation/ground via cable.

工作台铺设静电耗散垫，并通过导线连接到桌面接地点/或地线。

4.5.5. Workstation/Desk Rules 工作站/办公桌规则

- 4.5.5.1. Remove any non-essential, non-ESD safe items from work workstation. Such are chargeable items made from insulating material.

从办公桌上移除任何非必需、非 ESD 安全物品。这些物品是指由绝缘材料制成的带电物品。

- 4.5.5.2. Essential, non-ESD safe items (e.g. Keyboard, Mouse, Pen etc.) MUST maintain **minimum distance 12 in/30cm** from product.

It is recommended to mark ESD safe area, “forbidden” for non-safe item on workstation surface.

必需、非 ESD 安全物品（例如键盘、鼠标、笔等）必须与产品保持至少 12 英寸/30 厘米的距离。

建议在桌面上标记 ESD 安全区域，并将非安全物品标记为“禁止”。

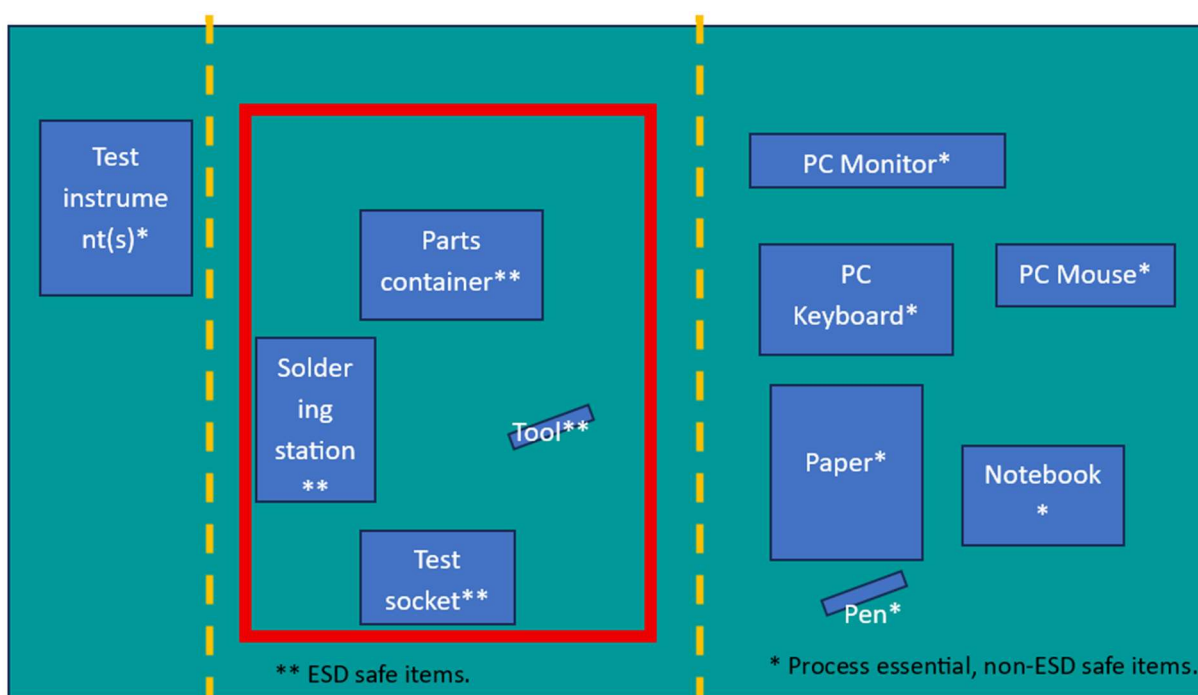


Figure 1 - Marked ESD-safe handling area 标记的 ESD 安全处理区域

4.5.6. Ionizers 离子发生器

- 4.5.6.1. The ESD standards recommend using ionizers, to remove charge from insulating items on workstation/desk surface. This is for redundancy, “Belt and Suspenders” principle, for insulating items too close to sensitive parts. However, make sure to follow the rules for non-ESD safe items is the first resort!

ESD 标准确实建议使用离子发生器来消除桌上绝缘物品上的电荷。这是为了实现冗余，并遵循“安全带和背带”原则，用于隔离过于靠近敏感部件的物品。但是，请务必首先遵守非 ESD 安全物品的规则！

- 4.5.6.2. **RISK: Uncontrolled Ionizers can create charge that can damage parts!** Ionizers must be closely controlled to ensure their effectiveness, and to prevent them from creating unwanted charge! Perform thorough risk assessment! Check surfaces using Field meter. Make sure there is no unwanted charge created!

风险：不受控制的离子发生器会产生电荷，从而损坏部件！必须严格控制离子发生器，以确保其有效性，并防止其产生电荷！务必进行全面的风险评估！使用场强计检查表面。确保没有产生不必要的电荷！



Figure 2 - ESD Field meters (examples) to verify surface charge ESD 场强计用于验证表面电荷

4.5.7. Tweezers 镊子

For potential use for TO pin straightening, if needed. Use metal respective ESD-safe type (example shown). Avoid tweezers from insulating plastic material.

镊子（用于 TO 引脚矫直）。请使用金属镊子（如图所示）。避免使用绝缘塑料材质的镊子。



Figure 3 - Tweezers 镊子

4.5.8. Soldering Tool 焊接工具

Soldering tips must be grounded $R < 10$ Ohms (via soldering station). Picture showing resistivity check tip to ground using Ohmmeter.

焊接工具必须接地（ $R < 10$ 欧姆，通过焊台实现接地）。图片显示使用欧姆表检查焊咀与地之间的电阻。



Figure 4 - Soldering tool resistivity check 焊接工具电阻检查

4.5.9. Floor 地面

Floor shall be dissipative/conductive, to avoid charge buildup and/or remove any charge from body via shoes to ground. If main floor is not capable (like in many offices!) use at least dissipative/conductive floor mat that is being connected to ground.

地板应具有防静电或导电性能，以避免电荷积聚和/或将人体上的电荷通过鞋子传导至地面。如果主地板不具备该功能（就像许多办公室一样！），请使用接地的防静电或/导电地垫。

4.5.10. Basic ESD safe setup 基本 ESD 安全设置

Picture showing elements of basic ESD safe facility setup

图片展示了基本 ESD 安全环境建设所需要素



Figure 5 - Elements of ESD safe setup ESD 安全设置的要素

4.6. Personal Protective Gear 个人防护装备

4.6.1. Wrist Strap 腕带

Wrist strap must be worn (on bare skin!) when sitting at workstation desk. Wrist strap is being connected to ground socket/continuous monitor at workstation, to remove charge from body. Continuous monitor serves to indicate any disrupted grounding connection.

坐在工作桌前时必须佩戴防静电手腕带（直接接触皮肤！）。腕带连接到办公桌上的接地插座/持续监测器，以释放身体上的电荷。连续监测可指示接地连接中断。



Figure 6 – Continuous Monitor 连续监测

4.6.2. ESD Gloves 防静电手套

ESD Gloves (dissipative) will further eliminate risk when touching products by hand.

防静电手套（耗散型）将进一步降低用手接触产品时的风险。



Figure 7 - ESD Dissipative Gloves 防静电手套

4.6.3. ESD Shoes 防静电鞋

ESD Shoes (dissipative) shall be worn. They avoid charge build-up and/or remove charges via floor to Ground.

必须穿着防静电鞋（耗散型）。它们可以避免电荷积聚和/或通过地板将电荷转移到地。



Figure 8 - Example of ESD protective shoes ESD 防护鞋示例

4.6.4. ESD Clothing 防静电服装

ESD safe clothing shall be worn (at least an ESD smock to cover the upper body)!

RISK: Normal garments (especially those made from Wools, Silk, Nylon, non-ESD artificial fibers) can generate significant charge that can damage parts!

必须穿着防静电服（至少穿一件防静电罩衫覆盖上半身）！**风险：普通服装（尤其是由羊毛、丝绸、尼龙、非 ESD 人造纤维制成的服装）会产生大量电荷，从而损坏零件！**



Figure 9 - ESD smock 防静电工作服

4.7. Surveillance Check Items 监控检查项目

Area	Check Item	Recommended Check Interval	Specification
EPA Electrostatic Protected Area	Floor at work station (dissipative, grounded)	3 months	Surface resistance (point to point) < 1×10^9 Ohms ANSI/ESD S20.20-2014
	Tables, shelves		Ground resistance < 2 Ohms ANSI/ESD S20.20-2014
	Table mat (dissipative)		Visual check of mat ground connection
	Wrist-straps/ sockets		0.8 through 1.2×10^6 Ohms ANSI/ESD S20.20-2014
	Carts, chairs		Visual check for intact connection cable, earthing chain

Ionizers	Function, use	3 months	Function and correct use
Facility Grounding	Building grounding	Annual	Resistance vs. mains grounding

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6. Glossary and/or Terminology Support 词汇表和/或术语支持

- 6.1. Conductive material: Material with surface/volume resistivity $<10^4$ Ohms
- 6.2. Dissipative material: Material with surface/volume resistivity 10^4 to 10^{11} Ohms
- 6.3. Insulating material: Material with surface/volume resistivity $>10^{11}$ Ohms