



Electrostatic Discharge (ESD)

Safety Guidelines

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1. Introduction

Electrostatic Discharge, or ESD, is defined as the transfer of charge between bodies at different electrical potentials.

If you scuff your feet as you walk across a carpet, electrons move from the carpet to you, leaving you with excess electrons. Touch a door knob and ZAP! The electrons move from you to the knob. You get a shock, at a minimum of 3,000 volts (the threshold of human feeling)!

The kind of ESD shock you feel may also be responsible for damaging electronic components in many computers and telecommunications systems. While it takes an electrostatic discharge of 3,000 volts for you to feel a shock, much smaller charges, well below the threshold of human sensation, can and often do damage semiconductor devices. Many of the more sophisticated electronic components can be damaged by charges as low as 10 volts.

2. How it Happens

Static electricity is defined as an electrical charge caused by an imbalance of electrons on the surface of a material. Once the charge is created on a material and it remains at rest on the material, it becomes an “electrostatic” charge.

An ESD event is a rapid transfer of charge (electrons) from one object to another in an attempt to become electrically neutral.

Electrostatic charge is most commonly created by the contact and separation of two electrically nonconductive materials. The amount and type of charge (positive or negative) depends on the materials involved. The following

common materials, often found in business and laboratory environments, are all sources of static electricity:

- common plastic bags
- common types of mending and packing tape
- paperwork
- common untreated plastic materials
- styrofoam cups

3. Types of ESD Damage

Static damage to components can take the form of upset failures or catastrophic failures.

Upset Failure

Upset failures occur when an electrostatic discharge has caused a current flow that is not significant enough to cause total failure, but in use may intermittently result in gate leakage causing software malfunction or incorrect storage of information.

Catastrophic Failure

Catastrophic failures can be direct or latent.

Direct catastrophic failures occur when a component is damaged to the point where it no longer functions correctly. This is the easiest type of ESD damage to find since it usually is detected during initial testing.

Latent catastrophic failures occur when ESD weakens a component to the point where it still functions correctly during testing, but subsequent minor electrical overstresses or power surges during normal operation of the equipment cause the component to fail. This type of damage is difficult to detect.

4. Controlling ESD

The basics of ESD control are simple, built on the following principles:

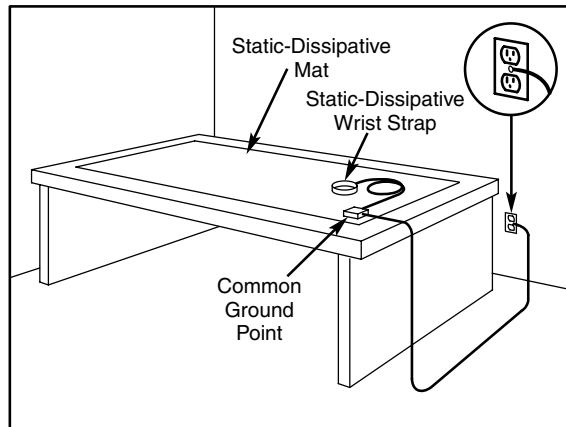
- Grounding
- Isolation
- Prevention

Grounding

Grounding is a means of draining the static charges present on your body, by use of a personal grounding device or a wrist strap. To function properly, a wrist strap must always be worn snugly to assure skin contact at all times, and grounded to a common point ground at a static-safe workstation.

CAUTION: To avoid possible damage to a circuit board, never remove the board from its anti-static packaging unless you are personally grounded.

Conductive or dissipative work surfaces are also an integral part of the static-safe workstation. As with the wrist strap, it is necessary for the work surface to be clean and properly grounded to a common point ground.



CAUTION: All computer boards are sensitive to electrostatic discharge. To avoid possible damage, handle all static-sensitive boards, components, and computers at a static-safe work area.

Isolation

Isolation involves the packing of components and assemblies during storage and transportation.

Static charges cannot penetrate containers that are made of conductive materials or have a conductive layer. This effect is called the Faraday cage. The

types of Faraday cages commonly used in controlling ESD are metallized shielding bags and the conductive tote box with a cover.

CAUTION: Do not remove circuit boards from anti-static packaging until you are ready to commence installation.

These Faraday cages can carry static charges on their exterior that should be dissipated before opening. Therefore, it is imperative that these protective containers only be opened at a static-safe workstation by properly grounded personnel.

Isolation can also be accomplished by keeping charge generating materials away from any ESD-sensitive items. This is best done by clearing your workstation of:

- plastic bags
- cellophane tape
- paperwork
- common untreated plastic materials
- styrofoam cups

Prevention

Prevention is the area where you can make the biggest difference. Proper use and implementation of ESD control materials are not the only weapons for fighting the ESD battle. A number of common sense rules can be applied. These rules do not require additional materials but are extremely effective in preventing static damage.

- Never enter an ESD-sensitive area without taking the proper precautions.
- Test ground devices for correct operation on a daily basis.
- Open ESD-sensitive items only at a static-safe workstation.
- Always keep your workstation clean and clear of unnecessary material, particularly common plastics.
- Place ESD-sensitive items on a dissipative surface, not on top of a blueprint or other paperwork.
- Return ESD-sensitive items to their ESD-protective containers when not actively working with the items.
- Do not hold ESD-sensitive items against your clothing. Even if you are wearing a wrist strap, your body is grounded but your clothes are not!