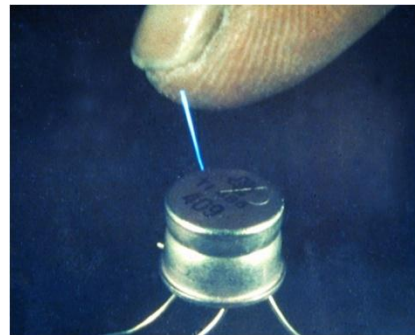
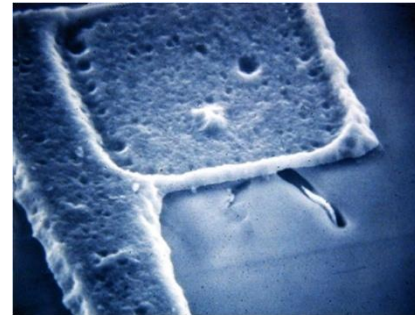




Electrostatic Discharge



ESD Basics and Protection

About Transforming Technologies

Transforming Technologies is a leading solution provider for static control in the electronics industry. We offer over 10 years experience in providing electrostatic solutions to manufacturing facilities; protecting products and processes from the many serious problems associated with static electricity.

Headquartered in Toledo, OH, USA, [Transforming Technologies](#) we offer a wide range of unique and exceptional ESD products to prevent, eliminate and monitor electrostatic charges.

We provide comprehensive knowledge of electrostatic issues, and above all outstanding, friendly service. We call it Static Care™.

What is ESD?

- ESD definition
- Common causes of ESD
- Sources of ESD
- Types of ESD damage

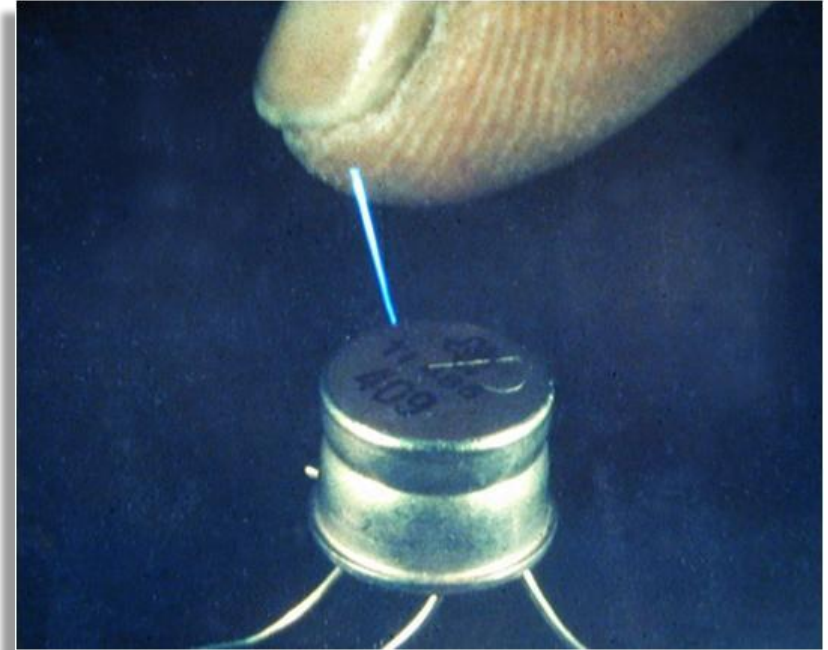
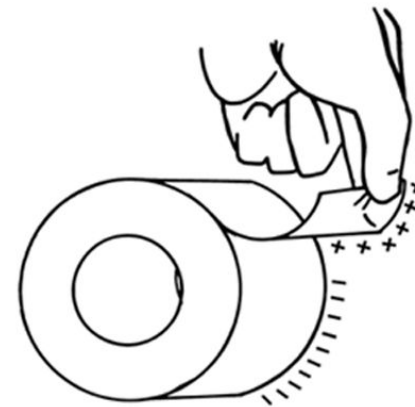
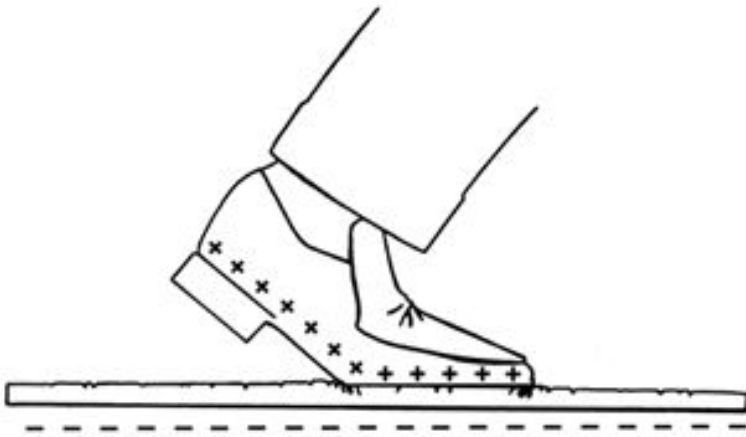


Photo of ESD arcing from finger to component

ESD Definition

ESD – Electrostatic Discharge: The transfer of an electrostatic charge between bodies at different electrical potentials.

- Also referred to as static electricity
- **Electrostatic charge is most commonly created by the contact and separation of two materials which results in Tribocharging**



ESD Is the Hidden Enemy

There are innumerable ESD events occurring all the time that we cannot see or feel.

People Feel ESD at **2000 Volts!!!!**

Component damage - can occur with as little as **15 – 30 Volts!!!!**

Examples of Static Generation Typical Voltage Levels		
Means of Generation	10-25% RH	65-90% RH
Walking across carpet	35,000V	1,500V
Walking across vinyl tile	12,000V	250V
Worker at bench	6,000V	100V
Poly bag picked up from bench	20,000V	1,200V
Chair with urethane foam	18,000V	1,500V

Typed of Materials that Charge

Conductors

- Materials that easily transfer electric charge
- **Can be used to transfer charge to earths ground**
- **Examples**
 - Metals
 - Water
 - Carbon
 - People

Insulators

- Materials that hold an electric charge and can not easily transfer the charge
- **Can not be grounded to earth by common means**
- **Examples**
 - Plastics
 - Glass
 - Dry Air



Sources of ESD

The following items are examples of materials that generate and hold electrostatic charge.

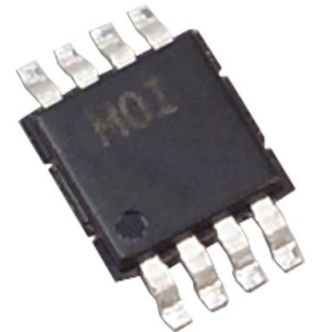
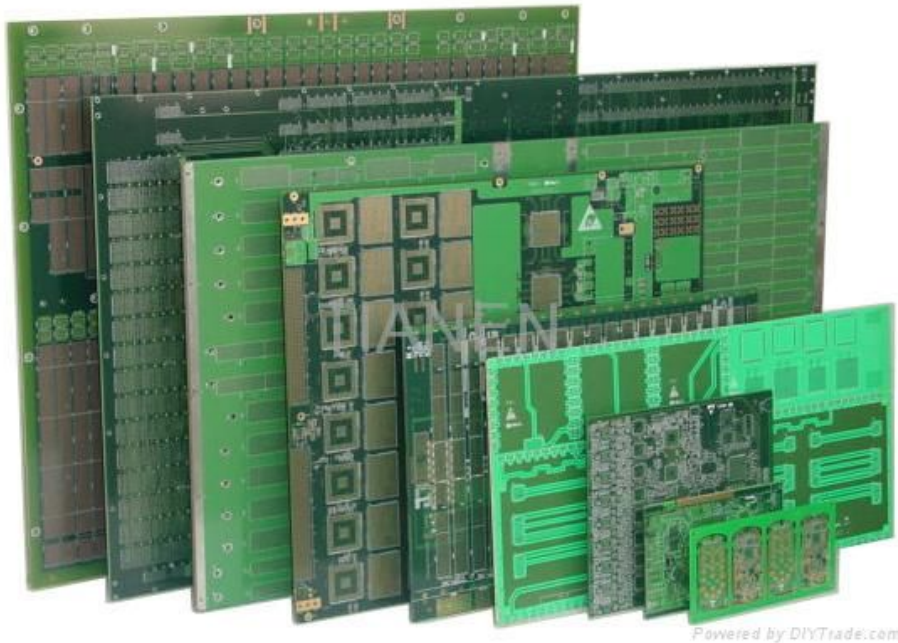
- Vinyl binders
- Equipment covers
- Plastic document holders/sheet protectors
- Post-It™ notes
- Plastic pens
- Bubble wrap
- Plastic housings on equipment
- Paper, schematics, etc.
- Plastic work travelers
- Plastic spray bottles
- Personal items
 - Purses
 - Sweaters/jackets
 - Insulated lunch totes
 - Combs/brushes
 - Lotion bottles

What type of Materials are ESD Sensitive?

ESDS – Electrostatic Discharge Sensitive

Integrated Circuits (DIPs, QFP, BGA, SOT, etc.)

- Crystals and oscillators
- Printed Circuit Board Assemblies
- When in doubt, treat it as ESDS!



Common Causes of ESD

- Opening a common plastic bag
- Removing adhesive tape from a roll or container
- Walking across a floor and grabbing the door knob
- Transporting computer boards or components around in their trays on non-ESD carts
- Sliding circuit boards on a work bench



Types of ESD Damage

CATASTROPHIC FAILURE

- A device is exposed to ESD and it no longer works
- The device circuitry is permanently damaged
- Such failures may be caught when tested, before shipment

LATENT FAILURE

- A device is exposed to ESD and is partially damaged, yet it continues to work
- The product may have a failure after the user places it in service

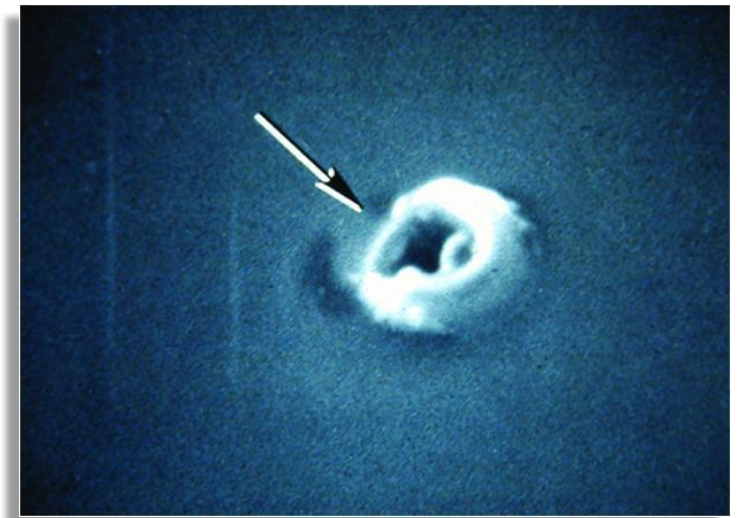
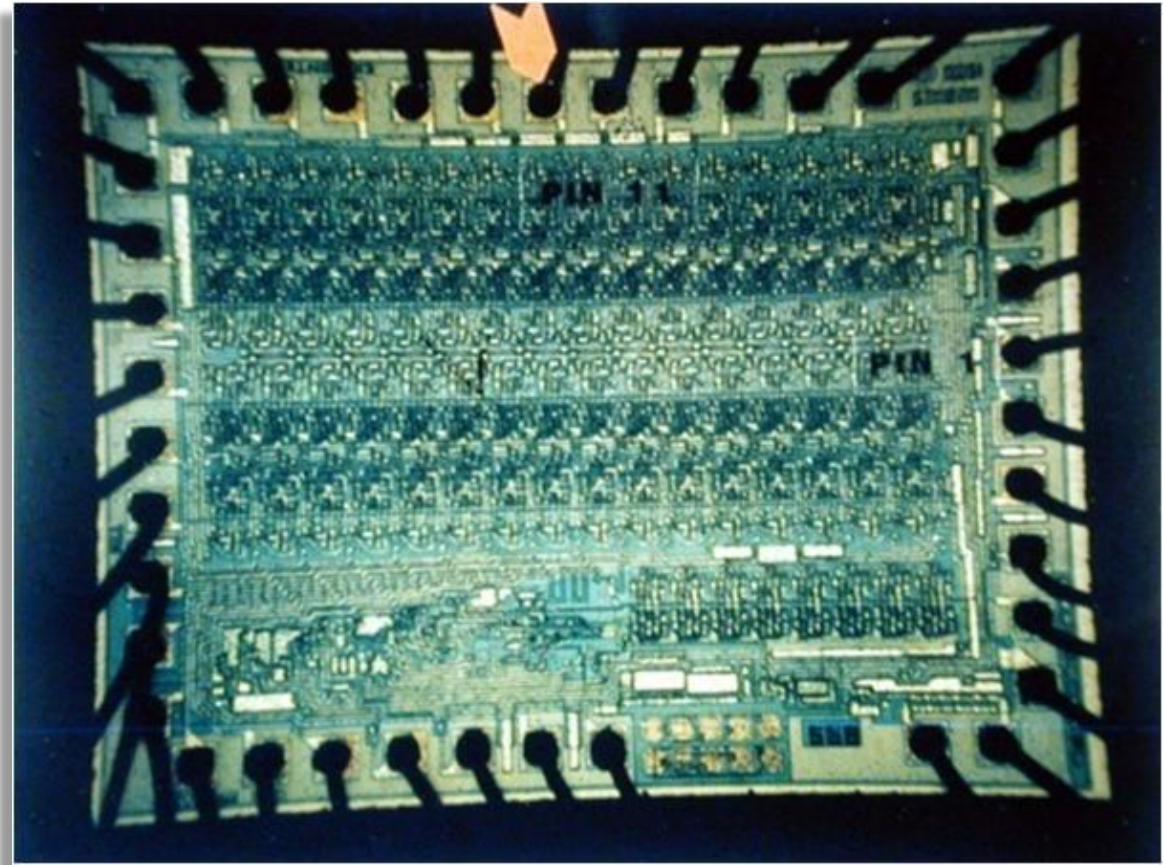


Image of the ESD damage after removal of the capacitor metallization.
Magnification is 10,500 times

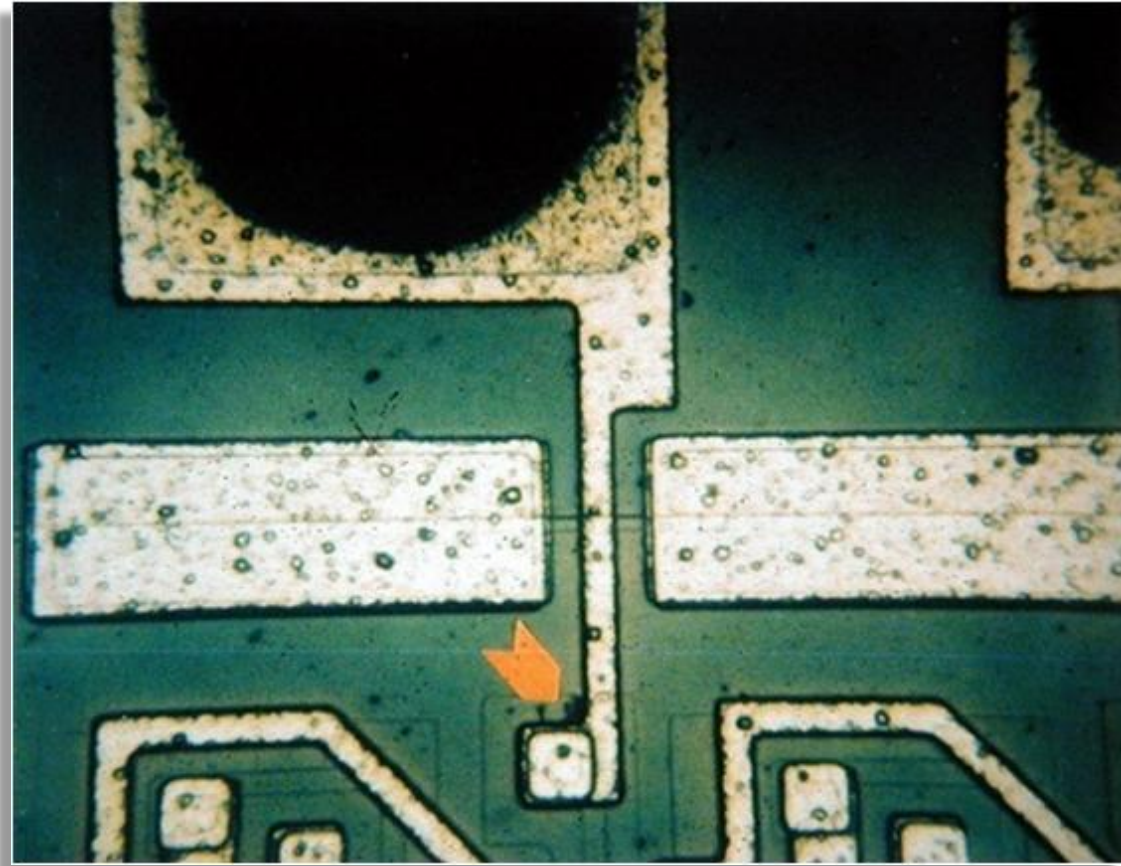
Example of ESD Damage

- Optical photo of a large Integrated Circuit which has experienced ESD damage to the pin noted by the arrow.



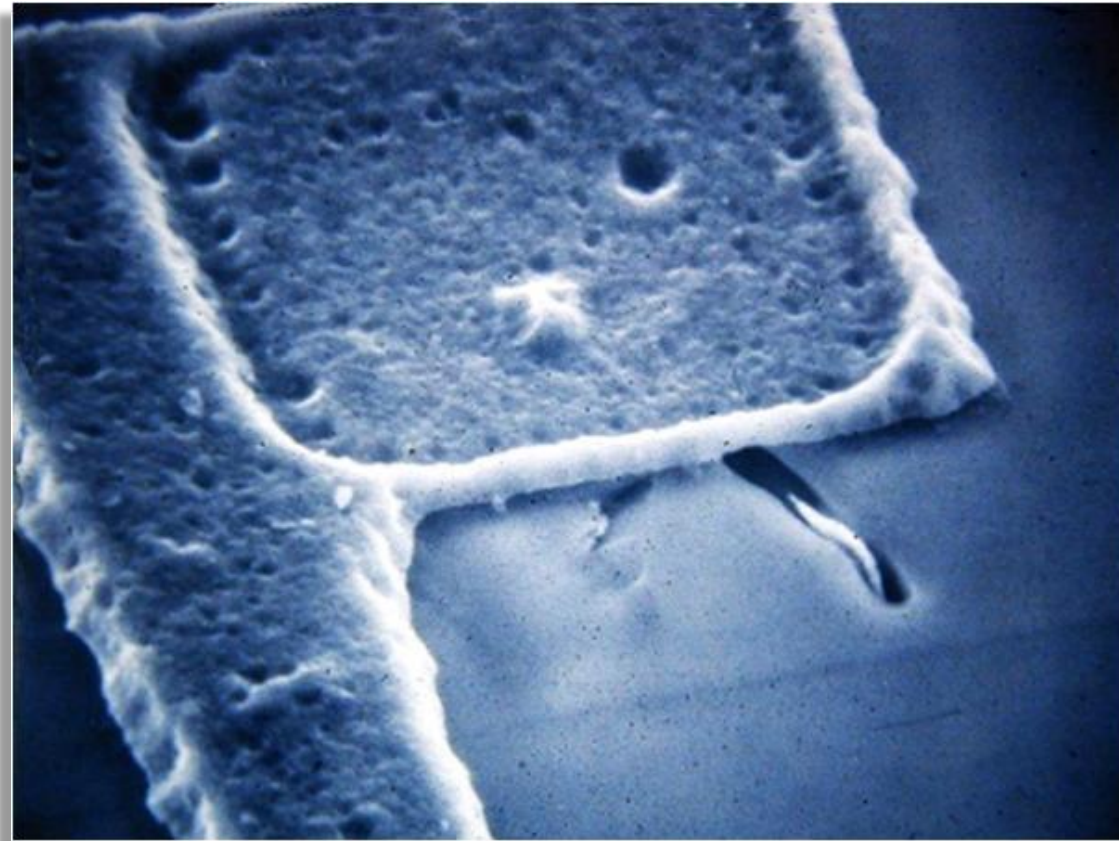
Example of ESD Damage

- Higher magnification photo of pin noted by the arrow in the prior slide This taken at 400 times magnification on a 4" X 5" photo. The damage is noted as the "fuzz" at the end of the arrow.



Example of ESD Damage

- **Overlying glassivation has been removed and the surface decorated to show the ESD damage at 5,000 times magnification in this scanning electron micrograph.**



Why is ESD Important?

Electrostatic Discharge (ESD) can damage sensitive electronic devices, resulting in:

- Higher manufacturing costs
 - Rework
 - Repair
 - Scrap
- Lower production yields
- Unhappy customers
 - Shorter product life
 - Reduce product reliability

Estimates of actual cost of ESD damage to the electronics industry = \$\$\$ Billions annually



How to control ESD?

ESD Control Program

- ESD Training
- ESD Control Areas
- Ground Conductors
- Ionization
- ESDS Component Handling and Storage



ESD Control Program

The first step in ESD control is to train all personnel who may come in contact with static sensitive materials



- Proper use of personal grounding equipment such as heel grounders or wrist straps
- Personnel should understand ESD equipment test methods and documentation
- Understanding of other ESD control methods such as ionization

ESD Control Program

Any area where unprotected ESD sensitive parts and assemblies may be handled shall be designated an ESD Control Area, and must meet the following requirements;

- The area is free from non-essential static generators, and the risk from process-essential static generators is minimized
- All personnel must be grounded and all equipment must be tested daily
- All movable carts, racks, etc. are grounded
- The area is labeled as an ESD control area, and the boundaries are clearly marked



Create an ESD Control Area

- Any area where unprotected ESDS parts and assemblies may be handled
- **ESD areas must be labeled with posted signs and their boundaries marked**



ESD Control Program Cont.

All Conductors within the EPA must be grounded

- Personal Grounding: All personnel, including visitors
- Work surfaces and flooring
- All equipment in EPA



Personal Grounding

Wrist Straps and Coil Cords

- Wrist Straps ground personnel at workstations



Heel Grounders

- Ground mobile personnel in areas where there are ESD floors



Smocks

- Smock sleeves should be in contact with the skin, clothing underneath should not show



Personal Grounding

All Personal Grounding Equipment Should be Tested or Monitored Daily

- Wrist Strap and Footwear Testing Stations
- ESD ground monitoring
- **Constant**
- **Impedance**



OHM Metrics and Monroe Electronics
Test and Measurement Products

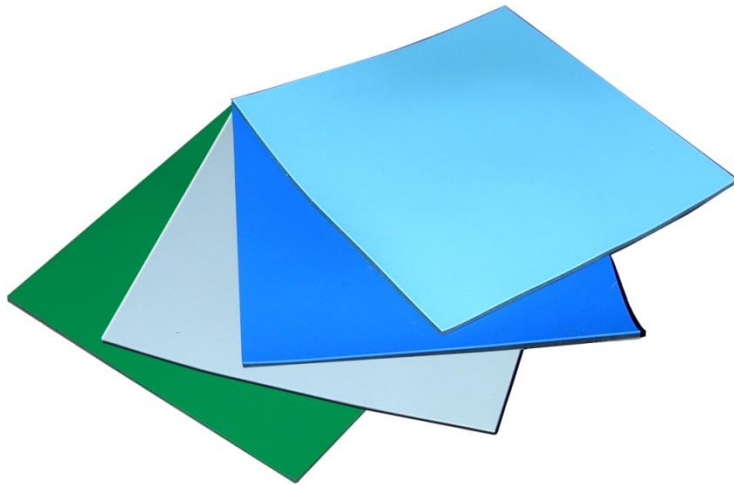


CM Series
ESD Workstation Monitors

Equipment Grounding

Work Stations and Tables

- Must have static dissipative surfaces connected to the building ground source.
- Must have wrist strap ground connections (2 recommended), preferably banana jack receptacles, connected in parallel to the bldg ground source
- Should be cleaned daily with an antistatic cleaner



Equipment Grounding

Shelving and Cabinets

- Must provide a grounded surface unless the parts remain fully enclosed within shielding-type packaging

Storage Bins

- All parts bins and containers must be static dissipative or antistatic
- Whenever practical, sensitive parts should remain in the original container until assembled



Ionization

Many times, equipment or objects (insulators) are unable to be grounded in which case air ionizers should be used.

What is Ionization?

Air Ionizers use a process called "neutralization" to remove static charge from insulators that cannot be grounded.

- Ionizers produce positively and negatively charged ions and floods ESD area with Ions.
- Ions are charged particles that are present in the air, and as opposites attract, charges will be neutralized over time.

Types of Air Ionizers



- Bench Top
- Ionizing Nozzles
- Air Guns
- Overhead Ionizers



ESDS Component Handling and Storage

To move ESDS parts or assemblies inside an ESD control area, use one of the following;

- Static dissipative containers
- Static shielding containers
- Conductive containers or board carriers
- Ground movable racks



Surface Mount Devices
SMD Boxes

ESD Basics Review

Things to remember about an ESD protection plan.

- Only allow trained or escorted people in EPA
- Ground all conductors including people at ESD workstation
- Test wrist straps at least daily, or use continuous monitors
- Test ESD footwear at least daily, if used
- Visually check all grounding cords
- Keep wristband snug, foot grounder grounding tab in shoe, and ESD smocks buttoned
- Ionizers are maintained and air flow directed at ESDS items
- Use shielded packaging for shipping or storing ESD sensitive items outside the ESD Protected Area
- Handle unpacked ESDS items only when grounded



About Transforming Technologies

Transforming Technologies is a leader in static protection, offering a wide range of unique and exceptional ESD products to prevent, eliminate and monitor electrostatic charges.

- Constant Monitors
- ESD Apparel: ESD Hot Glove, ESD Jackets
- Ionization: Alpha, Bench Top, Overhead, Gun, Nozzles
- Personal Grounding: Coil Cords, Wrist Straps, Footwear, Grounding Cords
- SMD Boxes
- Surface Protection: Rubber, Vinyl, PVC
- Test and Measurement Equipment

