What is ESD?

Introduction

Static electricity has been an industrial problem for centuries. As early as the 1400's, European forts were using static control procedures and devices to prevent electrostatic discharge igniting gun powders and other explosives.

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What is ESD?

What is Static Electricity?

- All items are made of small atoms. These atoms are made up of even smaller items called protons, neutrons and electrons. The protons are charged positive; the neutrons have no charge and the electrons are charged negative.
- Under normal conditions there are the same amount of protons and electrons giving atoms no charge.
- However, these electrons can move. When separating or rubbing together of materials, electrons can move from atom to atom or from one material to another (triboelectric charges). This can mean that atoms can hold a positive or negative charge. (Dependant on movement and direction of electrons). If the material in question is an insulator, this charge can be held and not move. This is called static electricity.
- The rapid movement or decay of these charges can cause expensive problems, whether it is huge and dangerous charges such as lightening or simply an annoying (and sometimes painful

What is ESD?

What is Static Electricity?

- “Electric shock” when touching a filling cabinet or when getting out of a car. (These charges are normally on you!).
- These charges can be a huge problem for small sensitive electronic devices. Some devices can be damaged or destroyed by as little as 30 volts. Charges on your body simply by walking or even sitting at your chair can be in excess of 5000 volts
- (Human body model). This is because of items of clothing rubbing together or as simple as shoes separating from the ground. When items are insulators such as carpets, charges are much higher.
- Imagine the damage this could cause. This is why it is important that insulators should be avoided and all possible static electricity generators (such as you) should (must) be grounded to eliminate any build up of charges.

What is ESD?

ESD OVERVIEW

Within today's electronics industry, it is widely accepted that Electro-Static Discharge (ESD) events are a significant cause of device failure and that implementing static control measures is not only desirable but essential.

- Damage to this industry has been estimated at billions of dollars annually. However, while the costs of static control measures can be high, the return on investment certainly does justify the implementation of such measures.

- ESD problems have magnified during the past 3 decades because 2 reasons. 1) The increased use of insulating man-made fibre's and plastics for clothing, furnishing, flooring etc, and 2) The ever increasing sensitivity of integrated circuits due to smaller and smaller conductors and components within the circuitry.

- ESD can change the characteristics of a semiconductor device, degrading or destroying it. Controlling ESD begins with understanding how electrostatic discharge occurs in the first place. Electrostatic charge is most commonly created by the contact or separation of two materials. This is known as "triboelectric charging", it involves the transfer of electrons between materials.

What is ESD?

Damage Classification

Electrostatic damage to electronic devices can occur at any point from manufacture to field service. Damage results from handling the devices in uncontrolled surroundings or when poor ESD control practices are used. Generally damage is classified as either a catastrophic failure or a latent defect.

Catastrophic Failure

When an electronic device is exposed to an ESD event it may have caused a metal melt, junction failure or oxide breakdown, permanently damaging its circuitry and resulting in failure. Such failure can usually be detected when the device is tested before shipping. If the ESD event occurs after the test the damage will go undetected until the device fails in operation.

Latent Damage

A latent defect is much more difficult to identify. A device may be partially degraded yet continue to perform its intended function. However, the operating life of the device maybe reduced dramatically. This could cause premature systems failure which could prove extremely hazardous and very costly.

What is ESD?

COMMON TERMS

- ESD: Electrostatic Discharge. An uncontrolled surge of “static”” between objects with different voltage potentials.
- “STATIC”: An electrical charge / field that isn’t moving.
- EPA: Electrostatic Protected Area.
- ANTISTATIC: Minimal generation or retention of a “static” charge.
- CONDUCTIVE: Low resistance i.e. less than 1Meg-ohm (10^6) - the closer to 1Meg-ohm, the slower the discharge.
- STATIC DISSIPATIVE: Increased resistance, which protects better against an ESD i.e. between 1Meg-Ohm (10^6) and 1000 Meg-Ohm (10^9).
- INSULATIVE: Does not allow the free flow of electrons, therefore, it will more than likely cause problems e.g. prevent a path to earth, hold a “static” field, etc.
- FARADAY CAGE: A conductive barrier against ESD e.g. Metalised Shielding Bag, Conductive Box etc.
- E.P.A.: Electrostatic Protected Area. A static safe handling area which could be a bench, a room or any other designed area, which should not have any “static field” greater than 100v maximum!
- TRIBOCHARGE: To generate “static” by the rubbing or separating of surfaces.

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Frequently asked questions

Q: What does “earthing” myself actually do ?
A: It puts you at the same voltage potential as your EPA.
Q: What if I don’t bother with “earthing” myself ?
A: You may cause am ESD onto component / PCB.
Q: If I can’t feel it, is it still a problem ?
A: YES !! We start to feel it from 3000v, hear it from 2000v and see it from 5000v. Considering that there are components around with thresholds of less than 50v, we are better off being rather safe than sorry.
Q: Is a damaged component obviously scrap ?
A: If a component has “catastrophic” damage it will show up in test, BUT “latent” damage may not appear as a failure until later; i.e. tomorrow, next week, next month, maybe next year ..... nobody knows ! ! !

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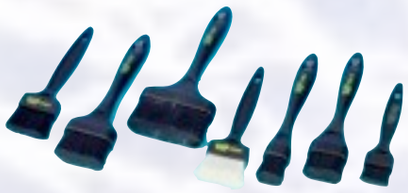
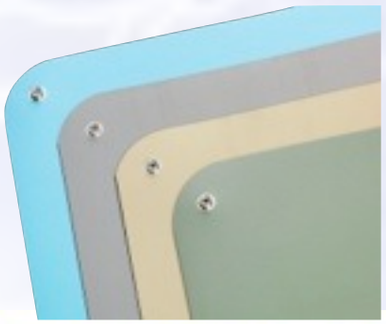
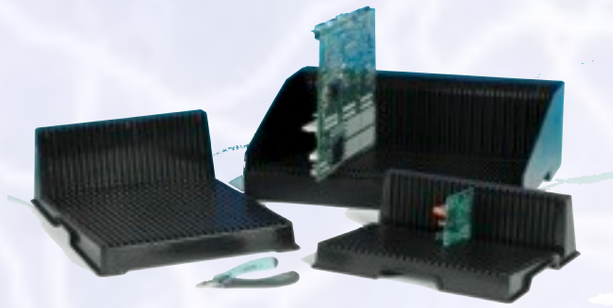
Essential ESD Items



- Floor and Bench Material
- Test Instrument
- Storage / Boxes/ PCB
- Hand Tools
- Footwear
- Awareness signs, Labels and Tape
- Stationary/ Awareness
- Brushes
- Clothing and Gloves
- Cleaners
- Benches/Chairs
- Ionization fans





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ESD FOOTWEAR

- ESD SHOES, HEEL & TOE STRAPS are effective methods of GROUNDING operators when mobility is an issue, but, only if used in conjunction with flooring that can be bonded to ground. (i.e. matting, tiles, resin, coatings etc.).
- When wearing HEEL or TOE STRAPS, there should be A STRAP ON EACH FOOT in order to ensure the best possible contact to GROUND when walking or standing. Whether the “earthing ribbon” fits under your foot or inside your sock doesn’t really matter, as long as the contact is a good and reliable one.
- When SITTING, WRIST STRAPS MUST ALSO BE WORN.
- TESTING IS VERY IMPORTANT BECAUSE:-
- A) 0.9 meg-ohm is checking that you don’t have a short circuit to ground. It has been calculated that 0.75meg-ohm will offer protection against 250v a.c. (500v d.c.)
- B) 35 meg-ohm ensures that you are not too resistive to ground.
- IF YOU FAIL A TEST, DON’T TRY AND FIDDLE IT, FIND OUT WHAT’S WRONG e.g. DAMAGED? DIRTY? DRY SKIN? NO RESISTOR?

CHEATING THE TEST IS CHEATING ON YOUR RESPONSIBILITY!!!

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What is ESD?

WRIST STRAPS AND CORDS

A WRIST STRAP is the most effective method of BONDING an operator to GROUND when mobility is not an issue. It DISCHARGES the "STATIC" being generated on the BODY to ground "instantly".

Wrist Straps must be WORN while SITTING, even when "E.S.D" footwear is being used.

Straps should be CLEAN, SNUG and COMFORTABLE. If your strap is LOOSE and/or DIRTY, you run the risk of having an INTERMITTANT CONTACT to ground.

Coil cords should have a 1MEG-OHM safety resistor in the "SNAP" that ATTACHES TO THE WRIST STRAP. The strain relief should be intact and the coil tight so that it doesn't hang and catch too easily.

Coil cords should have a 1MEG-OHM safety resistor in the "SNAP" that ATTACHES TO THE WRIST STRAP. The strain relief should be intact and the coil tight so that it doesn't hang and catch too easily.

The OUTER SURFACE of the WRIST STRAP should be INSULATIVE for operator safety.

TESTING IS VERY IMPORTANT BECAUSE:-

A) 0.9 meg-ohm is checking that you don't have a short circuit to ground, which could be dangerous. It has been calculated that 0.75 meg-ohm will offer protection against 250v a.c. (500v d.c.).

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BAGS AND PACKAGING-

USING THE CORRECT PACKAGING AND MATERIALS NOT ONLY PROTECTS YOUR STATIC SENSITIVE COMPONENTS, BUT CAN SAVE MONEY TOO!!!

“METALISED SHIELDING” BAGS (silver in colour)

If bags, holding STATIC SENSITIVE COMOPONENTS, are to be handled OUTSIDE OF AN “EPA”, they should be METALISED SHIELDING BAGS, a FARADAY CAGE!

Metallised Shielding bags can be an effective FARADAY CAGE, subject to the quality of material and physical condition.

DO NOT CREASE the bag, as this can breakdown the integrity of the metallised shield!

You should not use any bags damaged with TEARS AND / OR PUNTURES, as these can DESTROY THE FUNCTION OF THE FARADAY CAGE!

Metallised Shielding bags CAN DETERIORATE with use, MONITORING them for effectiveness is VERY IMPORTANT!

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ANTI STATIC BAGS

These are the only acceptable “plastic” bags in an EPA!
Antistatic bags offer NO effective protection against a contact ESD!
They should only be used for NON STATIC SENSITIVE components, e.g. nuts, bolts, paper etc.

ORDINARY PLASTIC BAGS
Can generate and hold static charges in excess of 10,000v! Antistatic bags deteriorate with time and wear, MONITORING them is VERY IMPORTANT.

ANTISTATIC BUBBLE WRAP
These bubble wraps DO NOT offer effective protection against a contact ESD!
They are an acceptable method of having mechanical protection for packaging of static sensitive devices, again, MONITORING their EFFECTIVENESS is crucial.

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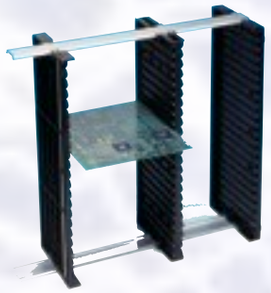
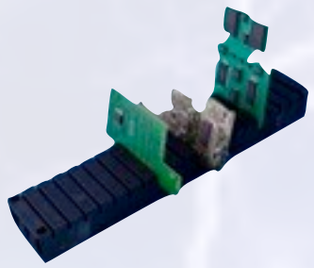
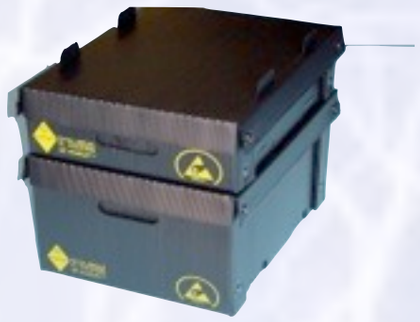
OTHER PACKAGING/ STORAGE

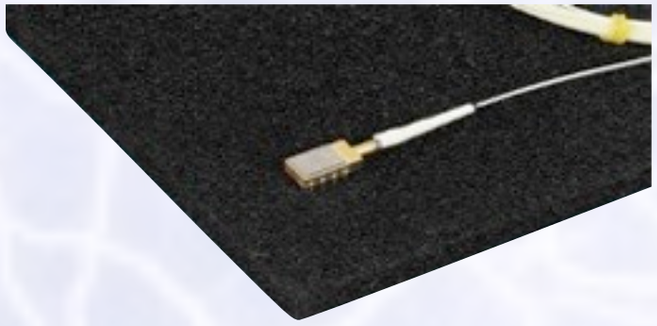


HIGH DENSITY BLACK CONDUCTIVE FOAM

- Used for inserting legged static sensitive components, because it “shorts out” all of the pins, ensuring no potential difference between any of them.
- CONDUCTIVE or STATIC DISSIPATIVE materials, e.g. tote boxes, work-mats, etc. etc. all damaged bags should be thrown away. Beware, NO BATTERIES should be stored inside Conductive bags, as their possible discharge may cause DAMAGE!







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WORKSTATION ITEMS

HAND TOOLS

- All hand tools used in an EPA should have STATIC-DISSIPATIVE HANDLES. Normal insulating handles can generate high voltages. (usually in the centre of the EPA !!!)
- EG Tweezers, cutters and pliers

MATTING

Protection of the work surface when handling static sensitive

devices, for use with safety wrist strap and grounding cord.

IONIZERS

- Ionizers generate positive and negative IONS which neutralise and static charges on INSULATING MATERIALS which cannot be grounded in the normal way.

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