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## Handling Procedure Electrostatic Discharge Sensitive Devices (ESD)

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## 1.0 Purpose

To define minimum requirements for effective electrostatic discharge (ESD) control. Adherence to this procedure will provide adequate protection for ESD sensitive devices during handling and storage processes. [REDACTED]

## 2.0 Scope

This procedure is specifically written for the handling of an ESD sensitive circuit card but may be applied to any ESD sensitive device included in any process as deemed applicable by the Responsible Authority (RA).

## 3.0 Discussion

All processing of an ESD sensitive device or of a subassembly or assembly containing an ESD sensitive device must [REDACTED]

## 4.0 Responsibility

### 4.1 Personnel

All personnel who handle ESD sensitive parts and assemblies must be trained and certified in ESDS handling techniques. Training and certification should be updated on an "as needed" basis. Each person should handle and protect the components according to this procedure. Each person is responsible for [REDACTED]

### 4.2 Supervisor/Training Requirements

All lead operators, supervisors, or other personnel who directly oversee or manage individuals who handle ESD sensitive parts and/or assemblies shall have ESD training. They will also ensure [REDACTED]

### 4.3 Non-Company Personnel

Customers, Government representatives, or other non-Company personnel (i.e., security guards) who have access to any area within the Company where ESD type components or assemblies may be present shall have ESD training.

## 5.0 Definitions

**Anti static (Anti-stat)** - Unable to drain a charge within a few minutes. Has low enough resistivity ( $10^9$  to  $10^{14}$  ohms/sq) to resist formation of static charge when rubbed, but not capable of preventing the build up of a voltage along or across the surface. (blue or pink bags, bubble wrap)

**Electrostatic Discharge (ESD)** - A transient, or rapid transfer of charge, between bodies at different electrostatic potentials (voltages), either:

- a) caused by direct contact,
- b) by arc-over due to the items being close, or
- c) induced by an electrostatic field.

**Electrostatic Discharge Sensitive (ESDS)** - Susceptible to damage or destruction by electrostatic discharge, usually from melting of a microscopic segment of semiconductive material.

**ESDS Device (component, part)** - Any component whose structure incorporates: (a) very thin insulating layers between conductive materials, (b) very small junction areas, or (c) very thin layers of a conductive material or any combination of these structures. This is inclusive of any assembly containing such devices, although once installed in a container (or other appropriate Faraday cage) slightly different handling procedures may be used.

**ESDS Device Zone** - An identified zone where there are exposed ESDS devices present. A high level of static awareness should be maintained.

**Electrostatic Field** - An electric field developed between two items at different voltages

**Faraday Cage** - a container in which ESDS devices are no longer considered sensitive

**Insulator** - Able to generate an electrostatic potential on its surface. Because of its high resistive nature it requires very long periods of time to lose its charge. Resistivity for this material is greater than  $10^{14}$  ohms/sq.

**Resistivity (Surface)** - A measure of resistance across the surface of a conductive mat, tabletop, floor, etc. The measurement is made in units of ohms/sq. What this means is for every square piece of conductive material the electrical resistance from along one side to the opposite side will measure the same no matter how big the square piece is, this the value of ohms/sq.

The lower the value of resistivity, the easier and quicker it is to drain away the static charge.

**Static Conductive** - Able to drain an electrostatic charge very rapidly, the range of resistivity for this material is less than  $10^5$  ohms/sq. Because of its low resistivity it has a high current carrying capacity.

**Static Dissipative** - Able to drain a charge in a few seconds to a few minutes. The range of resistivity for this material is  $10^5$  ohms to  $10^{15}$  ohms/sq. (i.e., most ESD mats)

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**Static Protective** - Materials characterized by static-conductive and antistatic properties, provides shielding from electrostatic fields, electrostatic discharge, and from frictional charge generation.

**Static Safe** - This is any material with resistivity less than  $10^{14}$  ohms/sq. characterized by its ability to not generate a charge, and (except for antistatic, above) can remove static charge from conductive items (including employees). It creates an environment that has a lower risk of charge build up within a Static Safe Perimeter. This is a general term including antistatic, static dissipative, static conductive, static shielding, and static protective.

**Static Safe Perimeter** - A radius of 12 inches around an ESDS device that shall not have an electric field that exceeds  $\pm 100$  volts, as measured with an ESD field meter.

**Static Shielding** - Able to shield the product from direct contact with electrostatic discharge, and from breakdowns caused by a near electrostatic field. Shields are conductive or have a conductive layer buried inside.

**Static Table Mat** - A flexible work surface composed of vinyl or rubber with an added component to allow static to drain from its surface to ground via a connected ground cord.

There are two styles of mats used at Static Safeguarded Work Stations:

- a) Multilayered - with conductive middle layer, a dissipating top layer, and an insulating (or dissipating in some models) bottom layer.
- b) Single layered - Homogeneous - No conductive middle layer, rather the entire mat is uniformly resistive.

## 6.0 ESDS Identification

### 6.1 ESDS ID requirements

All ESDS devices or assemblies containing ESDS components must be readily identified and easily recognizable at every location. The following provisions need to be reviewed for applicability and addressed as necessary:

- a) [Redacted]
- b) [Redacted]
- c) [Redacted]
- d) [Redacted]
- e) [Redacted]

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## 6.2 ESDS Device Designation

An ESDS device or component may reach a point during production where the assembled components are no longer considered ESD sensitive. This is true when the device is enclosed in a "Faraday Cage" such as [REDACTED]

[REDACTED] Once the device is installed in a Faraday Cage, the container may be treated the same as any other container with the following exceptions:

- 1 - [REDACTED]
- 2 - [REDACTED]
- 3 - [REDACTED]

**Note:** Work within the container should be treated as a potential ESDS hazard and be performed in an ESDS workstation whenever possible.

## 7.0 ESDS Device Handling Procedures

### 7.1 ESDS Device Handling

The handling procedures for ESDS devices have two basic requirements:

- 1 - [REDACTED]
- 2 - [REDACTED]

These requirements are met with daily wrist strap checks and with [REDACTED]

ESDS devices include both discrete components (individual parts) and assemblies having these components. Special handling procedures will apply to:

- [REDACTED]
- [REDACTED]
- [REDACTED]

### 7.2 Receiving Inspection Handling

When any item is received that indicates an ESDS device may be present, it shall have the outside packing container inspected for damage or penetration. If any damage exists, [REDACTED]

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### 7.3 ESDS Device Transportation

ESDS devices or assemblies will be transported to the ESD Workstation using the unopened container that the device was received in. If the device needs to be transported outside the ESD Workstation area the device will

### 7.4 Shipment of ESDS Device

When packaging an ESDS device for return shipment, keep it in the static shielding bag that it was received in, unless the bag was damaged. Close the bag using

For ESDS devices or assemblies that are built into a container, the container will

### 7.5 Specific Handling Procedures

ESDS devices should be kept in contact with a grounded surface. Where grounded surface contact cannot be maintained, keep the device's contacts shorted together with static conductive or dissipative material until ready for test, installation, etc. Once ESDS devices have been installed, avoid touching exposed connector pins.

Before handling ESDS devices, an individual shall

While handling an ESDS device, always maintain a static dissipation path for the device and operator by continuous contact to

Minimize physical handling of an ESDS device. Hold the device by its body without touching its leads or contacts. Don't slide the device against another surface. An ESDS device that has its leads shorted in black foam or other shunting material shall

**Warning: When working where 120 volts or more may be present, always remove your wrist strap grounding cord and ESD coat before applying power. After turning off the power, reattach to your grounding strap and coat before handling the ESDS assembly.**

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**7.5.1** The circuit cards used in a container will be kept in the original shipping carton until needed for inspection, testing, or assembly. The cards may be kept in R&I (preferably Bonded Storage) as long as the outside container is sealed. When needed for processing, the shipping container will [REDACTED]

While handling the ESDS device, maintain a static dissipation path for the device and operator by continuous contact to [REDACTED] When not in process the cards shall be stored [REDACTED]

Once the ESD device is installed in the next assembly, the connector pins [REDACTED]

[REDACTED] A conductive dust cap may be used to replace the normal dust cap. If a conductive dust cap is used [REDACTED]

**7.6 Low Humidity Operation**

When the relative humidity drops below 30%, the following precautions must be taken:

[REDACTED]



## 8.0 Static Safeguarded Work Station/Zone Requirements

### 8.1 Static Safeguarded Work Stations

Static Safeguarded Work Stations shall include:

- [REDACTED]
- [REDACTED]
- [REDACTED]

Basically, a properly grounded ESD mat with the connections for operator wrist straps along with an isolated work area are all that is required to set up a proper ESD work station. All Static Safeguarded Work Stations shall be identified.

### 8.2 ESDS Device Work Zone Requirement

Work zones that will be used for ESDS device processing will consist of [REDACTED]

This work zone will be inclusive of [REDACTED]

The work zone shall include the following requirements:

- 1) [REDACTED]
- 2) [REDACTED]
- 3) [REDACTED]
- 4) [REDACTED]
- 5) [REDACTED]
- 6) [REDACTED]
- 7) [REDACTED]

8) [Redacted]

## 9.0 ESDS Work Zone Operations

### 9.1 Personnel Grounding

For processes in which an operator stays at a fixed location and handles an ESDS device, an electrical connection from operator to work surface (wrist strap to mat ground connection) is required at all times. The resistance from the operator's body surface to ground shall [Redacted]

[Redacted] All personnel working within an ESDS Device Zone shall [Redacted]

[Redacted] If the wrist strap is removed, it shall [Redacted] All personnel who will be in the work zone while work on an ESDS device is being performed must [Redacted]

[Redacted] Visitors must not borrow or use another person's wrist strap without testing it at a wrist strap checker.

**Warning: When working where 120 volts or more may be present, always remove your wrist strap grounding cord and ESD coat before applying power. After turning off the power, reattach to your grounding strap and coat before handling the ESDS assembly.**

### 9.2 Personnel Apparel

Clothing and its movement on the operator is a significant source of static generation during the handling process. Clothing made of cotton is considered to be the safest clothing for an operator to wear during processes involving the handling of ESDS devices. The following will minimize the static generation within the Static Safe Perimeter.

- [Redacted]
- [Redacted]
- [Redacted]
- [Redacted]

### 9.3 ESD Shop Coats

All personnel working on ESDS devices in an area identified as a Static Safeguarded Work Station or personnel who will be in the ESD work zone while ESDS devices are present must wear an ESD shop coat. In order to properly block static fields from clothing, the operator must [Redacted]

[Redacted]

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[REDACTED] In addition, the sleeves of ESD coats shall not be rolled or pushed up to expose the garment under the ESD coat. It is recommended that shop coats [REDACTED]

An ESD shop coat improperly maintained can contribute to ESD damage rather than prevent it.

**9.4 Prohibited materials**

High static generating materials must not be allowed in the ESD Work Zone when ESDS devices are exposed. In general, this means that the following items shall be removed from the work zone prior to removal of any ESD protection from ESDS device(s).

- [REDACTED]
- [REDACTED]
- a) [REDACTED] s)
- b) [REDACTED]
- c) [REDACTED]
- d) [REDACTED]
- e) [REDACTED]
- [REDACTED]

**9.5 Paperwork**

Paper and wood products with normal humidity conditions (over 30% relative humidity) do not pose a problem with ESDS devices in the area. These type products absorb water out of the air and therefore tend not to build up static. As a normal precautionary measure, only paperwork needed for the ongoing process will be allowed in the ESD work zone while ESDS devices are exposed. Do not place an ESDS device on [REDACTED]

**9.6 Ionized Air**

Excessive static charge must be neutralized by providing a flow of ionized air over the affected work area and equipment when one or more of the following exist:

- [REDACTED]
- [REDACTED]
- [REDACTED]

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As a standard rule an air ionizer will be used to increase the confidence with the handling procedure. Air ionizers shall be tested per the manufacturer's recommended method and interval for proper operation to verify the equipment's ability to neutralize a static charge.

### 9.7 Equipment grounding (Electrical)

All electrical equipment used in the processing of ESDS devices must have a connection directly to ground unless the test setup needs a floating ground for proper measurement. Soldering irons, test fixtures, or meters are some examples of this type of equipment. Where equipment or tooling cannot be fully grounded, neutralize accessible areas using ionized air.

### 9.8 Hand Tools

All hand tools must [REDACTED]

### 9.9 ESD Shielding Bags

The standard bag for all ESD protection will be the ESD shielding bag. This bag is dark or silver tinted, and is slightly see through. Any shielding bag shall be discarded if found to be damaged, has holes larger than the diameter of a paper clip, or is determined to be worn or aged. The presence of staples, or staple holes does not necessarily degrade the bag, unless they are present in quantities or the holes are large enough for component leads to easily penetrate. Use the following rule: [REDACTED]

## 10.0 Work Station and Equipment Calibration

Equipment required:  
- [REDACTED]  
- [REDACTED]  
- [REDACTED]  
- [REDACTED]

All equipment shall be calibrated.

### 10.1 Calibration of Work Station

Place the 5# weight in the center of the ESD mat. Measure the resistance, with the resistance meter, from [REDACTED] [REDACTED] [REDACTED].  
If resistance measurements are above these values, try [REDACTED].  
Do not use mats that cannot pass this test.  
For the next measurement the operator must wear a grounded wrist strap.

The static field meter shall be pointed at the mat. The meter shall be an inch or two from the mat according to the meter's instructions. Turn on the meter and verify a zero volt reading. With the meter still on, point the meter at the different objects within the work station area, paying particular attention to plastic items. If a voltage of more than  $\pm 100$  volts is found, turn the meter off and repeat this procedure for that one item. If the second reading is still over  $\pm 100$  volts, and an air ionizer is located at the workstation, turn the meter off, turn the ionizer on and wait for 30 seconds. Turn off the ionizer since this can affect the meter readings, repeat the measurement, if the item is still over  $\pm 100$  volts it must be relocated three feet from the work area, or treated with an antistatic solution. If no air ionizer exists at the workstation, the item must [REDACTED]

### 10.2 Equipment Checks

Using the ohmmeter or DMM, measure the resistance from the tip of the soldering iron to the ground prong of the power plug. The value must be [REDACTED]

### 11.0 Potential Damage

If an ESDS device is exposed to a significant field or discharge, the device might fail immediately or have a latent failure. In the latter case, the device may function normally but for a shorter lifetime.

If an ESDS device is handled by an ungrounded person, that person will [REDACTED]

If an ESDS item has been exposed to a possibly damaging ESD field or environment, bring it to the attention of the area supervisor or lead. Devices exposed to ESD threats need [REDACTED]

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