Mini-Circuits®

ESD Control for Electronics Manufacturing

This application note presents recommendations for establishing basic ESD control equipment and practices in a small to mid-sized manufacturing facility which handles sensitive electronics components and printed circuit boards containing them. It is intended to give users the benefit of Mini-Circuits experience in training employees and in installing, using, and maintaining ESD control at individual manual workstations, as well as in automated (pick-and-place) assembly. In the event that assembly work is subcontracted, the contract manufacturing facility must also have an ESD control system which meets the requirements given herein as a minimum, as well as a program of training, preventive maintenance, and auditing to assure its continued effectiveness.

Suggested training videos:

"Becoming ESD Certified", 15 minutes; Hewlett Packard stock no. 90337HA

"Electro-Static Discharge", 18 minutes; Motorola Corp., Phoenix, AZ 85072

These videos can be used as part of a training program which includes demonstration of ESD control equipment and technique, guided on-the-job practice, and verification of operator proficiency. One video might be used for initial training, and the other for recurrent training.

Electrostatic Discharge Control Handbook, ESD Association, Rome, NY 13440, publication ESD-ADV-2.0.

The following sections of this application note provide practical advice for selecting, installing, and using ESD control equipment and materials. They correspond to, and are numbered the same as, those sections of the above Handbook that Mini-circuits recommends for establishing a basic ESD control system. Sections of the Handbook not covered in this application note, especially those relating to implementing a static control program and conducting audits, should also be considered in order to ensure having an effective system.

1. Introduction

In an electronics manufacturing facility of moderate size handling a variety of component types, it is safest to consider all parts and assemblies (including populated PC boards) to be ESD-sensitive to a degree that they require the following:

- Grounded equipment and fixtures
- Static-dissipative work surface (mat)
- Grounding of operators at all times that they handle, or might come to handle, parts or assemblies

In addition, air ionization (see paragraph 7 below) should be used when handling components and

assemblies which are known to be more sensitive than most; examples are GaAs FET switches, such as Mini-Circuits models having the letters "SW" within their model number.

This approach is a practical alternative to having to determine the ESD damage threshold value for each item, and then tailoring the procedures for ESD control individually.

2. Wrist straps

The woven or knit elastic-fabric type of wrist strap with conductive fibers on the inside surface has been found to meet the needs of operator comfort, grounding effectiveness, durability, and economy. Each operator should be issued one for personal use, should adjust it for a snug but comfortable "wrist watch" fit, wear it directly on the skin, and wash it (with soap and water) as necessary. It is convenient to continue wearing it during lunch and breaks, but frequent auditing should see that operators snap-up to the coiled cord (kept at the workstation) each time they return to work. Daily wrist strap testing must be logged. It should be done using any "tester readily available on the market, by the operator responsible for the workstation, and should be done as a "system test" as defined in paragraph 2.4 of the Handbook. Co-located workstations can share one tester. If dry skin prevents passing the wrist strap test, the operator should wipe onto the wrist a drop of special static-dissipative hand cream sold for the purpose. Wrist straps are considered an expendable item, and should be discarded and replaced when worn out.

3. Static Protective Floor Materials, and

4. Footwear

While these items can be useful in ESD control, we find that they may be omitted in facilities setting up a basic program in which operators and machines are adequately grounded by the means described in this application note.

5. Garments

Each operator should wear a static-dissipative ¾ length full-sleeve lab coat, and close at least 3 of its front snaps. Polyester-cotton fabric is good for comfort. The fabric should obtain its static-dissipative property by containing a grid of carbon-infused fibers. This kind of fabric will withstand repeated warm-water machine washing and warm tumble-drying, without having to be tested for maintenance of its dissipative property.

6. Packaging Electronics products for Shipment and Storage

Tape-and-reel packaged ESD sensitive parts are protected by their black-conductive carrier tape, and must remain in that packaging until removed by properly grounded pick-and-place assembly equipment. If manual assembly is used, parts must not be removed from the tape before the tape is placed on the dissipative workstation mat. Electronics parts in other types of packaging should be slid out gently onto the dissipative mat, so that they become discharged safely before being touched (by an operator who is grounded as in Section 3 above).

Populated PC boards should be packaged individually in fully closed static-shielding bags of the buried metal layer type. Pink antistatic foam should be used only as cushioning material; it is not static-dissipative and cannot discharge parts or assemblies. Only those cardboard boxes and cartons

that have black conductive coating should be used to transport in-process material. They should be constructed with a tab that shorts the inner and outer surfaces together, and should preferably have a static-dissipative coating over the conductive coating.

7. Ionization

For individual workstations a small, table-top air ionizer of the self-balancing type should be used at each station. Checking of the balance should be done periodically in accordance with manufacturer's recommendations. Have 10 - 20% extra quantity of ionizers available for use when ionizers are sent out for this calibration. Place the ionizer near the edge of the table top, directed away from the operator's face (to prevent a hazard from blown particles). Set the fan speed in the ionizer for a slightly perceptible flow on the hand where the work will be done.

8. Grounding

A Common Point Grounding device must be snapped onto the mat (see Section 9). Make sure that the mating snap on the mat is the correct size and gender; it is most conveniently purchased pre-assembled to the mat. The insulated wire of the Common Point Grounding device must be connected to the equipment ground (not the neutral) of the electrical service; have an electrician verify the wiring of the receptacle to be used for this purpose. Refer to ESD Association, ANSI/EOS/ESD-S6.1 paragraph 5.1.1.

A coiled "cord" (insulated wire) having 12-foot (extended) length is the most useful means of connecting the snap on the wrist strap to a banana jack on the Common Point Grounding device, for operators at individual workstations. It enables them to remain grounded when transferring material to and from carts.

9. Work Surfaces

A 2 x 4 foot mat is best for most kinds of manual work on electronics parts and assemblies; it can be the soft type (dissipative rubber upper layer and conductive bottom layer) or hard (dissipative fiber glass). Cleaning of the mat should be done using an antistatic mat cleaner.

10. Workstations, and

11. Equipment

For automated assembly, all equipment must be grounded to a properly functioning equipment ground of the electrical service, as in Section 8 above. Loading and unloading of assembly and handling equipment must be done to and from a static-dissipative mat, by properly grounded operators as described in Sections 2, 5, 8, and 9.

A grounded soldering iron must be used for all manual (hand) soldering, including rework. The integrity of grounding of its tip should be checked periodically.

Where tooling or fixtures having insulative surfaces which might contact electronics parts or assemblies need to be used, it is particularly important to provide air ionization because that is the only means of discharging such surfaces. If an automated assembly line occupies an area that cannot be covered by individual ionizer units, ionizers having room coverage should be considered.