

Application Note APNE-0010

A Novel Field Monitoring Technique to Protect an ESD Program Investment

In recent years the deleterious effects of static electricity on semiconductor devices has become widely recognized. Many companies involved with the manufacture or use of static sensitive devices have spent huge sums to alleviate the problems associated with static charges on personnel, work areas, transport containers and packaging materials. In general, the goal has been to eliminate static wherever it might occur. Investment usually is in conductive (or dissipative) workbench surfaces, flooring, tote boxes, plastic bags, clothing and wrist straps. Additionally, ionizer blowers and even room ionization systems are sometimes used. A rigorous training program must in general, accompany the utilization of these materials for the personnel involved in order to achieve maximum benefit.

This money is usually well spent. Most reports cite increases in yields and productivity as an immediate result. The question then is not whether these steps are necessary, but rather has the investor gotten the best out of his money. Has he spent enough? Are the people really trained? In other words, who is monitoring the effectiveness of this money already spent?

It is easy enough to find examples of disasters. There is a company who spent several hundred thousand dollars equipping an assembly area with conductive materials and although yields improved, there were still problems. It turned out that one of the production workers was using Teflon[®] ties to attach an FET to the circuit board. In spite of the fact that everything else was conductive, and the worker wore a wrist strap, the Teflon tie had a potential of upwards of 20,000 volts when it was attached to the FET. "I didn't think of that," was the supervisor's comment.

Another example concerns a company where one of the production workers held regular Tupperware[®] parties. Yields rose and fell depending on the sales of Tupperware.

It's easy to find fault with this kind of laxity, but in reality can anyone expect a production supervisor to think of everything? A seemingly minor oversight can negate the usefulness of an investment of millions.

Sometimes it isn't an oversight that causes problems. There is on the market a large array of products whose static dissipative properties depend on chemical additives. The effectiveness of these additives is often time dependent, so even when workers are using material they believe to be safe, problems can arise.

IT MAKES GOOD SENSE THEREFORE, TO FIND A TECHNIQUE TO CONTINUOUSLY MONITOR THE EFFECTIVENESS OF YOUR STATIC CONTROL PROGRAM.

What is the best way to monitor? There are two similar but basically different techniques currently on the market:

1. FIELDMETER PROBES:

There are at least two types of fieldmeter probes available: those which sense the field continuously and provide a readout of the field condition, and those which sense only a change in the field.

In both cases, these probes measure electrostatic field AT THE PROBE, and are therefore essentially point detectors. Their capability for detecting a charged object depends not only on the distance between the object and the probe and the size of the object, but also on the proximity of the charged object to other ground planes (for example: a benchtop surface, see ref. #1).

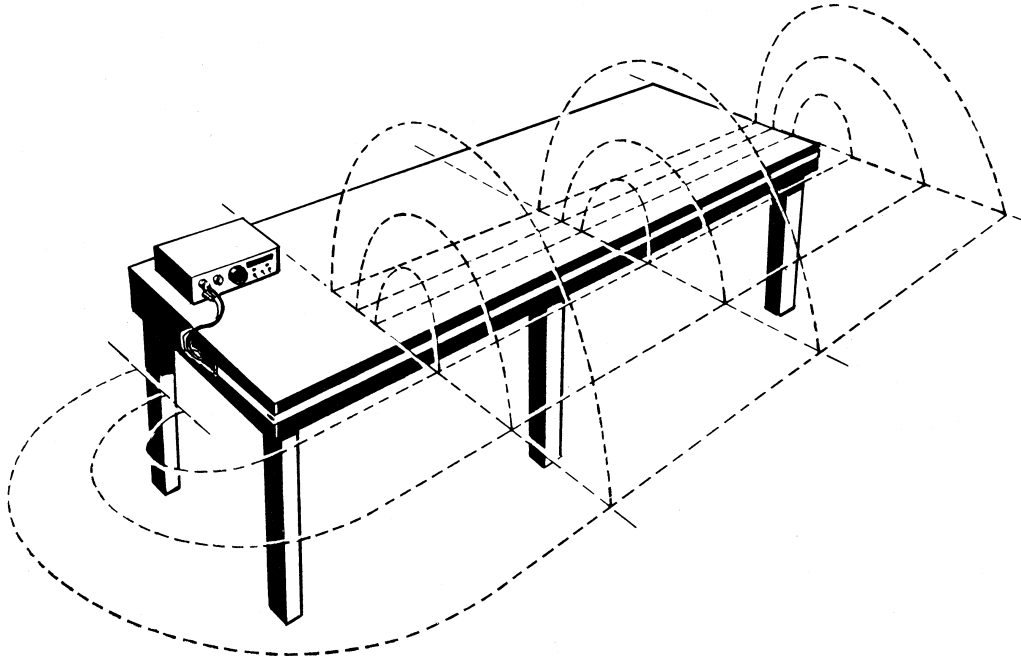
The fact that these probes are point detectors means that for many workbench applications it will be possible to monitor at a preset sensitivity only a small part of the work area.

Monroe Electronics has been manufacturing electrostatic fieldmeter probes for more than 30 years, but because of their limitations with regard to area monitoring, has never recommended their use in monitoring work areas. These probes are very well suited for monitoring materials production areas, e.g., plastic sheets, photographic film coating machines, etc., where they "look at" a specific surface and can provide an indication of the charge on that surface.

They also can be used for monitoring room air ionization systems. Note especially Monroe Electronics Model 268 Charged Plate Monitor.

2. MONROE ELECTRONICS MODEL 248 CHARGED BODY DETECTOR:

The Model 248 Charged Body Detector is not totally different from an electrostatic fieldmeter. It is, in fact, a fieldmeter which measures changes in electrostatic field above a selectable preset level, and as such its sensitivity is dependent on the size of the charged object and its distance from the probe. It is not dependent on the proximity of the bench top ground plane. The major feature of the Model 248 is its probe. Instead of a point detector, the Model 248 uses a tape probe which can be up to 50 ft. long (15 ft. is standard). Sensitivity is uniform along the entire tape length, and thus it is possible to monitor an entire workbench (or a group of workbenches). Additionally, it can be used to monitor the entrance to a sensitive work area or the doorway of a clean room. It can also be looped around a conveyor line (and looping provides additional benefits, see Ref. #2). Indeed, the applications for this tape probe are only limited by the imagination of the user.



A typical installation of the Model 248 for workbench monitoring is shown in the sketch for a grounded workbench. This is a recommended procedure, but actually it may be attached at virtually any convenient position providing it is out of the way of the worker. (The tape is pressure sensitive and will alarm on touch, like most fieldmeter probes.) The dotted lines represent levels of sensitivity. The lines closest to the tape represent a preset sensitivity from 10 to 10,000 volts (on a 6" square plate). If this closest line is preset to a sensitivity of, e.g., 100V then the next line would represent 200V and the further 500V.

This means that a 6" square plate at 500V passing through the plane of the furthest line would cause an alarm.

Since the instrument measures changes in electrostatic field, it detects not only charged objects approaching the (grounded) workbench, it will also detect a grounded object approaching a charged object, This can be useful, for example, if a stationary charged object somehow got on to the bench.

Of course, if a worker has a defective wriststrap and becomes charged, it will also detect it.

SOME CONSIDERATIONS WITH REGARD TO ESD MONITORING:

1. While it is true that a good electrostatic fieldmeter will continuously monitor the level of the field while instruments like the Model 248 Charged Body Detector monitor only changes in the field, most damage to sensitive parts occurs as a result of field changes.
2. The Model 248, like other monitors, provides an audible alarm; however, the Model 248 also provides several relay outputs. The audible alarm is extremely useful for worker training. They can identify immediately when something is wrong. It is likely however, that if the sensitivity is set to a level where it is really doing some good, there will be false alarms. These can be disconcerting and result in lost production. The relay outputs on the Model 248 were provided to trigger a remote alarm (while a switch on the instrument disables the local audible alarm). This remote "alarm" might take the form of a simple event counter in the supervisor's office. At the end of each day, he can check his counters and note the number of events at each monitored work area. Experience will teach what numbers represent a normal amount of false alarms and if these numbers are exceeded, he will know where to look for a problem. For doorway protection or conveyor belt monitoring the local audible alarm is still probably best.
3. It would seem that the only argument against monitoring equipment might be the cost of the equipment. However, even a good instrument, like the Monroe Electronics Model 248 Charged Body Detector costs only a small percentage of the total investment in an EOS/ESD control program. For this nominal additional cost, the potential benefits are very significant.

REFERENCES:

1. "Review of Current Electrostatic Measurement Techniques and Their Limitations" W.E. Vosteen, Presented at 1984 Electrical Overstress Exposition.
2. "The Tape Electrostatic Field Sensor and Its Applications" W.E. Vosteen, Presented at 1986 Electrical Overstress Exposition.