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TECHNICAL NOTE

Ionizer Measurements for Critical Static Sensitive Applications

Critical Protection for Sensitive Devices

Static charge control has become essential to maximizing production yields and product throughput in the manufacturing of semiconductors, disk drives, flat panel displays, and many other products. One of the most serious problems in these production areas is electrostatic discharge, or ESD.Most electronic devices are not sensitive to ESD events that occur below 200 volts. In the disk drive industry, however, the increasing use of magnetoresistive (AMR through TMR) read heads has caused concern for ESD events at under 5 volt levels. The need for static control at this low level has driven the introduction of alpha ionizing blowers specially designed for this application.

In alpha ionizers, Polonium 210 is the source of alpha particles which collide with nitrogen and oxygen molecules in the surrounding air. This collision displaces electrons, creating positive nitrogen and oxygen ions at the collision site. Scattered electrons from the collision site rapidly (within 2-3 cm) attach themselves to other nitrogen and oxygen molecules to form negative ions. In this way, each alpha particle collision produces positive and negative ion pairs that result in an inherently balance ion output.

This technical note is concerned with the measurements required to characterize alpha ionizing blowers for use in MR head and other critical applications.

Ionizer Measurements

When ionizers are used for static their performance is measured using a Charged Plate Monitor (CPM), and the procedures of the industry standard ANSI EOS/ESD S3.1-1991 (S3.1). S3.1 provides procedures to determine balance (known as offset voltage) and the discharge time of the ionizer. One of the most important issues to remember about making the balance measurement is that the voltage measured by the CPM is not the same as the voltage on an MR head or IC. Ionizer measurements of balance using a CPM produce a value that is generally much larger than the voltage measured on real parts in actual applications.

The CPM was designed to ESD Association standard S3.1 to do testing of ionizer discharge time and balance under laboratory conditions. At the beginning of each measurement, the zero setting of the CPM is verified. In 1987, when the standard was written and the CPM was specified, overhead ionizers and MR heads were not in production. In fact, the standard was modified in 1991 to add the test method for overhead ionizers, now commonly used in HDD production. The issue of 20 volts and better ionizer balance did not arise until MR heads began being produced in quantity about 1995.

The CPM was never designed to be a long term monitoring device for ionizers, nor was it designed to accurately measure balance to values of 5 volts or less. Anyone using a CPM for precise balance measurements should understand that they may be measuring the performance of the CPM, not the ionizer. This is particularly true when measuring the balance of an alpha ionizer, which by its nature is always at zero balance.

Altering the CPM for Measuring at Extremely Low Temperatures

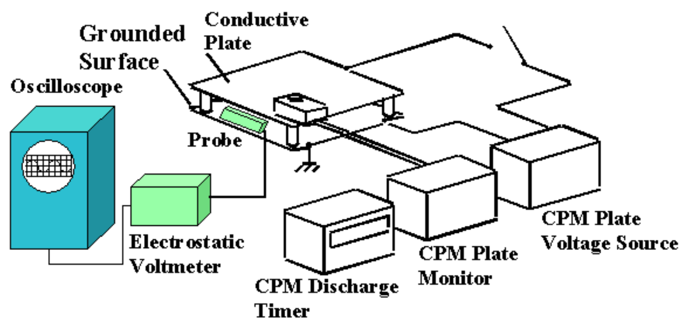
Since the CPM and the measurement methods of S3.1 are contained in many industry and corporate standards, replacing them with an alternate instrument and test method can be difficult. Most models of CPMs that meet the requirements of S3.1 use an electrostatic fieldmeter to determine the voltage induced by the ionizer on an isolated 15cm x 15 cm conductive plate having a 20 picofarad capacitance. The fieldmeter is limited by its design in its accuracy, bandwidth, and stability. For the purposes of this discussion, CPMs and other measuring techniques that do not meet the requirements of S3.1 (although they may make useful measurements) will not be considered.

The first issue that arises is the bandwidth of the measurements. Due to the bandwidth limitations of the fieldmeter sensor (typically 10 Hz), and the time constant of the plate assembly (2-20 seconds with most ion sources), the CPM cannot make accurate measurements of the voltage swings produced by an AC ionizer. Polarity changes at the power line frequency are too fast to be measured by any CPM.While other measurement techniques might be used, such as discharge current transient measurements, these are not covered by any existing standards. Anyone considering the use of an AC ionizer around products sensitive to 10 volts or less should consider another type of measurement before using the AC ionizer. While there is no way to improve the ability of the CPM to accurately measure AC signals, there is a relatively simple way to improve the accuracy and stability of the DC measurements. There are a number of manufacturers (for example, TREK or Monroe Electronics) of stable, highly accurate electrostatic voltmeters that could be used to sense the voltage on the isolated plate. In finding an electrostatic voltmeter with the required accuracy (+/-0.5 volts or better) a compromise on maximum range may be necessary, perhaps to +/-200 volts. This should pose no problem if the desired ionizer offset (balance) measurement is to 5 volts or less.

Choose an electrostatic voltmeter with a small enough probe to securely mount it under the existing CPM plate. An electrostatic voltmeter works by nulling the field from the plate by raising its probe voltage to a level similar to the plate voltage. Care must be taken to mount the sensor probe where shorts and voltage arcs to the sensor or plate will not occur. Once mounted, the sensor calibration can be adjusted and checked by applying accurate, known voltages to the plate. If necessary, a calibration chart can be constructed.

While most electrostatic voltmeters have a digital display, be sure that the least significant digit is +/-0.1 volts. There is always a +/- 1 digit uncertainty in digital displays that must be considered if you are trying to measure to zero volts with accuracy. It may be better to use an analog output from the electrostatic voltmeter connected to an oscilloscope or an accurate voltmeter. Once again, it is a good idea to calibrate the test setup using known voltages on the CPM plate.

Using an oscilloscope with an electrostatic voltmeter will typically provide a measurement bandwidth of at least 3KHz and you may be able to see some of the variations caused by an AC ionizer. Unfortunately, the long time constant of the plate assembly still causes orders of magnitude errors in the measurement.



Refer to the following diagram of a possible test setup. Note that the Probe should be mounted at least 3 cm from the edge of the plate for best accuracy.

Ion publishes additional information regarding the limitations of using a CPM with AC ionizers in flat panel display (FPD) applications in the Technology Solution paper, *Getting the Full Picture from Your Charge Plate Monitor*.

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