SIMCO ION™
An ITW Company

APPLICATION NOTE

AeroBar Balancing

Irregularity of Ion Delivery

Summary

Simco-Ion AeroBars utilize patented sequenced bipolar ionization. During "on-time," positive and negative ions are released sequentially. During "off-time," no ions are released, allowing the dispersion of existing ions.

The Need for Balancing

Due to a variety of factors including environment variables and the physical properties of ions, over time positive and negative ions will go out of sync as a normal part of production line activity.

The goal of balancing is to regulate the ion delivery so that the correct number of positive and negative ions arrive at the work surface or substrate to neutralize any existing static charge.

In order to ensure proper ionization performance and therefore static charge elimination on sensitive devices, it is necessary to periodically adjust the ion disbursement. This is commonly referrerd to as system or balance adjustment.

This document describes the recommended balance adjustment procedure for digital AeroBar ionizers. Simco-Ion recommends performing a balance adjustment as part of a regular maintenance program. In general, AeroBars should be balanced every six months to a year. The actual frequency of balance adjustment needs may depend on the specific activity of your application and environment.

For the balance adjustment procedure for analog AeroBars, see the sister Application Note titled "Recommended Adjustment Procedure for Analog AeroBars."

Balance Adjustment Equipment

- Charge Plate Monitor (Simco-Ion Model 280A is recommended). The Model 280A displays positive and negative voltage swings along with balance. If a Model 280A is not available, use a scope that has graph capability and digital reports.
- Tripod for the Charge Plate Monitor
- Anemometer
- Periodic Verification System (Simco-Ion Model 775PVS)

Variables that Affect Balance

Airflow (direction and velocity): AeroBars depend on external airflow to carry ions toward the target to be ionized. Local variations in airflow readings help explain why discharge times at several apparently similar locations in the same cleanroom can be quite different.

In a typical cleanroom, discharge times will be fastest (and in a pulsed DC system, swing peaks will be highest) in an aisle and discharge times will be slowest and swing peaks will be lowest when the CPM is placed next to a tall, grounded tool enclosure or if the nearest ceiling emitter is placed next to a blank ceiling panel that provides no airflow.

Likewise, in a flowbench or minienvironment, discharge times will be fastest at an open, unobstructed area on the bench top or in the process chamber and where the airflow is high, and slowest adjacent to a microscope or robot tower and where the airflow is limited.

- You need to know the airflow in the location you want to have ionized because if it is high or low, you will need to adjust the AeroBar settings to compensate.
  - Proximity to grounds and large isolated conductors Because they will soak up ions
  - Distance from the ionizer to the test instrument
- You need to know the Ion density decreases over distance, so if your ion density is too high you will get a crazy swing voltage or something.
  - Ionizer density (e.g.: spacing of ceiling emitters or AeroBars - more ionizers make more ions) and
  - Ionizer settings (on/off times and output levels - higher output levels make more ions).
- You need to know the settings because if you're on or off times are too high or low, your balance will be crazy.
  - Open areas tend to have larger voltage swing ranges than areas near (grounded) walls and tools, so each location will not display the same swing.

Understanding what you need in order to balance a bar you need to know the following:

- Peak swing spec
- Balance spec
- AeroBar timing
- Decay time
- Airflow in the environment

Understanding Voltage Swing and Decay Timing

Voltage swing refers to the range of the CPM plate voltage reading between the positive and negative peak readings at sample locations. For example, for a desired swing of ±150 volts:

- The average of the sample positive peak readings should be 150 volts
- The average of the sample negative peak readings should be -150 volts.
- The sum of the average positive and negative peak voltage readings should approach zero.

Decay timing is a measure of the time (in seconds) that it takes to decay a charge of +1000V to +100V, and –1000V to –100V. The conductive plate is charged to the initial test voltage of 1000V and is allowed to discharge to 10% of the initial test voltage. The time required for both polarities will be recorded.

Balance and decay testing requirements are established by EOS/ESD STM 3.1-2000 standards.

Performing a Balance Adjustment

1. Choose a specification for the measurements to meet.

If the facility has an existing specification for voltage swings and decay times, obtain these numbers. If specs are not available or do not exist, use the industry's typical setting.

A desired balance and decay time will depend on the sensitivity of the product to electrostatic-related problems. Choose values that meet the static charge protection needs of your environment.

- Choose a decreased voltage swing range for products more sensitive to electrostatic related problems (such as <Cheryl>)
- Choose an increased voltage swing range for less sensitive products.
- Choose a decay time of such as 30 seconds or better
- Choose an airflow range
- Set AeroBar timing

Industry Typical Settings

- For most semiconductor room applications: ±100 to 150V.
- For semiconductor benches and mini-environments: ± 50 to 75V
- For wafer fabrication environments: ±100 to 150V

2. Set the CPM in an appropriate location for obtaining measurements.

For the AeroBar Model 5225, ideal locations include:

- FOUP ports
- Pre-aligners
- Metrology equipment
- Buffer stations
- Load ports

For extremely tight spaces, use a detachable charge plate that can be placed in tight or remote spaces such as robot arms.

For the AeroBar Model 5585, ideal locations include:

- FOUP ports
- Pre-aligners
- Metrology equipment
- Buffer stations
- Load ports

For extremely tight spaces, use a detacheable charge plate that can be placed in tight or remote spaces such as robot arms.

3. Record the airflow.

Use an anemometer to record both vertical and horizontal flows. You may also want to record a few different locations in order to get a complete picture of airflow in the environment.

You need to know the airflow because an extreme (low or high) airflow rate will affect the true balance behavior of the ions.

Follow these general guidelines:

- Do not hover too close to the CPM or you may influence airflow and ion movement.
- If measuring inside a tool, seal the chamber and let airflow stabilize before making any measurements

4. Measure voltage swing on the CPM.
    1. Allow the CPM to warm up for at least 15 minutes.
    2. On a Model 280 CPM, press the Manual button and then the Balance button. (If there is no time set for the test to run for, use the default time of 60 seconds. See the Model 280 instruction manual for more information on setting default times.)
    3. Note the numbers for +Vp (positive voltage peak), -Vp (negative voltage peak), and Vave (average, or balance).
5. Measure positive and negative decay times on the CPM.
    1. Allow the CPM to warm up for at least 15 minutes.

2. On a Model 280 CPM, press the Manual button and then the +Decay button.

3. Once the +Decay test is finsihed, press the -Decay button.

Note the numbers.

The above tests can be performed automatically using "Auto" mode. This function will allow testing in an enclosed environment. The 280 CPM will perform both Decay tests followed by a Balance test. Individual parameters of the testing can be adjusted in the setup menus. The "Auto" test can also be setup to perform multiple runs based on a timing interval.

6. Consider the data.

The peak swing voltage, decay, and airflow readings give you an accurate picture of how balanced the AeroBar is.

If your positive and negative peak swing voltage numbers are well beyond the facility or industry specification, adjust the AeroBar timing and re-measure to reach the specification.

If your decay time reading is beyond the facility or industry specification, adjust the on/off times and high voltage power levels.

Simco-Ion
Technology Group
1750 North Loop Rd., Ste 100
Alameda, CA 94502
Tel: 800.367.2452 (in USA)
Tel: 510.217.0600
info@simco-ion.com
www.simco-ion.com

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