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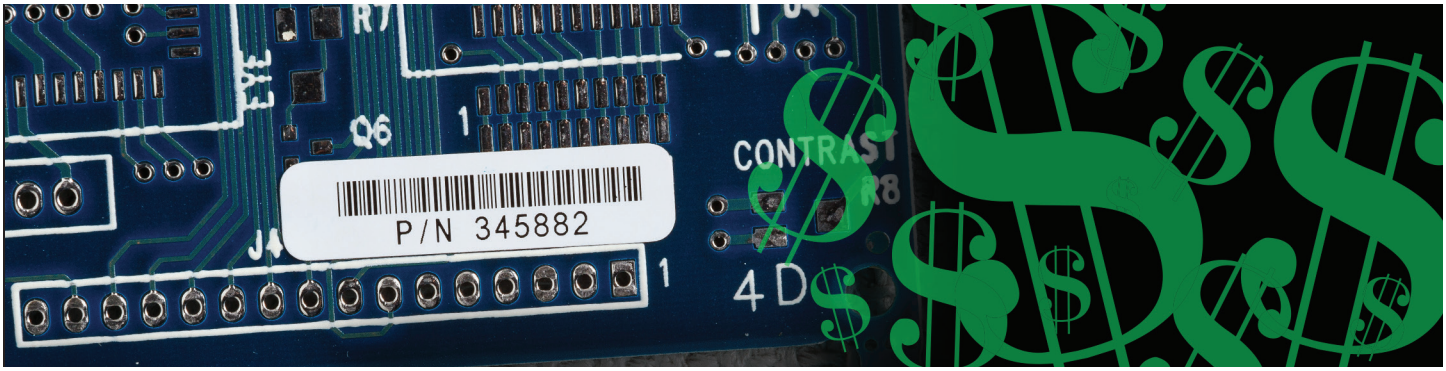
UNDERSTANDING & AVOIDING THE COSTLY EFFECTS OF ESD



By Justin Bergholz, regional product specialist, & Vicki Heideman, principal engineer, Brady Corporation
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The Costly Impact of ESD

Electrostatic discharge (ESD) is the sudden release of static electricity when two objects come in contact. While it can be harmless in some cases, such as walking across carpet and then feeling a small shock when touching a metal surface, this high-voltage electric charge can be disastrous in the electronics industry. It can cause severe and permanent damage to printed circuit boards (PCB) and electronic components.

The ever-evolving age of electronics has increased the problems of ESD, as more intricate, smaller technology has a greater sensitivity to the discharge. ESD is one of the industry's most costly causes of damage, impacting virtually every area of the electronics environment, including production yields, manufacturing costs, product quality and reliability, and company profitability. Industry experts have estimated average product losses due to static to range up to 33%, while others estimate that it costs billions of dollars annually.[1]

Reducing ESD Damage

To combat the problem of ESD harming products and components, electronics manufacturers:

- Establish electrostatic protective areas free of static
- Avoid highly charging materials
- Remove static by grounding workers, providing antistatic devices and controlling humidity[2]

One common area where ESD can be present that may be overlooked is in standard PCB and component labels used to track work in process and provide long-term records of production, repair and warranty information. Many people who are familiar with ESD and controlling ESD in the electronics assembly environment may not have considered standard labels as a potential source for ESD events that can damage electronic components or assemblies.

With the costly impact of damage caused by ESD, it is essential for electronics manufacturers to partner with a label supplier that is accurately testing and certifying its labels to align with the proper ESD standards. Failing to select an appropriate and safe labeling solution for each application will lead to accrued costs from increased downtime and product failures, and lack of confidence from your customers.

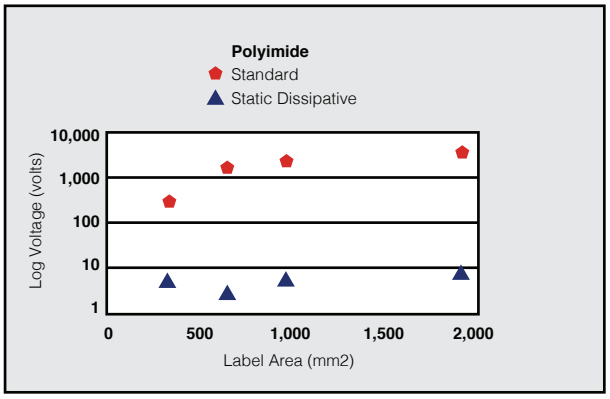
When determining an ideal labeling solution to meet the needs of your components and manufacturing process, it's important to consider label size and electrical properties.

Label Size

When selecting a label size, in terms of a standard label, a smaller label is better for ESD applications. The creation of the static build up takes place when the label is being removed from the liner. Voltage increases as the size of the label increases and more static is being created that can be stored up within the label. By decreasing the label size, an end user will create less static and have a lower risk of causing ESD-type failures.

When a large label is required for any application within an ESD-sensitive work area, users should consider a label that is static dissipative. Static dissipative labels are designed in such a way that voltage remains at a comparatively low level, even as the size increases.

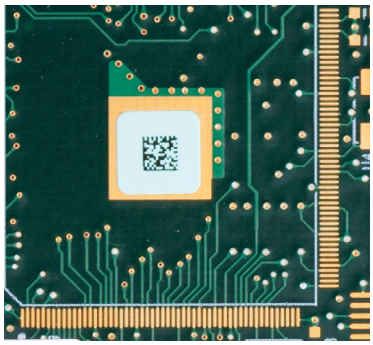
Voltage Versus Label Size for Polyimide Labels



This data confirms that for standard labels the measured voltage on a label increases as the size of the label increases. For static dissipative labels, the voltage remains at a comparatively low level even as the label size increases.

[1] The ESD Association. (1998). ***Basics of Electrostatic Discharge Part One - An Introduction to ESD.***
[2] ***Electrostatic Discharge.*** (n.d.). Retrieved 2014, from Wikipedia: http://en.wikipedia.org/wiki/Electrostatic_discharge

Electrical Properties



Three electrical properties should be considered when selecting labels used on sensitive components:

Triboelectric Charges

Triboelectric charging is the creation of an electrostatic charge by the contact or separation of materials.[3] There are multiple instances that can cause voltage build-up within a label due to triboelectic charging, but the most common occurrence is when the label is removed from the release liner that the labels are supplied on. Voltages created from removal of the label from the liner will vary by material type and label size.

While standard labels can be a source of charge, static dissipative labels significantly reduce the potential for an ESD event. The difference between standard and static dissipative labels is the amount of charge that they retain on their surfaces. Standard labels, comprised of layers of insulative materials, can generate and retain hundreds or even thousands of volts when removed from the release liner. On the other hand, static dissipative labels are modified to allow the charge to dissipate from the label to ground. As a result, static dissipative labels retain significantly less voltage than standard labels and reduce the amount of remaining voltage to a level considered safe for most electric components. It is important to note that labels will not perform optimally if the person applying them is not grounded or if plastic-coated tweezers or other non-conductive tools are used to handle or apply the label.

Surface Resistivity

Surface resistivity must fall within the $\geq 1 \times 10^4$ to $< 1 \times 10^{11}$ ohms range, as defined by ANSI/ESD S541-2008, to be classified as static dissipative. Measuring adhesive surface resistivity can also aid in predicting a label's voltage behavior, as can measuring static decay time, which is quantified as the rate at which charge dissipates from the label to the ground. Test method EOS/ESD S11.11 is the standard test method for measuring and classifying labels as static dissipative.[4]

Voltage can be measured with a hand held static meter. However, no industry standards exist describing the measurement of label voltage, so test results can vary depending on the meter used, rate of label removal from the liner, angel and direction of label removal from the liner, use of grounding and test environment.

Static-Decay Time

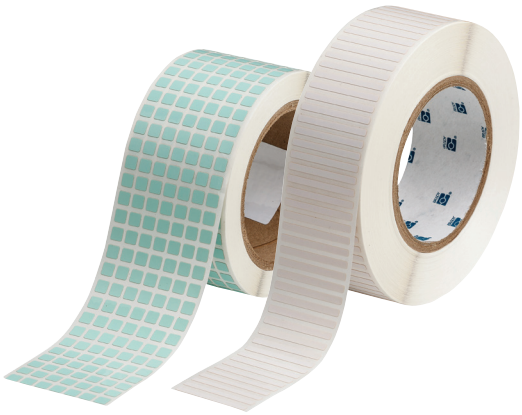
Static decay refers to the amount of time it takes for the label to dissipate the built up static (which is generally created by removing the label from the liner). Static decay testing should be performed in accordance with EIA-541, "Packaging Material Standards for ESD Sensitive Items," Appendix F "Measurements of Electrostatic Decay Properties of Dissipative Planar Materials." The intent of this test is to determine the label material's ability to dissipate 99% of a 5kV charge to ground within a specific time period. The material is considered acceptable if the average static decay time for each test sample is less than 2.0 seconds.

[3] Electrostatic Discharge Association. (1997). *Electrostatic Discharge Handbook.*
[4] Electrostatic Discharge Association. (1997). *Surface Resistance Measurements of Static Dissipative Planar Materials.* 1993.

In Conclusion

ESD is one of the electronics industry's most costly causes of damage, and the use of standard labels in the manufacturing environment is a commonly overlooked potential source of ESD. Implementing an effective static control program which includes the use of static dissipative labels and following industry guidelines can help reduce the risk of damage to ESD-sensitive devices and components.

To prevent ESD damage to a circuit board and its components, a label should have surface resistivity values in the recommended range for dissipative ESD packaging materials as defined by ANSI/ESD S541-2008 (surface resistivity $\geq 1x10^4$ to $<1\ x10^{11}$ ohms). Since static dissipative materials have lower resistivity than standard label materials and short static decay times, they are unable to build up significant levels of charge on their surfaces. This reduction in retained voltage will help label users in the electronics assembly environment reduce the likelihood of ESD induced product failures. It is imperative that end users work with label suppliers that have tested their labels per ANSI/ESD S541-2008. Failure to utilize a label that has been properly tested to the ESD specification leaves the end user open to potential product failures resulting in extended periods of downtime and millions of dollars in product failures.



Brady's Background with ESD

In response to the changing needs of the electronics industry and the increasing impact of ESD, Brady has developed static dissipative polyimide label materials that feature a patented, static dissipative formulation and ultra-durable adhesive. Not only do they protect PCBs and electronic components from ESD damage, but they are built to withstand the harshest circuit board cleaning processes.

For more information on Brady's ESD labeling solutions, visit BradyID.com/ESD

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