Technology White Paper

Basics of ESD Safety and Data Tracking

Overview of ESD Safety Protocols for Manufacturing Environments

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Basics of ESD Safety and Data Tracking

This white paper presents an overview of the basics of ESD and its impact on electronics manufacturing – specifically, as it necessitates protocols for maintaining safety and product quality. ESD damage to electronic components can greatly reduce production efficiency and drive up costs. It is important for all personnel working in electronics manufacturing environments to follow ESD safety protocols to eliminate these risks. Topics of this white paper include:

- *What Makes ESD Important?*
- *Data Tracking in an ESD Environment*
- *ESD-Safe Imaging for Total Tracking Solutions*

Microscan Systems, Inc.

What Makes ESD Important?

Electrostatic discharge, more commonly known as ESD, appears in many forms. From lightning bolts to a near-invisible spark when touching a piece of metal, there is no single way to encapsulate all of the different forms of ESD. In many cases, ESD can be felt in the form of a mild shock, usually more irritating than painful. However, when it comes to the world of electronics and manufacturing, this little shock can prove costly.

ESD Defined

An ESD event occurs when an electrostatic charge rapidly transfers between two objects. This transfer is usually caused when two objects with a notable potential difference in electrical charge contact each other. However, ESD events can also happen when two objects close to one another create a highly charged electrostatic field.

Before the actual discharge event, the electrostatic charge builds due to an electron imbalance on the surface of the material. This charge can be created in a number of ways, including shoes scuffing against a particular surface, or certain materials rubbing against each other. This accumulation of electrical charge causes one surface to gain electrons (negative charge) and the other to lose electrons (positive charge). The ESD event brings the electrical charge back into balance by transferring electrons via current.

The Dangers of ESD

Static charges can accumulate at almost any stage of a manufacturing process. Any object that moves and is not a perfect conductor is susceptible. For example, imagine a line of parts moving past a plastic window during the manufacturing process. As the parts move, a static charge builds up on the window; when the charge reaches a certain level, it can arc and discharge to a grounded point. If the arc is intense enough, components may be damaged in the process. (See Figure 1.)

The human body is very susceptible to the build-up of electrostatic charge. Many factors can contribute to this, from the atmosphere's humidity to the type of shoes a person wears. These small charges will not harm a person, but electrical components can be damaged by a single ESD event. Sensitive components can be damaged even by a discharge of a mere 20 volts.
Less sensitive components may still be susceptible, and cumulative discharges can create long-term problems affecting the functionality and performance of electronic components. ESD safety precautions are extremely important in the electronics and semiconductor industries. The advancement of integrated circuit and semiconductor technology comes with an increased ESD risk. As circuits become smaller and faster, the overall sensitivity to ESD typically increases, depending on the materials used.

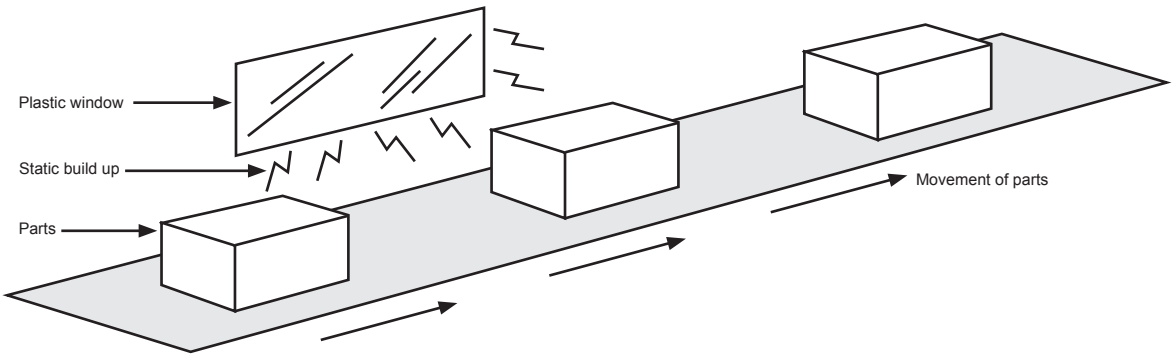

Figure 1: *Static within a moving manufacturing process*

In addition to causing physical damage, ESD events can create logistical problems. An ESD event can create delays in manufacturing and delivery, and can affect everything from the equipment to the environment to the staff involved with the event. ESD safety is critical in protecting manufacturers from technological and practical complications as well as significant financial loss.

The Basics of ESD Safety
ESD safety begins with proper equipment. Some essential ESD safety items are:

- Personal grounding wrist straps: Adjustable wrist straps use a standard resistor connected to a retractable cable that attaches to a grounding point, usually via crocodile clips.
- ESD-safe bags: ESD-safe bags are typically used for packaging integrated circuits and other sensitive electronic products. They use a metal shield between plastic layers for protection from electrostatic discharge.
- Safety jackets: ESD-safe jackets are usually manufactured with carbon fibers woven into the material, resulting in a Faraday-cage effect between the operator and hardware to reduce the likelihood of ESD events.
- Ankle straps: Ankle straps work in a similar way to wrist straps.
- Coated paper: Coated paper can act as a non-conductive surface for work stations and assembly areas.
- Static-free transfer bins: ESD-safe bins use an integrated conductive liner to create safe storage for static-sensitive devices.
- Grounding wires for tools: Since most tools contain rubber, plastic, and metal, it is extremely important to be sure that tools are grounded. One example of how to ground tools is to use a ground wire as a safe travel path for electrostatic charge.

These precautions protect sensitive electronic components in a wide variety of manufacturing environments.

Data Tracking in an ESD Environment

One of the primary challenges facing any manufacturer is tracking inventory and supplies without compromising ESD safety. Even simple movement – human or otherwise – can generate static charges. Within the life of a single component in an assembly process, charge can accumulate in many ways:

- Contact between components when inventory bins are filled.
- Wheeled parts bins rolling across a production floor.
- Handling of components by workers who aren't wearing or using ESD-safety equipment.
- Friction between components and the conveyor line during movement.
- Contact between components and other parts during manufacturing.

These are just a few of the circumstances that can lead to the build-up of static charge. As charge accumulates, the risk of damage becomes greater. A charge remains active until the conductive circuit closes, allowing the charge to return to a balanced state. Protective ESD bags only minimize charges; they cannot fully prevent charge build-up.

Bar code readers are a vital tool in efficient manufacturing. Components can be labeled with bar codes for process and inventory tracking (see Figure 2), and then the bar codes can be decoded and logged for automated updates. Printed circuit boards, integrated circuits, and other electrically sensitive components are often marked with very small bar codes and labels, making it difficult for readers to decode from a distance. When decoding at a distance is impossible, a new ESD risk element is introduced. Readers frequently collect static charge, and if they are brought into close proximity with a sensitive component, an ESD event could occur, potentially damaging the component.

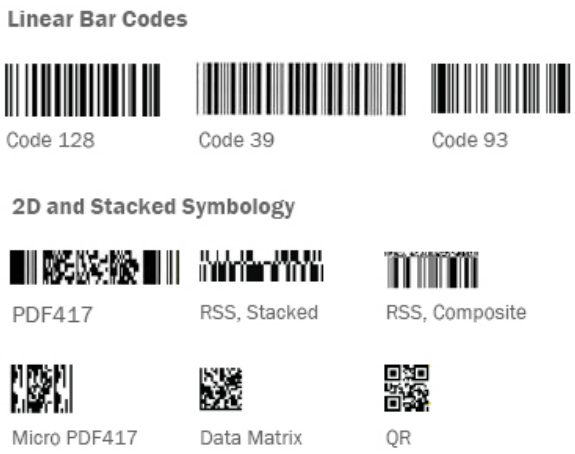

Figure 2: *Examples of bar codes and symbols*

Some manufacturing environments use a workaround by mounting the reader after applying a special anti-static spray for protection. There are two problems with this attempted solution: the coating must completely cover the area for maximum effectiveness and risk prevention, and anti-static sprays can wear off over time, requiring frequent reapplication. Without an accurate measure of a spray's efficacy period, companies either waste money by spraying too much or put their components at risk by exposing them to an unprotected environment.

ESD-Safe Imaging for Total Tracking Solutions

Microscan's MINI HAWK ESD Safe
Today, companies have a simple and affordable solution that gives them the freedom to use bar code tracking without fear of ESD events. Microscan's MINI HAWK ESD Safe with X-Mode decode algorithms is a powerful high resolution imager capable of reading both 1D and 2D symbologies, whether on printed adhesive labels or directly marked onto the surface of the part, all in an electrostatic discharge-safe package.

The MINI HAWK ESD Safe unit features a unique nickel coating and ESD-safe labels and cabling for maximum ESD safety. Rated for discharges up to 8 kV, the unit's ESD immunity features a surface resistivity of less than 10 * 10-9 Ω/inch^2. The MINI HAWK ESD Safe is certified compliant for ISO Class 3 (Federal Standard 209E Class 1) cleanrooms, meaning that it can be used even in cleanroom environments where the latest ionizers are required for ESD control.

Using the MINI HAWK ESD Safe
The MINI HAWK ESD Safe offers ease of use and a wide range of functionality for any manufacturing environment. A simple plug-and-play connection links the unit to a host computer with Microscan's ESP® Software, making configuration a simple point-and-click process. The EZ Button at the back of the unit automatically focuses and calibrates the reader for optimal decode performance.

Simply The Safe Choice
ESD events happen every day. Tiny shocks such as those that occur when touching a car door may seem insignificant, but in manufacturing environments, even the smallest shock can damage components, resulting in delayed shipments, higher manufacturing costs, and numerous other complications.

Some ESD workarounds exist for process control and inventory tracking, but with significant levels of risk. The most reliable solution is Microscan's MINI HAWK ESD Safe – the only ESD-safe fixed-mount bar code reader. The MINI HAWK ESD Safe is simply the safe choice for any bar code tracking process involving ESD risk.

Sources

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Additional Resources

ESD Association: www.esda.org

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