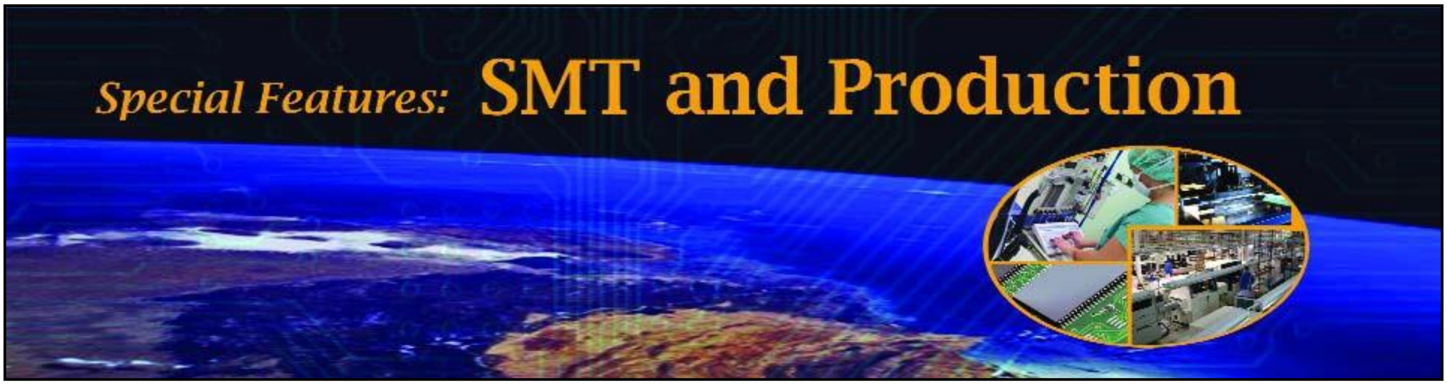
Reprinted with permission from the May, 2016 issue of ...



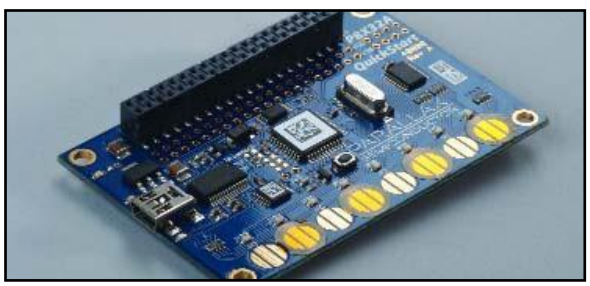
Taking Charge of ESD Caused by Tapes and Labels

By Dave Genest, Marketing Communications Manager, Polyonics, Inc.

Electrostatic discharge (ESD) is present in everyday life, and its effects range from mildly unpleasant to extremely dangerous. From taking static-charged clothes out of the dryer to touching a lamp after shuffling your feet across a rug in dry weather, to storm clouds creating lightning, ESD particularly affects the electronics industry where it has become a critical pain for design and manufacturing engineers.

In electronics manufacturing, ESD occurs when triboelectric charges are released in the form of electrical currents into an ESD-sensitive (ESDS) device. If the charges exceed the device's specified threshold, it can cause immediate or latent damage that adds to the overall production cost through repair, return or customer dissatisfaction. The PCB industry estimates product losses due to ESD can be up to 7 percent of manufacturing costs, and despite the implementation of an array of antistatic materials and devices (bracelets, booties, mats, ionizers, etc.) the ESD problem continues to grow.

Every aspect of PCB manufacturing is susceptible to ESD. Now, greater importance than ever is being given to the creation of rigorous ESD control plans used to qualify PCB manufacturers. In addition, the effects of induced charges generated from process-required insulators, which include labels and tapes, have become a new focus of these plans.



PCB with labels and tape dots, which can cause ESD when peeled off.

Triboelectric Tribulations

Tapes provide protection for components during the assembly process by covering or masking sensitive parts from flux, solder, cleaning agents, and conformal coatings. Barcode labels are used to provide an accurate means of tracking PCBs during their assembly. Most robust manufacturing processes collect data from the PCB during each assembly step and allow for lot tracking by using barcodes. Using print on demand labels at the site of manufacture offers a cost-effective and flexible way to track products.

Labels and tapes contribute significantly to the occurrence of ESD. When required in a manufacturing process that includes ESDS devices, they need careful consideration to guarantee a successful ESD control plan.

Before being applied to PCBs, both tapes and labels are removed from their release liners. This can be done manually or automatically with an auto-apply mechanism. By design, the pressure-sensitive adhesive (PSA) and liner have a weak bond, which allows for easy release when separated. The weak bond is achieved by using a coating on the liner that is chemically dissimilar to the adhesive.

However, the nature of the PSA and liner has the potential to cause a significant triboelectric charge when they are separated or pulled apart.

During the application process, the charged adhesive will then induce a charge in any conductive components in their vicinity, including circuitry. The magnitude of the charges generated when non-ESD labels or tapes are removed from their liners can be greater than 5kV.

The same charge generation applies when tapes or labels are removed after processing. Typically, barcode labels are applied for the life of the PCB, however, in cases where the board is made by one contract manufacturer and then shipped to another for final assembly, the label may be removed. Masking tapes are primarily used to cover or protect areas on PCBs during assembly and removed at the end of the process. In both cases, the removal can generate additional triboelectric charge.

After tapes and labels are applied to the PCB, they can then become a source for charge accumulation that can lead to electrostatic discharge. Since the top surfaces of both materials are either polyimide or have organic coatings, they are inherently insulate. As a result, when PCBs are handled — and the tape or label surfaces are contacted by a conveyor, human or robot — there is a risk that charges can build up on their surfaces. These charges have the potential of inducing charges on neighboring devices, or discharging, both of which can result in ESD damage.

The best way to prevent this charge buildup is to make sure the label and tape faces allow charges to move over their surfaces and to a ground. The charge movement should not be fast, but rather gradual so a large electric current is not introduced to the PCB.

In addition, after the tape and label are removed from their liners, the liner itself has a static charge both from the separation process as well as from handling — an often under-considered factor in an ESD control plan. If not managed, the charge could be introduced into the production environment and become a source of induction charging.

Charge Behavior

The primary measurement for charge movement or dissipation is the ANSI/ESD STM11.11 test method which details the measure of surface resistance. In the test method, surfaces are characterized by the speed at which charges move across them as follows: conductive (rapid), dissipative (slow), and insulate (minimal/none).

Each type of surface produces a different behavior when a triboelectric charge is introduced to it. If a charge is placed on an insulate surface, it will create an immediate high charge density at the point of contact that will have minimal decay over time and be prone to a damaging ESD event in the future. If the same charge is placed on a conductive surface, it will not produce as high a charge density because of its rapid dissipation across the surface through electrical conduction. This rapid movement of charge has the potential to cause damage to static-sensitive devices if the current it generates exceeds the design limits.

On a dissipative surface, the charge density will be initially lower than on the insulate surface and will immediately dissipate slowly across it. Dissipative surfaces help prevent both high charge densities and rapid discharges while safely neutralizing them.

Minimizing ESD Risk

The ESD Association develops the guidelines and test procedures that make up the ANSI/ESD S20.20 standard and its international equivalent IEC 61340. The standards are used to create ESD control plans by defining the requirements for ESD-protected areas (EPA). PCB manufacturers must have an S20.20 ESD control plan in place to qualify to create today's sophisticated electronic products.

SURFACE TYPE	CHARGE MOVEMENT	SURFACE RESISTANCE (OHM)
Conductive	Rapid	$<10^4$
Dissipative	Gradual	$>10^4$ to $<10^{11}$
Insulative	Minimal/None	$>10^{11}$

Three types of surfaces and their resistances in ohms.

Within the S20.20 standard is ANSI/ESD S541, which governs ESD levels in PCB packaging. This includes process-required insulators such as labels and tapes when used in proximity of ESDS devices. The S541 standard requires that labels and tapes must have a surface resistance of $>10^4$ and $<10^{11}\wedge$, as measured per ANSI/ESD STM11.11, to be considered static dissipative. Also, the materials must have accumulated voltages of <125V when used within 1in, and <2000V within 12in of ESDS devices.

A robust ESD control plan is an absolute requirement to mitigate the risks of ESD failures. A key element of the successful ESD control plan is managing the effects of charged insulators inside the production environment. Selecting low-charging and static-dissipative tapes, labels and liners that conform fully to ANSI/ESD S20.20 or IEC 61340 requirements, can effectively eliminate a major source of ESD.

Polyonics has developed a family of ESD-Safe™ polyimide and polyester (PET) label and tape materials that comply fully with both standards. The materials have durable, static-dissipative top surfaces, combined with low-charging PSAs and liners that generate less than 125V with liner removal.

Contact: Polyonics, Inc., 867 Route 12, Westmoreland, NH 03467 603-352-1415 fax: 603-352-1936
E-mail: info@polyonics.com Web: www.polyonics.com