Hot Topics in ESD

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Q: How is my automated handling equipment treated under an S20.20 compliant ESD program?

A: Automated handling equipment (AHE) plays a key role in today's manufacturing environment. Modern factories could not exist without handlers. In many cases, no human ever touches an IC from its birth on a silicon wafer, throughout its assembly and testing, or during its life on a PC board in a computer somewhere. Automated handlers perform all sorts of transfer, test and assembly operations for the entire process.

It is imperative that we exercise effective control over the ESD environment associated with the AHE. With today's high-speed equipment, failure to control static charges can result in product damage that affects thousands of parts in a very short time before being detected. Repairing or replacing products damaged by ESD can incur considerable cost. Discharges can occur when devices contact charged isolated metallic pieces of the AHE. Charged Device Model (CDM) type discharges may also occur from uncontrolled electric fields or tribocharging of the device and subsequent contact with ground. Human Body Model (HBM) discharges are typically not a concern in AHE since humans are not touching the sensitive devices.

There are two basic ideas that define electrostatic control. First, minimize the amount of charge built up on sensitive devices. Second, safely dissipate the charges where electrostatic charge generation cannot be avoided. These ideas translate into key ESD control principles for AHE:

- Eliminate isolated conductors. All conductive or dissipative materials should be grounded.
- When devices contact grounded parts of the AHE, the material at the contact point should be static dissipative.
- All necessary non-conductors should be evaluated for their charging propensity and the effects of that charge must be controlled or mitigated below the damage threshold of the product being handled. This is typically done by isolating or shielding the product from the charged insulator or neutralizing the charge with ionizers.

These principles are consistent with *ANSI/ESD S20.20-2014* [1]. Previously, S20.20 was primarily directed toward HBM threats, but the latest version provides for safe handling of 200-volt CDM-sensitive devices. S20.20 mandates a comprehensive ESD control plan designed to accommodate the most sensitive device and a periodic verification process to demonstrate that the ESD control plan is effective. Technical requirements specifically include:

- Equipment ground with a recommendation of < 1-ohm impedance.
- Automated handling equipment would be treated as a necessary process item and it should be addressed within the ESD Control Plan, including procedures for verifying its compliance.
- Voltage on any isolated conductor should be less than +/- 35 Volts.
- Electric field on process essential insulators (including the product itself) must remain below defined levels. If the insulator is within 1 inch (25.4 mm) it must measure less than 125 Volts/inch. If the insulator is within 12 inches (305 mm) it must measure less than 2000 Volts/inch. If either of these levels is exceeded, S20.20 mandates neutralizing the charge with air ionization.
- When used, air ionizer offset voltage (balance) should be less than +/- 35 Volts.

Fortunately, there is available guidance on how to achieve these requirements. ESD Association *Standard Practice ESD SP10.1-2016: Automated Handling Equipment* [2] provides procedures to verify the integrity of the ground path to equipment parts, as well as to determine if the product is being charged during its passage through the equipment. Appendix A of that document gives some practical guidelines for grounding handlers. In addition, even though S20.20 is specifically designed for devices with >100 V sensitivities, a Technical Report [3] is available to inform users of additional concerns when <100 V sensitivities are encountered. Some examples of those concerns include EMI, avoidance of metal-to-metal contact and ionizer balance to tight tolerances.

All conductive or static dissipative components of automated handling equipment should provide a continuous conductive path to ground, whether the handler is stationary or in motion. Parts that are grounded when stationary can lose their ground connection when in motion. The equipment should minimize charge generation on the ESD sensitive items that are being handled. Where insulative materials are necessary in the device path, they should be designed to minimize electric fields and the charge imparted to devices being handled. Isolate the charged insulators from ESD-sensitive items by an appropriate distance, or shield the ESD-sensitive parts from the electric fields of the charged insulators. When these methods cannot be used, ionizers are used to

eliminate the charge on the insulators, as well as on the ESD-sensitive device packages (which are insulators).

Making or keeping AHE safe for handling ESD sensitive devices is an important part of any comprehensive ESD control program.

References

1) *ANSI/ESD S20.20-2014*: *ESD Association Standard for the Development of an Electrostatic Discharge Control Program for – Protection of Electrical and Electronic Parts, Assemblies and Equipment* (Excluding Electrically Initiated Explosive Devices)
2) *ESD SP10.1-2016: Automated Handling Equipment* (AHE), ESD Association, Rome, NY
3) *ESD TR 10.0-01-02: Measurement and ESD Control Issues for Automated Equipment Handling of ESD Sensitive Devices below 100 Volts*, ESD Association, Rome, NY

About the Authors

This article was prepared by Arnold Steinman on behalf of the ESDA's Standards Workgroup on Automated Handlers, now a part of the Standards Workgroup on Process Assessment.

About the ESD Association – CHANGE THIS??

Founded in 1982, the ESD Association is a not for profit, professional organization dedicated to furthering the technology and understanding of electrostatic discharge. The Association sponsors educational programs, develops ESD standards, holds an annual technical symposium, and fosters the exchange of technical information among its members and others. Additional information may be obtained by contacting the ESD Association, 7900 Turin Rd., Bldg. 3, Rome, NY 13440-2069 USA. Phone: 315-339-6937. Fax: 315-339-6793. Email: info@esda.org. Website: http://www.esda.org.