ESD Open Forum

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Demonstrating CDM Discharge Using Common Hand Tools

Q: I know how to demonstrate good old fashioned static discharge, the Human Body Model type, but how can I demonstrate Charge Device Model (CDM) or Machine Model (MM) discharge?

A: In last month's Article "Compliance Verification for Common Hand Tools" we outlined methods for classifying non-electric hand tools in two dimensions, handle static charging characteristics, and handle resistance. In this second part we will present a practical demonstration on the CDM charge generation process using a common screwdriver and a plastic page protector. These methods are not intended for the initial qualification and selection of hand tools.

As was mentioned last month, Hand tools can be a significant source of damage to ESD sensitive hardware. The continuing demand for increased speed and capability in a smaller package has necessitated a decrease in the width, and distance between the current carrying paths built into Integrated Circuits. This makes it more likely for smaller charges to jump the gaps and or just damage the path. Indications are that this trend in design will continue well into the next decade. As a result, more and more new IC designs will be classified as HBM Class I and will be more sensitive to electrostatic discharge and overstress during handling. Therefore, everyone involved in handling ESD sensitive products and components will need to make sure that their ESD control programs keep pace with the increasing sensitivities. There always has been a damage threat from hand tools, but it will become more critical with year passing year in light of these industry changes.

Caution must be taken anytime work is performed on energized product. A wrist strap should not be worn while working with any device operated at more than 50 volts.

The damage threat from hand tools is CDM charging of the hand tool accompanied by MM discharge to the component or device. Volt for volt MM discharge is an order magnitude more powerful than HBM discharge because the resistance of human body has been removed from the equation. CDM charging can produce two separate discharge events. Here is how it works. If you ground a conductor (the conductive metal blade of a screwdriver for example) while it is in the presence of any item carrying an electrostatic field (a charged piece of plastic, or clothing) the conductor will acquire an electrostatic charge that may be sufficient to cause damage when discharged. If the handle of a hand tool is sufficiently insulative, and if it acquires a charge, it will remain on the conductive portion of the tool until it is brought in contact with a ground path, even if the user is

wearing a wrist strap. That ground path might be an ESD sensitive component. In this case damage may occur both from initial contact with the charged hand tool and again when the charged component is grounded.

The following is a method for demonstrating how the CDM charging process works. It is not intended that any correlations or proofs be concluded from the data.

Equipment Required

1. 2 Screwdrivers, one with a known insulative handle, one with a dissipative/conductive handle
2. Common Plastic page protector
3. Handheld static field meter with charge plate attachment
4. Wrist strap (test first to confirm proper function)
5. Ground source (Static Safe Work Station or other)

Steps to generate and display CDM charge acquired by the screwdriver (see photos below)

1. Turn on the hand held field meter and zero the reading. Be sure to ground the case of the field meter.
2. Rub the page protector against any dissimilar material
3. Using the field meter measure the resulting field strength (the higher the better). (See Fig. 5)
4. Attach the charge plate to the field meter so that the charge plate is at the top. (See Fig. 6)
5. Put on the wrist strap and plug it in. (be sure to confirm that the wrist strap is functioning properly first)
6. Hold the screwdriver by the handle only and touch it to ground, and then to the charge plate to confirm that there is no charge on the screwdriver blade prior to the test. (See Fig. 6)
7. With the other hand, pick up and hold the charged page protector. Bring the screwdriver to within about an inch of the page protector and momentarily touch the blade of the screwdriver using your index finger. (See Fig. 7)
8. Immediately touch the blade of the screwdriver to the charge plate of the field meter. The reading on the field meter is an indication of the CDM charge acquired by the screw driver blade from the static field of the page protector. (See Fig. 8)
9. Repeat the above steps with a dissipative/conductive handled screwdriver and observed that little or no charge is deposited on the charge plate. (it was there for a moment but dissipated to ground through the handle, your hand, and the wrist strap as it should before it could be measured)

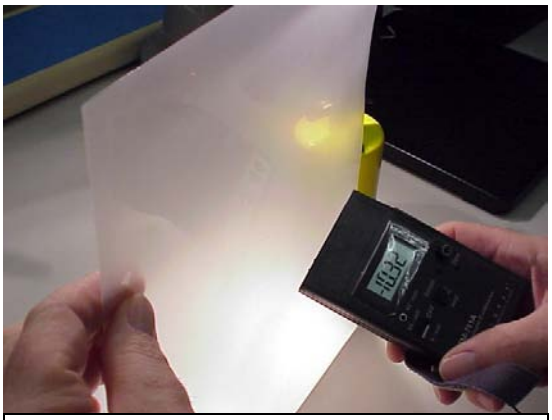

Fig. 5 Charged page protector reading negative 10,320 volts

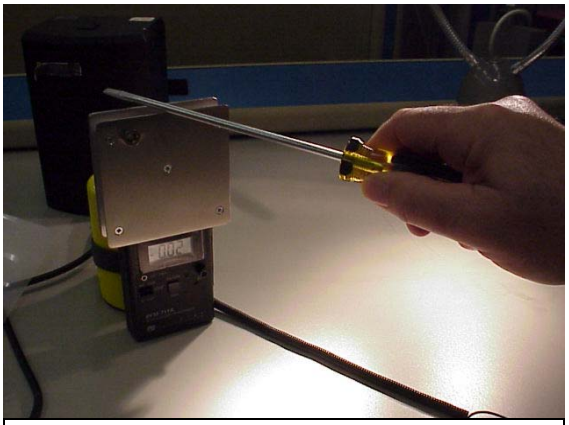

Fig. 6 Insulative handled screwdriver with a 20 volt charge (meter wasn't accurately brought to a zero reading

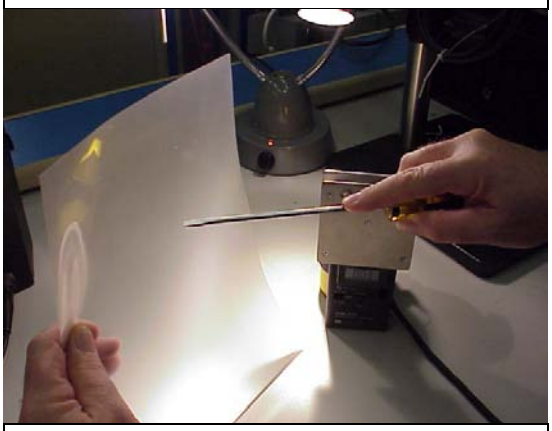

Fig. 7 Screwdriver blade momentarily grounded by the operator's index finger with the blade tip about an inch away from the page protector (the operator is wearing a wrist strap)

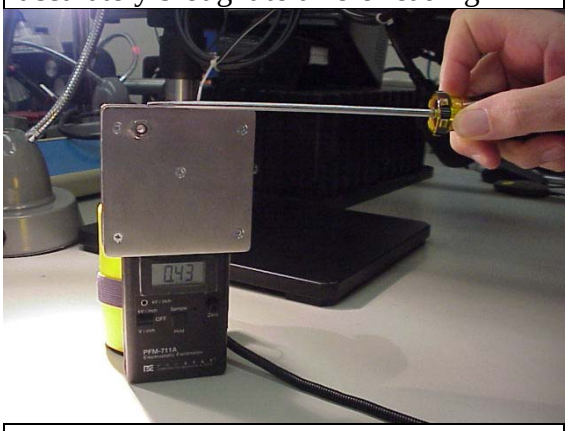

Fig. 8 Screwdriver blade with CDM charge immediately brought in contact with the charge plate and the resulting 430 volts of CDM discharge - That is significant!

The above steps are not complex and require only basic ESD control and monitoring equipment. They may be used to identify and separate existing inventories of hand tools for proper use according to their inherent properties. The decision to remediate or replace hand tools is left to the reader based on time, and resources. As mentioned above these tests are not intended for the initial qualification and selection of hand tools. The ESD Association is in early stages of drafting a Standard Test Method for the qualification of hand tools.

About the Author

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About the ESD Association

Founded in 1982, the ESD Association is a not for profit, professional organization directed by volunteers 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.
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