ESD Open Forum
Conformity Magazine
Provided by the ESD Association
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Cable Discharge Events – CDE

Q: What is meant by a "Cable Discharge Event"?

A: A Cable Discharge Event, or CDE, occurs when a charged cable is discharged either into a piece of electronic equipment – often, but not limited to computer modems and telecom input ports on products. Manufacturers of telecom equipment have know about this phenomena for some time, but modems and other ports (Ethernet, USB, etc..) are now common in a large variety of consumer products. Some of these manufacturers are just learning.

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Q: What does the discharge look like?

A: The discharge is composed of a very fast initial transient -- much like a system level ESD event -- followed by a slower ringing wave which can contain significant energy The frequency of the ringing wave is determined by the length of the charged cable.

Q: How does the cable get charged up in the first place?

A: Charging typically takes place via triboelectric effects – rubbing two materials together.

For example, when an Ethernet cable is installed in an existing facility, it's likely to be pulled from one point to another – up a wall, across a ceiling, etc. As it is being pulled the outer layers of the insulation rub against wood, metal, tile or whatever material is in the way and charging occurs. The charge is then transferred to the metal conductors of the cable capacitively. If the line is long, the charge can get quite high resulting in voltages of several thousand volts with respect to other objects nearby.

Q: If the cable is already installed and isn't being moved, how does it get charged up again?

A: Good question – It may or may not be re-charged, but you can still have an ESD event involving the cable. Remember your ESD basics: An electrostatic discharge is simply an equalization of charge between two objects. As long as the cable is at a different potential than the victim equipment being connected to it, there will be an equalization of charge.

Keep in mind, the cable could be charged either positive or negative with respect to the victim equipment, so current could flow either into or out of the cable. If it's the "victim" equipment that gets charged, it to could be either positive or negative with respect to the cable, so again, the current could flow either in or out of the cable.

To take it one step further, it's possible the cable becomes charged again by the discharge from some ungrounded, charged equipment (a laptop perhaps?). The next laptop that gets connected may NOT be charged, and the result will likely be a cable discharge event.

Q: Is this effect only for long cables? What about USB or other short cables?

The effect is not limited to long cables; however, longer cables can hold more charge. Cable capacitance is dependant on a number of factors but for all cables, longer ones have more capacitance than shorter ones.

Even relatively short cables can be destructive, although it's widely assumed ESD at the system level is generally a disruptive event. I managed to permanently disable the audio input of my lap top's docking station by picking up a audio cable that was about 6 feet long and plugging it directly into the audio input jack. I saw the spark when I did this, so I knew right away the cable had become charged before I plugged it into the docking station.

Q: How do I test products for a CDE event to make sure I don't have field failures?

A: People are using various methods for testing products: some simply use a hand held ESD gun to simulate the initial discharge; others use coaxial cables that are charged to some voltage and then discharged into the Equipment Under Test (EUT). ESDA Working Group 14 is currently working on a standard practice to provide manufacturers with a guideline for performing CDE testing. Although still in a draft stage, it will likely recommend test methods and simulators for unshielded cables, a typical twisted pair, or shielded cables that include testing with handheld simulators as well as charged cables.

About the Author

Michael Hopkins has held a number of positions with Thermo Fisher Scientific's Lowell, Massachusetts facility, the manufacturer of former KeyTek product lines. He has been involved with specifications of ESD simulators since the mid-1980's and is chairman of the ESD Association Standards Working Group 14.0 and a U.S. delegate to the IEC Maintenance Team for the revision and maintenance of several documents, including IEC 61000-4-2. Michael is a member of several IEEE, ESDA and SAE committees for several pulsed immunity standards.