# ESD Open Forum

Provided by the ESD Association

By: Robert Ashton

Q: My company makes integrated circuits which connect directly to system level I/O ports such as USB and Ethernet. Our customers often ask us for IEC 61000-4-2 ESD ratings for our products. I have read IEC 61000-4-2 and it does not tell me how to test components, only how to test completed systems such as computers and mobile phones. I have heard that the Electrostatic Discharge Association (ESDA) is working on this problem but I have also heard that ESDA is working on HMM. Is HMM related to IEC 61000-4-2 and will it help me meet my customer's requests for IEC 61000-4-2 ESD data on components?

A: Yes, HMM is related to IEC 61000-4-2 and the ESDA is committed to helping you provide the ESD data that your customer wants by defining a measurement procedure that will produce meaningful results. HMM stands for Human Metal Model, and it describes the IEC 61000-4-2 waveform. For the remainder of my answer I will refer to the IEC 61000-4-2 waveform as the HMM waveform. The HMM waveform consists of an initial current spike with a 0.8 ± 0.2 ns rise time followed by a broader current pulse with a fall time of about 50 ns. It is intended to represent the ESD current of a person holding a metal object such as a screw driver or key touching a grounded electrical system. The initial spike is the discharge from the low resistance metal object, while the broad current pulse is discharge of the more resistive person.

In your question you state that IEC 61000-4-2 does not give guidance on how to test components with the HMM waveform and that is a correct observation. ESDA Working Group 5.6 for HMM is developing a test method for applying the HMM waveform to components in a well-defined and reproducible manor. The HMM test is intended to provide a metric for comparing different components for their ability to survive within an electronic system during an IEC 61000-4-2 system level ESD test. The test environment for an electronic component, such as an integrated circuit, during an HMM stress should therefore reflect the electrical environment that the component will experience in the final system. The HMM test document therefore has the following features. (A number of the features of HMM testing are similar to the IEC 62228 EMC standard for CAN bus transceivers. The HMM test method is intended for a much broader range of products, however.)

- The component will be mounted on a circuit board in a manner that approximates use conditions. This includes the use of power supply bias capacitors if these capacitors are recommended in the component's data sheet. The test fixture board must have a pulse insertion point close to the IC to avoid distortion of the pulse by a long trace.
- The component will be stressed in both powered and unpowered states since ESD stress to a system can occur for both powered and unpowered systems. There is no requirement that the component be functioning during the HMM test since this would greatly complicate the test.

- Only pins that are connected to system I/Os are to be tested.
- Pins are to be stressed 10 times positive and 10 times negative with respect to ground for each stress level, similar to the IEC 61000-4-2 stress.
- Failure is defined as failure to pass the component's datasheet parameters after the stress.
- Soft failures are not considered since soft failures can be dominated by the system implementation rather than the properties of the component.

An IEC 61000-4-2 compliant ESD gun can be used as the pulse source for HMM. The waveform specifications for ESD guns in IEC 61000-4-2 are, however, fairly loose. ESD guns also emit a large amount of EM radiation which varies considerably between manufacturers. WG 5.6 is therefore concerned that the use of ESD guns could cause wide variations in the test results. The HMM standard practice gives an option of using a 50 ohm pulse source if its current waveform matches the IEC 61000-4-2 waveform specifications. A 50 ohm pulse source can be designed with much tighter specifications than an ESD gun and will not emit large amounts of EM radiation. A 50 ohm pulse source can also be coupled to the device under test more cleanly than an ESD gun's output can be coupled to the device under test.

At this time the HMM document is a Draft Standard Practice and is being reviewed by industry experts. The ESDA defines a Standard Practice as a measurement technique which represents the best understanding of how to perform a measurement as proposed by industry experts. A Standard Practice has not, however, been PROVEN to be a reproducible and repeatable measurement method. ESDA WG 5.6 is now starting to perform round robin experiments to evaluate the HMM Standard Practice to determine if the measurement technique produces reproducible and repeatable measurements. In a round robin experiment several laboratories perform measurements according to a Standard Practice on identical samples to evaluate the repeatability and reproducibility of the measurement technique. If the round robin experiments show that the Standard Practice produces repeatable and reproducible measurements the Standard Practice can be elevated to a Standard Test Method. A Standard Test Method is a measurement technique which has been demonstrated to provide repeatable and reproducible measurements. A key element of the round robin will be comparing ESD guns from different manufacturers and 50 ohm pulse sources.

Note, even when the HMM test procedure achieves Standard Test Method status it will not guarantee that systems manufactured with 8 kV HMM integrated circuits will produce a system that will pass 8 kV IEC 61000-4-2. The goal of the HMM test method is that test results from different manufacturers can be compared with confidence.

**About the Author:**

This article was written on behalf of the ESD Association by Robert Ashton.
Robert joined ON Semiconductor in 2007 in the Discrete Products Division as a Sr. Protection and Compliance Specialist after 3 years as Director of Technology at White Mountain Labs, a provider of ESD and latch-up testing of integrated circuits. Before that

he was a Distinguished Member of Technical Staff at Agere Systems, Bell Labs Lucent Technologies, and AT&T Bell Labs, in integrated circuit technology development. He has published numerous articles on ESD testing of integrated circuits, test structure use in integrated circuits and CMOS technology development. He has also presented tutorials on ESD, latch-up, and Transmission Line Pulse testing at IEEE and ESD Association conferences. Robert is an active member of ESDA Working Group 5 for Device Standards, ESDA Working Group 14 for System Level Test as well as the JEDEC Committee 14.1 ESD and Latch-Up Working Groups.

**About the ESD Association**

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.