A Primer on TVS Device ESD Modeling and Testing

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Human generated Electrostatic Discharge (ESD) is the primary cause of component and equipment failure, with an average loss of 27-33%. Without an effective protection strategy, the price of failure can be costly to manufacturers.

ESD is defined by three primary models:
- Human Body Model (HBM)
- Machine Model (MM)
- Charged Device Model (CDM)

Of the three models, the Human Body Model is the most widely accepted method for evaluating ESD performance by component and equipment manufacturers. There are two types of ESD standards for the Human Body Model. The first originated from the need to define ESD withstand levels for IC component susceptibility during the manufacturing, packaging and handling process. IEC 61000-4-2 was later developed to define potential levels of exposure to components and equipment by users through contact or air discharge. Typically, static charge buildup from a human body ranges from 2kV to 40kV depending upon humidity levels in the air and contact materials.

Both types of standards use test circuitry similar to that depicted in Figure 1. The main storage capacitor Cs is charged from the high voltage power supply via Rch and discharged to the DUT via Rd and the discharge switch. The switch is typically a relay under the control of the operator. Compliance testing uses a single discharge. However, for exploratory testing the capability of a fast discharge rate of 20 per second is suggested.

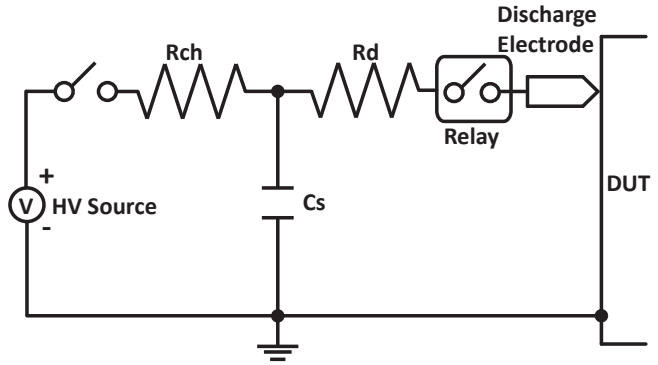

Figure 1. Typical Test Circuitry

The critical aspect of the ESD generator (IEC model) is that it must provide a well-defined discharge waveform with a rise time between 0.7 and 1 nanosecond and a current over tens of amperes. The distributed capacitance and inductance of the electrode and associated components forms part of the discharge circuit and essentially determines the initial rise time.

In the real world, the generated ESD pulse could exhibit a higher transient voltage of several tens of kilovolts, with over tens of amperes transient current. Latent or catastrophic damage may occur when the interface I/O components are exposed to the ESD transient without an effective protection strategy.

By sitting in parallel with the circuit to be protected, a transient voltage suppressor (TVS) provides a very low impedance path for the ESD transient current and clamps the voltage down to a tolerable level. For example, the typical response of a 5 Volt TVS device to 25kV of air discharge (per the IEC model) is shown in Figure 2.

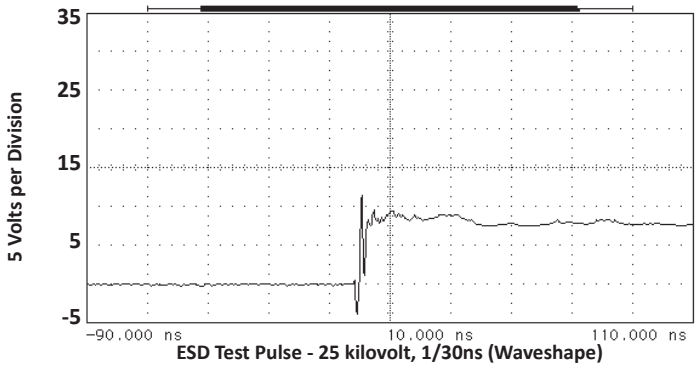

Figure 2. Overshoot & Clamping Voltage Model

The protection device acts instantly (approximately 1/30 ns), effectively diverting the transient current to ground and clamping the input voltage to a safe level, which prevent damage to the IC.

COMPANY INFORMATION

COMPANY PROFILE

ProTek Devices, based in Tempe, Arizona USA, is a manufacturer of Transient Voltage Suppression (TVS) products designed specifically for the protection of electronic systems from the effects of lightning, Electrostatic Discharge (ESD), Nuclear Electromagnetic Pulse (NEMP), inductive switching and EMI/RFI. With over 25 years of engineering and manufacturing experience, ProTek designs TVS devices that provide application specific protection solutions for all electronic equipment/systems.

ProTek Devices Analog Products Division, also manufactures analog interface, control, RF and power management products.

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