Sources of Transients : Electrostatic Discharge

Few pieces of electronic equipment today are void of semiconductors. With the focus on lowering the operating levels, the problem of malfunction caused by the environment is critical. Electrostatic discharge (ESD) is a major cause of failure in electronic systems. The products which are most prone are those with external connections to data and I/O lines.

ESD Generation

Electrostatic discharge is the result of a sudden and violent redistribution of electrons between two objects. The excess charge on an object usually results from the contact and separation of two non-conductive materials causing the transfer of electrons from one material to the other, thereby building up a triboelectric charge on the surface (Figure 1). If the discharge path includes semiconductor based equipment, catastrophic or latent damage may occur. The amplitude of the static discharge can exceed 30kV, with currents reaching 30A or more. The rate of the discharge is extremely fast, lasting less than 1ns. The human body is one of the most common generators of ESD. It stores charge capacitively with respect to ground The voltage potential with respect to earth ground can exceed several thousand volts. It is very common in fact for a person to develop voltages as high as 15kV. Higher voltages such as 35kV are possible but rarer.

ESD Threat to Equipment

The ESD pulse contains little energy, but the extremely fast rise time and high power can cause semiconductor devices to fail. Catastrophic destruction of semiconductor devices may occur as a result of the high static potential of ESD or from the discharge current in an ESD event.

One common misconception is that ESD is only a threat during equipment assembly. In reality, ESD is a threat to semiconductors throughout the life of the system. Operator control panels, indicators, and user accessible I/O pins are especially vulnerable to ESD. In a portable computer, for example, when attaching a mouse, printer, or modem, the user can inject a potentially hazardous ESD pulse of 2,000 volts and not even realize it. Component failure may be catastrophic or latent. The latter can be the worse since there is no known way to test for it. The product may simply be perceived as being of poor quality.

ESD Standards : IEC 61000-4-2

Industry standards are now in place which define the ESD immunity requirements of electronic equipment. The most widely accepted standard, set forth by the European Community, is IEC 61000-4-2. IEC 61000-4-2 defines requirements for human generated ESD transients. Test voltages range from 2kV to 15kV with peak currents as high as 30A. The ESD waveform as defined by IEC 61000-4-2 is extremely fast with a maximum rise time of 1ns and a total duration of only 60ns (Figure 2). The total energy contained within the pulse is a few hundred microjoules.

Several countries including the U.S. and Japan are using IEC 61000-4-2 as the model for developing their own ESD immunity standard.

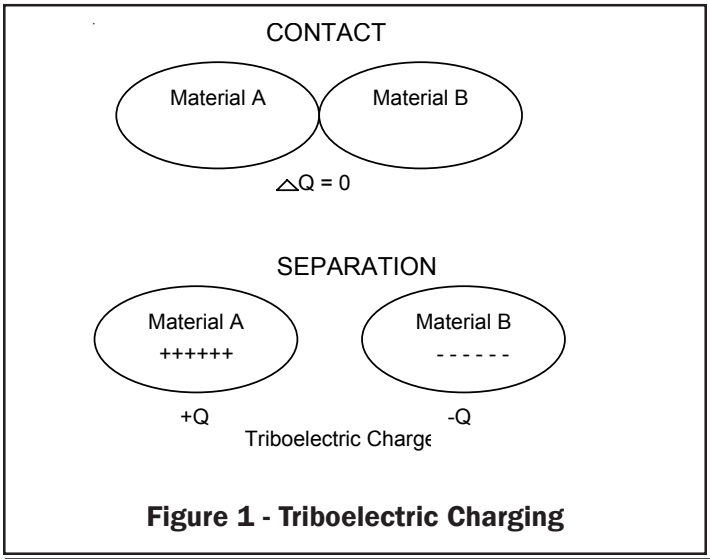

Figure 1 - Triboelectric Charging

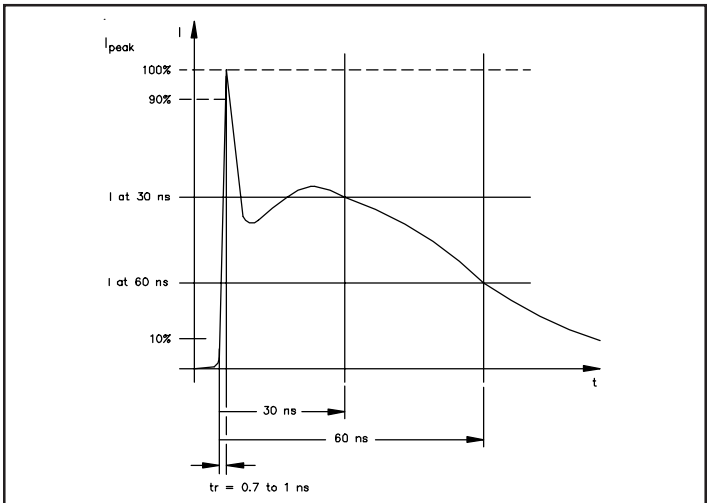

Figure 2 - ESD Waveform per IEC 61000-4-2