ESD Simulation

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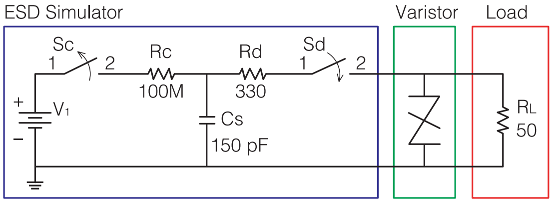
■ Simulation for Static Electricity Countermeasures

This will explain the method for efficiently removing static electricity using simulations. As with static electricity tests, the simulations used a simulation circuit consisting of a load circuit, static electricity generator, and countermeasure component as shown in Figure 1.

Figure 1



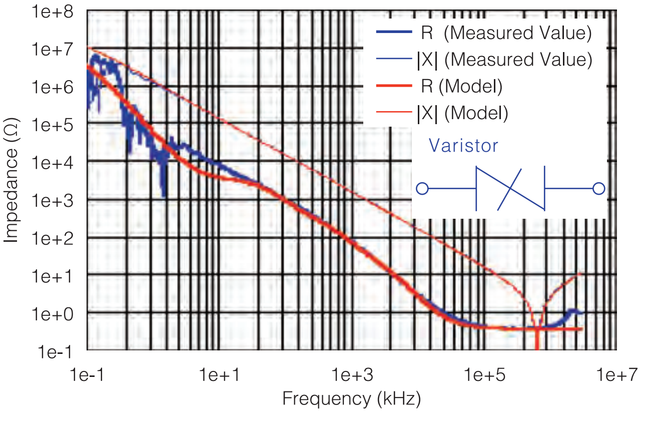
1 Simulation Model

● **Load Circuit :** The circuit for the test target device was used. Here, a resistance of 50 Ω (R_L) was set the same as the measured waveform.

● **Static Electricity Generator** : This consisted of a DC power supply (V_1), charge switch (Sc), charge resistor (Rc), energy storage capacitor (Cs), discharge resistor (Rd), and discharge switch (Sd). Here, a human body model was used, so Cs was set to 150 pF, and Rd was set to 330 Ω. The V_1 output voltage was set to 2 kV. The set IC of the Cs was set to the same voltage as the V_1 output voltage so that the calculation could begin with the Cs at full charge. The charge resistance was 100 MΩ (standard 50 to 100 MΩ). The switch was set to low resistance (1 mΩ) during contact, and was set to high resistance (10 GΩ) while open.

● **Countermeasure Components :** These are acquired from each vender. Static electricity tests include wide frequency components, so a wide range of accurate electrical component models are needed. Figure 2 shows examples of the characteristics for the electrical component models. TDK provides very accurate electrical component models such as for chip varistors.

Figure 2

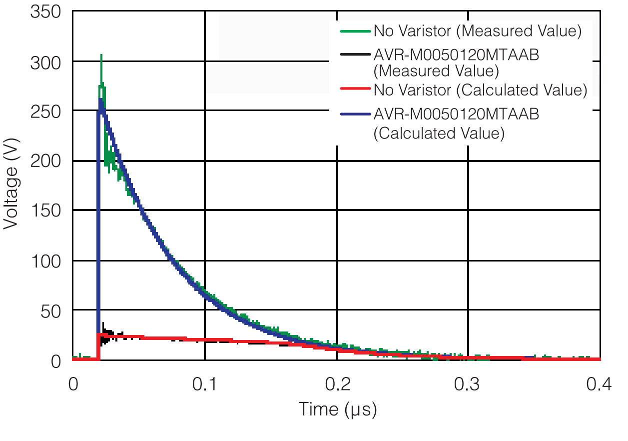


2 Simulation Results from the Static Electricity Tests

Figure 3 shows the results of the simulations.

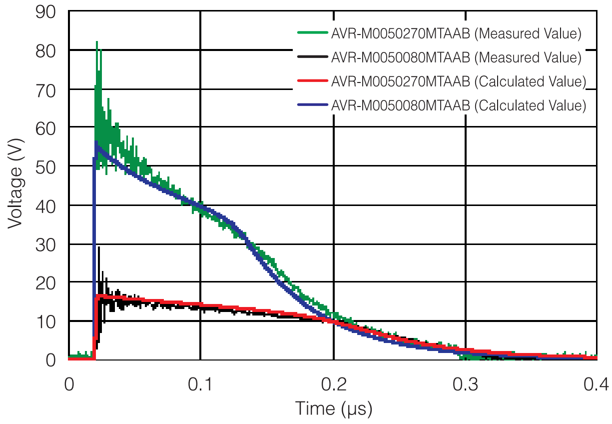
When no countermeasure component was used (blue line), the peak voltage was about 260 V, and when a chip varistor (AVR–M1005C120MTAAB) was used (red line), the peak voltage was reduced to about 25 V. Actual measurement results were almost the same.

Figure 3



Next, Figure 4 shows the simulation results when two varistors with different varistor voltages were used. When AVR–M1005C270MTABB was used, the peak voltage was about 60 V, and when AVRM1005C080MTAAB was used, the peak voltage was about 15 V. It was verified that the requirements were met by using AVR–M1005C080MTAAB when the allowable voltage was 30 V or less.

Figure 4



3 Conclusion

Usually, there are many samples available for tests, and there are other factors such as waveform quality, so there are many tests that need to be executed. When the countermeasure components are not sufficient, the target device may be damaged during testing. Actual measurements are required for final verification, but simulations make it possible to eliminate unnecessary tests. As a result, static electricity countermeasures can be determined more efficiently.