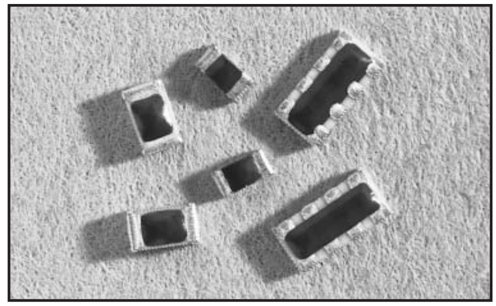
COOPER Electronic Technologies

Selection Guide
Polymer ESD Suppressors With SurgX® Technology

Features:



- The best ESD protection for high frequency, low voltage applications.
- Exceeds testing requirements outlined in IEC 61000-4-2
- Extremely low capacitance
- Very low leakage current
- Fast response time
- Bi-directional
- Surface mount
- Solder Termination

What is it:

The Voltage Variable Material (VVM) based on SurgX® polymer technology has unique property that it is highly preferred in ESD suppression application. The polymer matrix responds to an over-voltage condition by rapidly changing from a high impedance state to a low impedance state. Cooper Electronic Technologies utilizes this polymeric matrix in the ESD suppression device family for fast response, ultra low capacitance, and very low current leakage. The device is activated by over-voltage threat and clamps to a low value to protect sensitive circuit components.

How it Works:

ESDA series are board level circuit protection devices designed exclusively for the fast, transient over-voltages associated with ESD. When a sufficient over-voltage occurs it exhibits a dramatic increase in the ability to conduct electrons. The nature of the material creates a bi-directional part, which means that only one device is required to provide complete ESD protection regardless of the surge polarity. In a typical application, the device is placed across a signal line leading to an integrated circuit and ground. The device exhibits minimal capacitance and is “invisible” to the circuit during the normal operation. Under normal operating voltages (typically 3 to 15V) the high impedance of the device insulates each signal line from ground. When an ESD event occurs, the SurgX® material switches to a conductive state within nanoseconds. The voltage across signal line collapses to the clamping level, and current is shunted through the device to the ground. When the over-voltage event ends, the circuit returns to its normal operating state as the device switches back to its $>10^{12}$Ohm, high resistance state and “invisibility.”

ESDA Series Selection Guide:

Part Number	Package Size	Lines	Operating Voltage (VDC)	Capacitance (pF @ 1KHz ~ 1.8GHz)	Current Leakage (nA @ 12VDC)	Clamp Voltage V	Specification
0603ESDA	0603	1	0 ~ 14	< 0.15	< 0.1	35	IEC61000-4-2, Level 4
0805ESDA	0805	1	0 ~ 12	< 0.25	< 0.1	35	IEC61000-4-2, Level 4
41206ESDA	1206	4	0 ~ 12	< 0.15	< 0.1	35	IEC61000-4-2, Level 4

Part Numbering

Note: Spacing in part number is shown for clarity only. Device part number contains no spaces (e.g. 0603ESDA-TR1)

0603 ESD A -TR1

- 0603 — Packaging Configuration
- ESD — SurgX® Device Designator
- A — Device Characteristics
  - A = Standard
- -TR1 — Packaging Options
  - -TR1 = Standard, 5,000 pcs in Tape-and-Reel
  - -SP1 = Samples, 10 pcs on tape, in bag

Device Marking

SurgX devices are marked on the tape and reel packages, not individually. Since the product is bi-directional and symmetrical, no orientation marking is required.

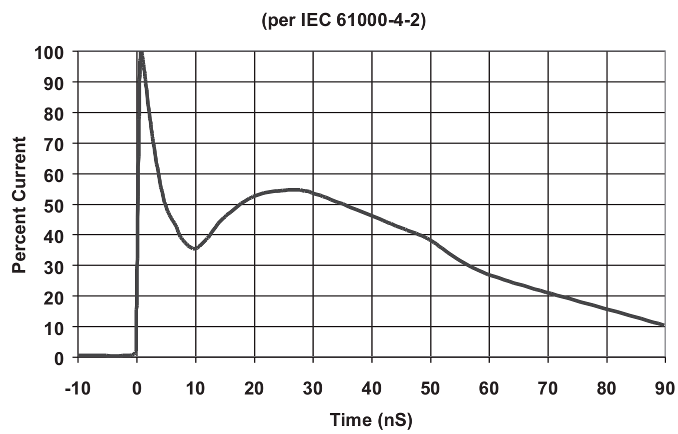
Test Methodology

Full product characterization requires testing in a variety of scenarios. Different test methods reveal unique information about the device response. Evaluating the results for all of the tests is crucial to fully understand the SurgX device response to an over-voltage event.

Electrostatic Discharge (ESD) Pulse

The ESD pulse is the defining test for an ESD protective device. The ESD pulse is an extremely fast rising transient event. The pulse, as characterized in IEC 61000-4-2, has a rise time of less than 1ns, peak currents up to 45A, and voltage levels to 15 kV. Characteristics determined by this test are those such as voltage overshoot, peak voltage, clamping voltage, peak current, and device resistance.

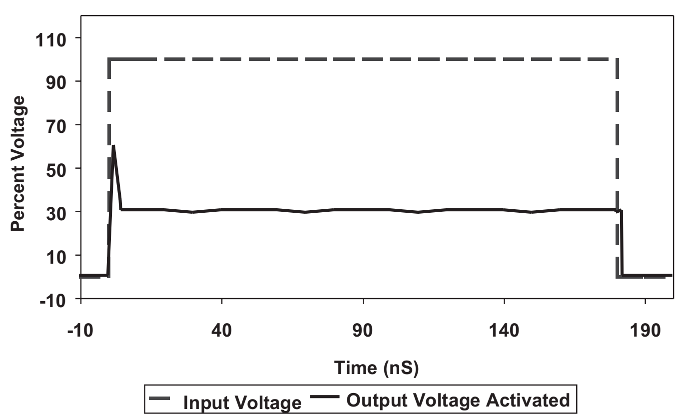
Due to the extremely fast rate of rise of the ESD pulse, the test setup can have a definite impact on the above factors. Variables such as wiring inductance and probe capacitance can produce inaccurate readings on an otherwise capable oscilloscope.



Transmission Line Pulse (TLP)

The Transmission Line Pulse tester implements a controlled impedance cable to deliver a square wave current pulse. The advantage of this technique is that the constant current of the square wave allows the behavior of the protection structure to be more accurately studied.

The actual implementation of this technique produces a waveform that has a slightly slower rise time that the ESD pulse but can be correlated to the deliver approximately the same surge current and energy. This controlled impedance pulse provides a more accurate depiction of the trigger voltage of the device because of the reduced voltage overshoot caused by a fast rising transient and the reactive components of the test fixture.



Definition of Terms

Clamp Voltage – The voltage at which the SurgX device stabilizes during the transition from high to low impedance. This is the voltage experienced by the circuit, after stabilizing, for the duration of the ESD transient.

Trigger Voltage – The voltage at which the SurgX device begins to function. When the ESD threat voltage reaches this level, the SurgX device begins the transition from high impedance to low impedance, shunting the ESD energy to ground.

Threat Voltage – The voltage that the test equipment is set to operate (i.e. the voltage across the discharge capacitor).

Peak Current – The maximum instantaneous current level that a device will receive. IEC-61000-4-2 states that the peak current should be 30A at 8kV ESD and 45A at 15kV ESD.

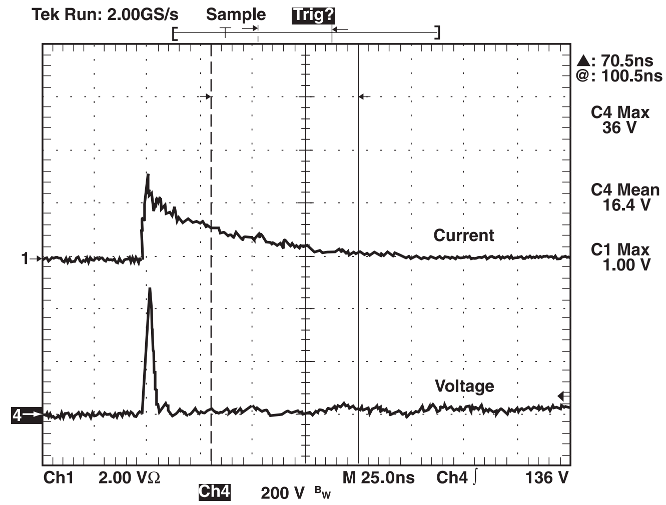
Selected Characterization Data

ESD Transient Pulse Energy Controlled by SurgX®

Figure 1 shows typical SurgX® device response to an 8 kV contact ESD pulse. Triggered polymer in SurgX® conducts excess energy to ground and prevents system damage by ESD transient threat. As the polymer resistance drops current flows to ground.

The top scope trace indicates current, and the bottom scope trace indicates voltage.

Figure 1. Typical Device Response to 8kV ESD



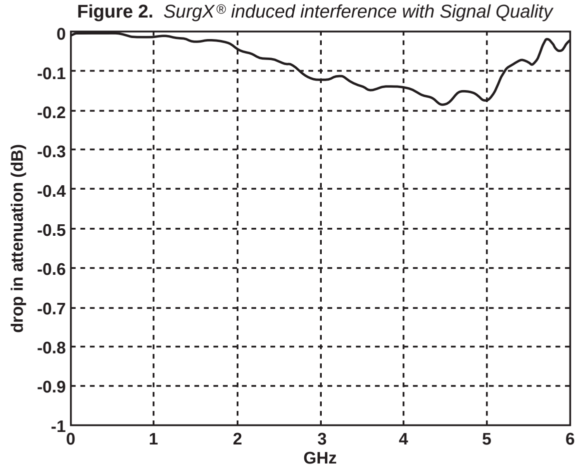
SurgX® Protects from the ESD Voltage Transient without Effecting Signal Quality

The SurgX® ESD over voltage protection devices have an ultra low capacitance of <0.25pF and when typically installed from the signal line to ground SurgX® has a negligible effect on the signal.

As *Figure 2* shows, the test conducted with a precision network analyzer on a 50 Ω circuit at up to 6GHz. Only a 0.2dB deviation from the original signal was recorded.

The setup was similar to the addition of the SurgX® device to a circuit with very fast digital signal or a cellular phone antenna.

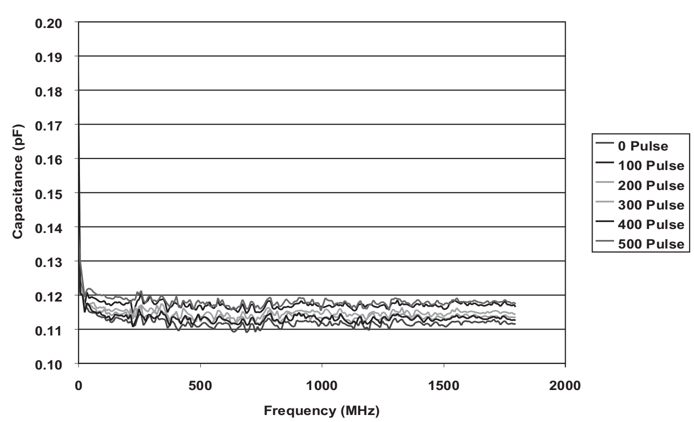
Figure 2. *SurgX® induced interference with Signal Quality*



Signal Frequency does not effect the Capacitance of the Device

The device capacitance is very low and constant over wide frequency range. The typical capacitance is less than 0.15pF over the tested range of 0.1MHz to 1.8GHz. In addition, as shown in *Figure 6*, the capacitance will remain same over the life cycle of the device (i.e. the number of the ESD pulse does not change the device capacitance.)

Figure 6. Capacitance vs. Frequency

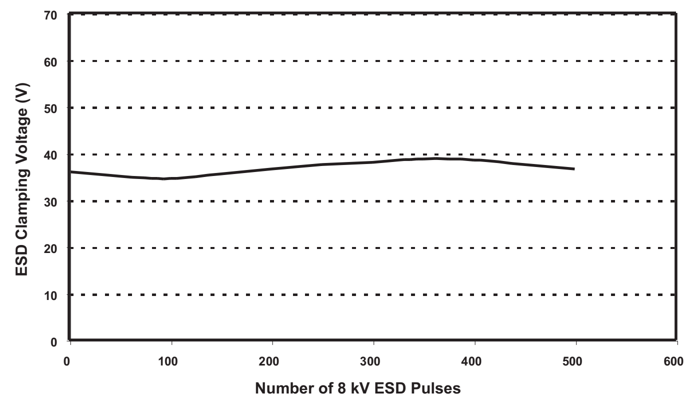


Clamp Voltage Remains Consistent through Many ESD Pulses

As *Figure 4* shows, the SurgX® device is highly reliable and stable through over hundreds of pulses.

The SurgX® device has been tested with fast rate ESD pulses at 8kV contact discharge. Clamping voltage measured at every pulse shows minimal changes throughout the test.

Figure 4. ESD Clamping Voltage vs. Number of 8 kV ESD Pulse



Typical non-triggered (Off State) Current Leakage of SurgX® is Very Low at Normal Operating Voltages and Temperatures

As shown by *Figure 3* the current leakage of SurgX® is typically very low, well under 1nA, even over 12VDC operating voltage. Some increase in the current leakage may be expected at much higher operating voltage and elevated temperature.

Figure 3. Average Off State Current Leakage vs. Temperature