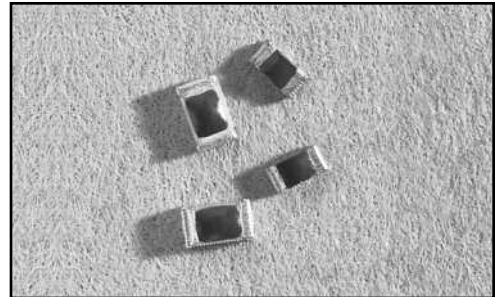


**Features:**

- Outstanding 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:**

Our Voltage Variable Material (VVM) has unique properties that are highly preferred in ESD suppression applications. The polymer matrix responds to an over-voltage condition by rapidly changing from a high impedance state to a low impedance state.

Cooper Bussmann utilizes this polymeric matrix in PolySurg ESD Suppressors 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:**

The PolySurg TR and MLP 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 voltage variable 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 overvoltage event ends, the circuit returns to its normal operating state as the device switches back to its  $>10^{12}\Omega$ , 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
0402ESDA-MLP7	0402	1	0 ~ 30	< 0.15	< 0.1	35	IEC61000-4-2, Level 4
0603ESDA-MLP7	0603	1	0 ~ 30	< 0.15	< 0.1	35	IEC61000-4-2, Level 4
0603ESDA-TR1	0603	1	0 ~ 24	< 0.15	< 0.1	35	IEC61000-4-2, Level 4

### Device Marking

PolySurg™ ESD Suppressors are marked on the tape and reel packages, not individually. Since the product is bi-directional and symmetrical, no orientation marking is required.

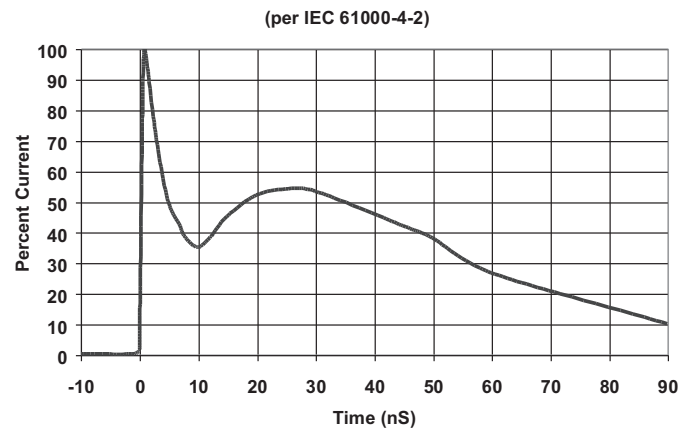
### Test Methodology

Full product characterization requires use of multiple test methods. Each test method reveals unique information about the device response. The results of all of the tests must be analyzed to fully understand the PolySurg™ ESD Suppressor 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.

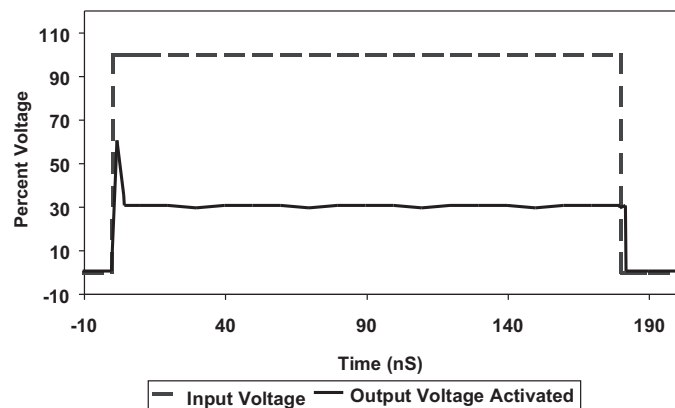
Due to the extremely fast rate of rise of the ESD pulse, the test setup can have a definite impact on the above factors. Variables such as wiring inductance and probe capacitance can produce inaccurate readings on an otherwise capable oscilloscope.



### 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 than 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 PolySurg™ 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 PolySurg™ device begins to function. When the ESD threat voltage reaches this level, the PolySurg™ 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.

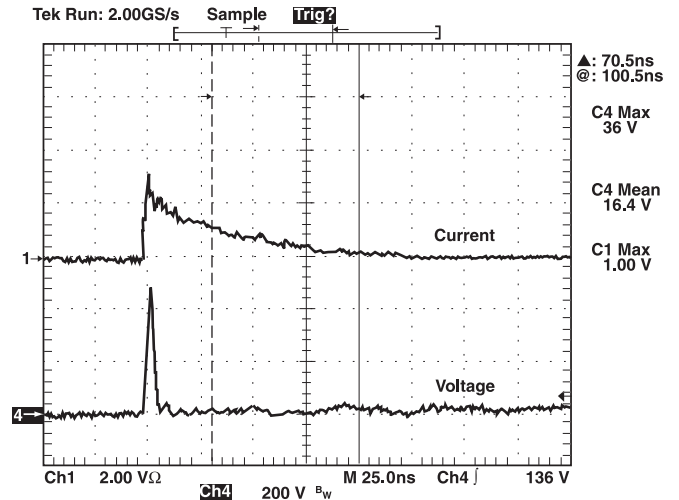
**Selected Characterization Data**

**ESD Transient Pulse Energy Controlled by PolySurg™**

Figure 1 shows typical PolySurg™ ESD Suppressor response to an 8 kV contact ESD pulse. Triggered polymer in the device 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



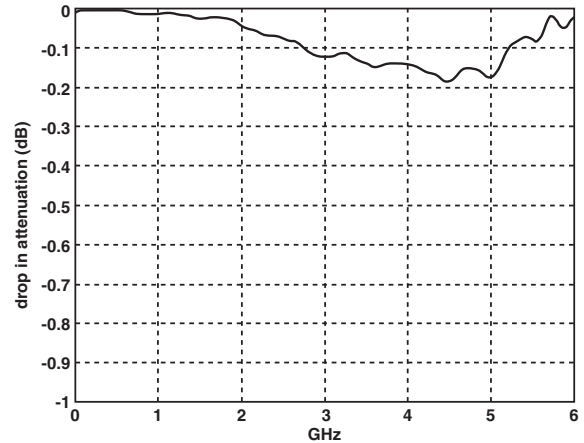
**PolySurg™ Protects against ESD Voltage Transient without Affecting Signal Quality**

PolySurg™ ESD Suppressors have an ultra low capacitance of <0.15pF and when typically installed from the signal line to ground have 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 PolySurg™ ESD Suppressor to a circuit with very fast digital signal or a cellular phone antenna.

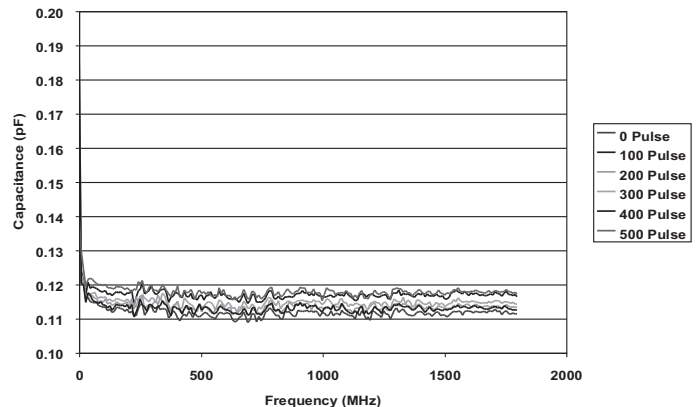
Figure 2. ESDA device induced interference with Signal Quality



**Signal Frequency does not affect 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 3, 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.)

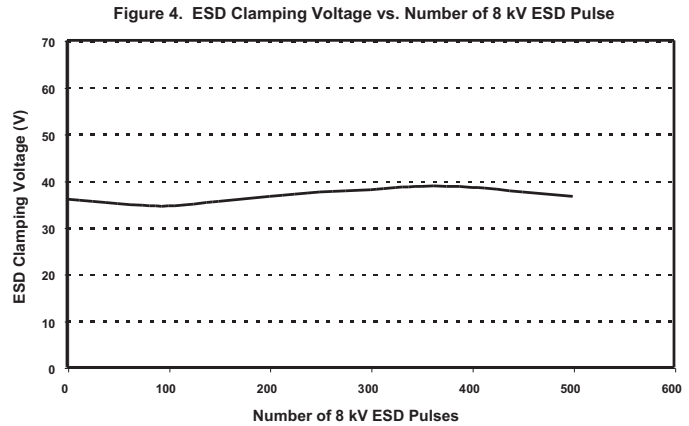
Figure 3. Capacitance vs. Frequency



**Clamp Voltage Remains Consistent Despite Repeated ESD Pulses**

As Figure 4 shows, PolySurg™ ESD Suppressors are highly reliable and stable over hundreds of pulses.

PolySurg™ ESD Suppressors have been tested with fast rate ESD pulses at 8kV contact discharge. Clamping voltage measured at every pulse shows minimal changes throughout the test.



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

As shown by Figure 5 the current leakage of the PolySurg™ ESD Suppressor 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.

