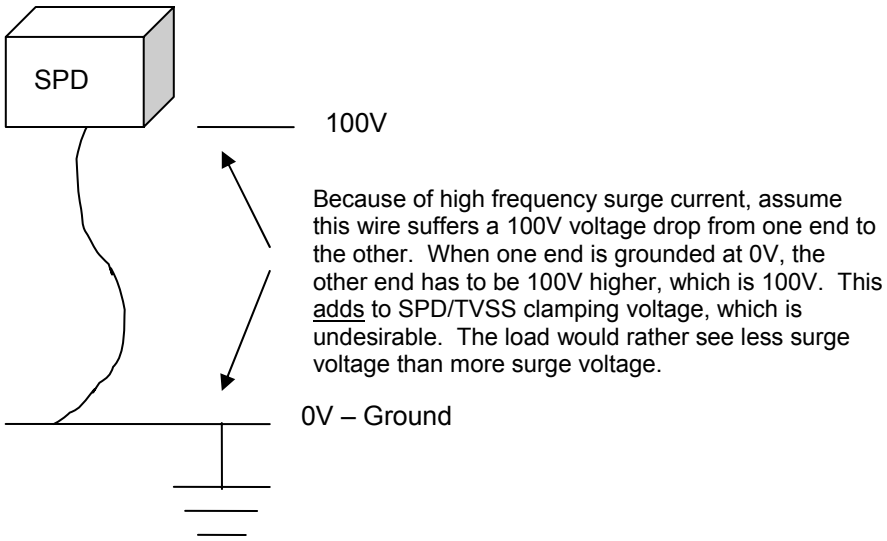
ENGINEERING
BULLETIN

Lead Length Effects on SPD/TVSS

Lead lengths affect SPD performance. In simple terms, **short and straight leads are better**. Most electrical personnel have experienced a power line drop a few volts over several hundred feet. That might involve a hundred amps at normal 60Hz. Surges are very different because they can involve thousands of amps in the kilohertz range! This dramatically increases the voltage drop across the conductor.

How does a voltage drop *increase* clamping voltage? Why is that bad?

Suppose the voltage drop from one end of a conductor to the other is 100V. Reworded: one end is 100V higher than the other end. When one end is at ground, which is 0V, then the other end is 100V higher. Thus voltage increased. This *adds* to clamping voltage too, which is undesirable.



Why are voltage drops so severe in this application? It's not like normal 60Hz power!

This is because of inductance, not resistance or capacitance. Those with math background might recall that voltage across an inductor is defined as V = -L di/dt. Inductance, L, of wire is less than 1µH/meter (not much). However, di (change of current) is very high; IEEE suggests 10,000A and dt (change of time) is very small; IEEE suggests 8 microseconds.

$$V = -L\,di/dt = -\,1\mu H/m \times (10{,}000A / 0.000008s) = -1250V/meter$$

- In the real world, it is not that bad, but leads need to be as short and straight as possible
- Twisting, bundling or tie-wrapping leads reduces inductance

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