Filtering out Power Surge Filters

A filter for power surges? I imagine a water filter connected to the kitchen sink. The water filter keeps all the "bad stuff" out of my glass. I start to fill my cup when the shower is turned off. Suddenly the water pressure spikes and water surges into the glass. The water filter did not prevent the water from surging when the pressure went high, so why would a power filter keep power surges out of my appliances and electronics? I decided to investigate.

Using a lab equipped with power surge generators and sophisticated measuring equipment similar to those used by Underwriters Laboratories (UL), I explored the properties of a surge filter and compared it to that of an everyday off the shelf surge protector. What I discovered surprised me.

I measured how much surge voltage both devices let through to an appliance. The voltage between the hot and neutral wires during the transient were nearly the same for both the filter and suppressor, it was the voltage from hot and neutral to ground that was surprising. Given identical surges, the filter let through nearly twice as much voltage as the suppressor. Voltage is to electricity as pressure is to water, so the surge filter did indeed behave like my water filter. The filter merely took the incoming surge from the hot wire and spread it to the neutral wire so that they both ended up with a near equal amount of surge voltage going to my appliance. I then realized that when you compare the hot to neutral wire voltage at the appliance they would give the appearance of a near zero surge event; however, the hot and neutral voltages were still several times normal voltage to ground. The surge was still getting to my appliance through the filter.

The surge filter seemed to operate on the principle of two wrongs making a right. A surge entering from the hot wire is divided between the hot and neutral wires going to the protected electric device. The theory appears to be that since the divided surges reach the electric device at the same time, they should cancel each other out. The problem is that high surge voltage is still being placed on the electric device you want to protect.

The major concern I had was for my data, audio and other similar connectors as well as possible arcing to the metal cases of my electronics. The surge suppressor provided more protection. The maximum surge voltage let through the surge protector to my test appliance on the hot and neutral wires were significantly less than that of the surge filter with respect to ground, thus providing better overall protection to the test appliance.

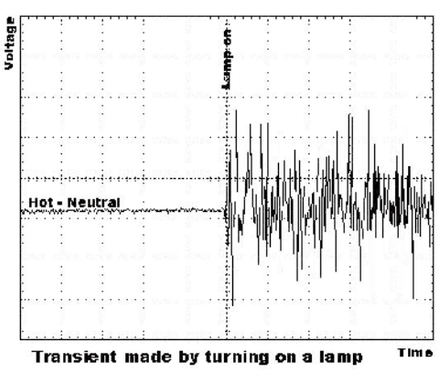
The surge filter had no real reference to ground at all. How can my stereo or television be protected if these devices are referenced to ground and my protection is not? I would feel better about a protection device that ensured my appli-ances and electronic equipment were completely protected from high voltages.

An interesting behavior was observed during the surge testing. The surge suppressor provided an area of effect in providing protection to equipment. The suppressor device protected both the connected test appliance as well as anything that was in front of the suppressor. All nearby electrical devices benefited by the presence of the surge suppressor. The surge filter did no such favor. It had no area of effect and would only work on connected electrical devices. All devices not connected downstream of the filter received no benefit. In fact, because the filter dumped so much voltage on the neutral wire during the transient, an electric device connected upstream of the filter can get a higher surge than if the filter was not there!

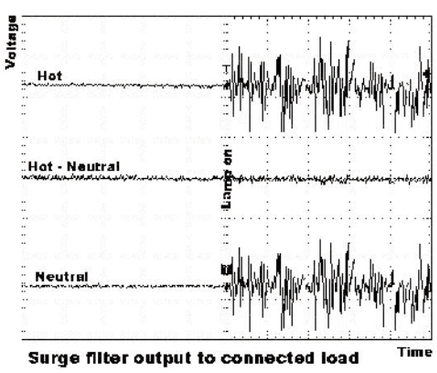
The surge filter, by its nature, can only be connected in series with a device you want to protect. Therefore all the power that the protected device needs must pass through the filter first, making it useful for small electric devices only. You would not want to run an electric water heater or stove through a surge filter, the load is too much. A surge suppressor can be connected in parallel so it does not need to carry the electricity to the electric devices. This allows one surge suppressor to protect large or multiple devices, even offering protection for an entire home at the breaker panel.

The inability of the surge filter to carry large loads combined with the small useful area of effect and the high hot/neutral to ground surge voltage let through makes this device suitable for protecting individual, ungrounded electrical equipment only. Since most electrical items are either grounded, or reference ground, this extremely limits the surge filters applications. A surge suppressor appears to be the best way for me to protect my appliances and electronics.

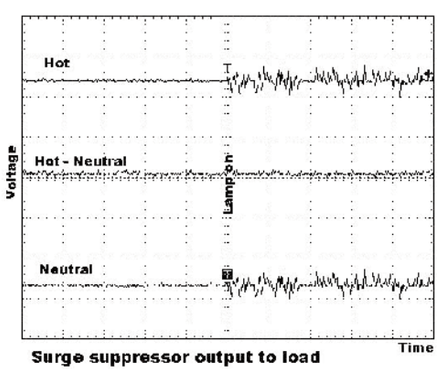
The following shows a few oscillographs taken during the evaluation. The transient is caused by an average fluorescent desk lamp being turned on, a typical everyday transient event.



Transient made by turning on a lamp



Surge filter output to connected load



Surge suppressor output to load