POWER CONDITIONER VS SURGE PROTECTORS

THERE IS A DIFFERENCE

INTRODUCTIONS

What is the difference is between a power conditioner and a surge protector? A surge diverter is less costly but most importantly is a surge diverter provides little protection for your electronic equipment.

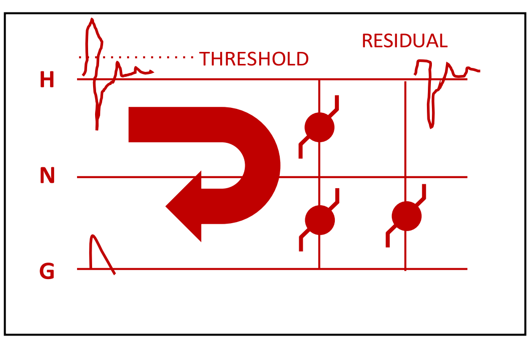
Manufacturers of these devices often do not tell you about performance differences which makes everything more confusing. Power conditioners and surge protectors (or known as surge diverters) have substantial differences, but to those who purchase power protection devices without knowing the facts, they will discover that they have invested in far less protection than they anticipated.

The difference between the two is far more than just the price point between the two. As we will go more in detail, surge protectors can provide only basic protection whereas a power conditioner provides full protection for electronic equipment.

SURGE DIVERTERS

A spike is more accurately defined as a high voltage transient or impulse. Surge diverters are designed to redirect the impulse or the spike away from the sensitive electronic system. That is why the term diverter is more appropriate – it better describes the function of this device.

Surge diverter products commonly use one or more of several electronic components. These include silicon avalanche diodes (SADs), metal oxide varistors (MOVs) and gas tubes. There are differences in how each function, but the intention is the same (See Fig. 1), divert a *part* of the harmful impulse energy away from the computer or system being protected.



"Figure 1 – Surge Diverter Operation"

All surge diverters have a voltage threshold, called a *"clamping voltage"*, at which they begin to conduct. Above that threshold, impulses are shunted across the diverter to another pathway. When the impulse voltage once again falls below the threshold, the diverter stops conducting. Surge diverters also have a *"clamping response"* time or the time required for the device to respond to an impulse. The amount of energy each is capable of handling without being destroyed is also a consideration.

Due to these factors, each type of component used in surge diverters has distinctive advantages and disadvantages. MOVs have a high clamping voltage (300 to 500 volts) and a slow response time. This means that in best case scenarios, voltage impulses of less than 500 volts usually enter the computer system unimpeded. Also, higher voltage events with very fast rise times may pass by the MOV before it is able to respond. And if the MOVs can handle a significant amount of energy, they are physically degraded each time they clamp. This characteristic alters their future performance and ultimately leads to physical failure.

These drawbacks have led to the use of the silicon avalanche diode (SAD) either in conjunction with the MOV or in standalone applications. Compared to MOVs, SADs have a faster response time and are not subject to the physical degradation that characterizes MOVs design. The overall energy handling ability of the SAD, however, is not as high, and an impulse that merely degrades and MOV may cause outright destruction of the SAD. To overcome this disadvantage, many surge diverter manufacturers whose designs use standalone SADs will match multiple SADs to increase the overall energy handling capability of the protector.

Gas tubes are relatively slow and have a high clamp voltage. Yet, they handle almost unlimited amounts of energy. Some surge diverter designs have employed gas tubes as the final line of protection to spare the lives of the other surge diverter components in the presence of a catastrophic powerline disturbance. Furthermore, many surge diverter designs incorporate paralleled MOVs, SADs, and/or gas tubes to improve performance by combining the strengths of each component.

FUNDAMENTAL LIMITATIONS

All surge diverters have certain fundamental limitations. Some have already been discussed, clamping voltage, response time, energy handling, etc. Other factors are equally important. The impulse illustrated in Figure 1 is highly simplified.

At the end of a long branch circuit, where most computer equipment is installed, powerline transients look more like the "ringing" transient. Building wiring contains significant inductive and capacitive reactance, which means that for each location in a building's wiring system, there is a unique frequency at which the system will oscillate. Much the same as a radio transmitter oscillates when its output circuit is energized, building wiring also oscillates when energized by a surge current.

While much work has been done by the IEEE to characterize the "typical" characteristics of a branch circuit impulse, the actual circumstances vary greatly. The surge diverter becomes part of the wiring system when it is installed on a branch circuit, and the circuit impedance that results from the wiring reactance becomes a factor in the performance of the surge diverter.

The implication is an important one, electrical characteristics vary throughout the system, the performance of the surge diverter will vary as well. Since these identical characteristics affect the frequency, waveshape, and risetime of an impulse within the system at different places, the performance of surge diverters becomes unpredictable.

The surge diverter is still subject to all these limitations, it is realistically best suited for limiting the worst part of a catastrophic electrical impulse.

FUNCTIONAL FACTORS

In addition, there are two other functional factors of significant importance. The first is longevity and second is what happens when a surge diverter operates.

Since MOVs and SADs are both electronic components, it is important to remember that both are subject to failure from a high-energy impulse. This is true if they are used singly or in combination with one another. The likelihood of ultimate failure is the reason so many surge diverter products incorporate an indicator light to signal when the protective elements are no longer functional. In most instances, surge diverter components are operating “naked” on the powerline and eventual failure is a foregone conclusion.

What happens when a surge diverter operates is a key issue? Where does the surge go and what are the effects of sending it there? The answer to this question along with the inherent functional factors of the surge diverters are the key differences between surge diverters and power conditioners.

POWER CONDITIONERS DEFINED

A common question asked, **“What is a power conditioner?”** To put it simply, a power conditioner is any electrical device that provides all the power protection elements needed by the technology it is protecting. This definition does focus our attention on the fact that today’s modern systems require different protection than what they had in the past.

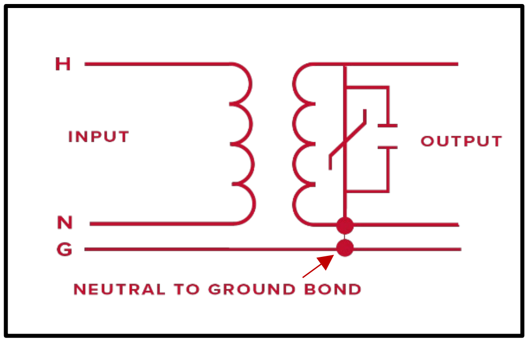
The linear power supplies used in older generation computers required voltage regulation, they also utilized a transformer on the input. Today’s’ modern systems are powered by switch mode power supplies (SMPS) which are technologically quite different. SMPS are immune to voltage regulation problems but require protection from impulses, powerline noise, and, most importantly, common mode voltage because they do not incorporate a transformer in its design. That is where a power conditioner is needed.

Common mode voltage is disruptive to the operation of a computer. The computer’s microprocessor makes logic decisions with reference to a clean, quiet ground. Common mode (neutral to ground) voltages disturb this reference and result in lockups, lost data, and unexplainable system failures.

Surge diverters function by diverting disturbance energy to ground (Figure 1). In the process, they transform a destructive disturbance into a disruptive one. The surge protector allows substantial energy to pass on to the computer, the computer itself may still be degraded by the residual surge energy.

This describes why in so many instances a user experiencing catastrophic hardware failure will install a surge diverter only to find that hardware failures, while fewer, still occur and that the system now behaves unreliably at times.

A power conditioner for a state-of-the-art system recognizes the need to meet state-of-the-art system requirements. It will incorporate three elements: a surge diverter, an isolation transformer, and a powerline noise filter (See Figure 2). This approach provides several operational benefits.



“Figure 3 – Power Conditioner with Elements”

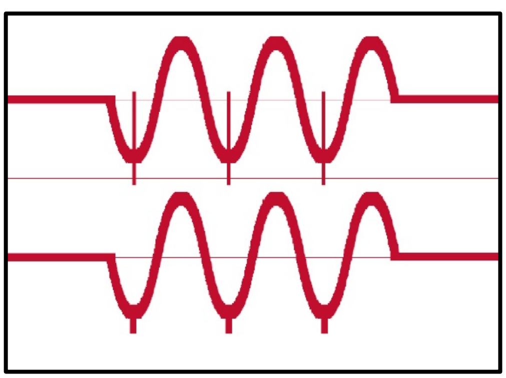
Isolation transformers allow the bonding of neutral to ground on the transformer secondary. Permitted by National Electrical Code paragraph 250- 5d, this “newly derived power source” eliminates common mode voltages. What this means is that the surge diverter can now divert surge energy to ground without creating a common mode disturbance in the process.

Since noise filters also function by diverting EMI and RFI to ground in the same manner, their performance is also improved by combining them with an isolation transformer.

THE SOPHISTICATION OF THE TRANFORMER

Transformers are a sophisticated power quality tool. Their secret is in their unchanging secondary impedance. As stated above, surge diverters interact with the impedance of the building wiring in a way that makes their performance unpredictable. Noise filters suffer similar fates. Though, when combined with the fixed secondary impedance of the isolation transformer, their performance is not only predictable but also controllable and repeatable by design.

Surge protectors limit transient impulses to hundreds of volts. Power conditioners limit the same transients to tens of volts (typically ten volts or less). Figure 4 illustrates the relative result of a 600-volt impulse passing through a surge diverter and a power conditioner, respectively. A transformer-based power conditioner allows far less of the disturbance to reach the critical load.



“Figure 4 – Surge Protector vs Power Conditioner”

CONCLUSION

Electronic systems can be destroyed, degraded, and disrupted (The 3'D's) by powerline disturbances. Surge diverters are only capable of limiting damage from destructive events. Power conditioners utilizing the shown elements (a surge diverter, an isolation transformer, and a powerline noise filter) eliminate system destruction, component degradation, and operation disruption.

The performance of a bare surge diverters in an electrical system is unpredictable. The performance of power conditioners with an isolation transformer in the same electrical system is predictable and repeatable. Surge diverters create common mode voltage. Power conditioners eliminate it. The differences between the two technologies is measured in system reliability, dependability, and performance.

Power protection is a concern for every application, and the risks are not going to go away. Protect your critical electronic systems from potentially irreparable damage with an optimized power protection solution provided by NXT Power.

NXT Power provides power protection solutions you can rely on every minute of every day. Your electronic systems are vulnerable to every power problem out there: power outages, lightning, common mode voltage and high voltage transients.

We at NXT Power manufacture the highest quality of power quality solutions for both North American and International electronic equipment. We deliver clean and reliable power to protect your systems to give you and your business piece of mind.