SURGE PROTECTORS[1]

A. SURGE PROTECTORS AND HOW THEY WORK

1. Definitions

A surge protector protects electronic devices from power surges. A power surge, sometimes called transient voltage, occurs when voltage increases above the standard normally associated with electricity in a specific area. The standard voltage in the United States is 120 volts.

2. Types of Surge Protectors

A standard surge protector passes electrical current from the outlet to a number of electrical devices plugged into the power strip. If and when the voltage increases above the normal level, the surge protector diverts the extra electricity into its grounding wire. In the most common types of surge protectors, a component called a metal oxide varistor, or MOV, diverts the extra voltage. The MOV forms a connection between the hot power line and the grounding line. The MOV is made of a piece of metal oxide material joined to the power and grounding line by two semiconductors. When standard voltage is flowing into the surge protector, the MOV does nothing. However, when the voltage is too high, the MOV conducts current to eliminate the extra voltage.

Another type of surge protection device is a gas discharge arrestor. The gas discharge arrestor does the same job as an MOV. It diverts extra current from the hot line to the ground line, except is uses an inert gas as the conductor. When the voltage is at the standard level, the makeup gas is a poor conductor. However, when the voltage surges above the standard level, the electrical power is strong enough to ionize the gas, making it an effective conductor. It then passes the current to the ground line until the voltage reaches normal levels.

Both the MOV type surge protector and the gas discharge arrestor use a parallel circuit design to protect the electrical devices that are plugged into it. A parallel circuit design is one that feeds the extra voltage away from the standard path to another circuit. Other types of surge protectors use a series circuit design. A series circuit slows down the extra electricity on its way through the "hot line" rather than diverting the extra electricity to another line. Basically, the suppressor detects the high voltage, stores the electricity, and then releases it gradually.

Additionally, as a backup, some surge protectors have a built-in fuse. A fuse is a resistor that can easily conduct current as long as the current is below a certain level. If the current increases above acceptable levels, the heat caused by the resistance burns the fuse, thereby cutting off the circuit. If the main protection system does not stop the power surge, the extra current will burn the fuse, saving the connected electrical device from the power surge. However, the fuse only works once because it is destroyed in the process.

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[1] Due to the technical nature of surge protectors, the following is taken from and summarizes Tom Harris' article, *How Surge Protectors Work*.

3. Understanding the Effectiveness of a Surge Protector

There are a few ratings that are important and can assist in understanding the effectiveness of a protector. These ratings include, clamping voltage, energy absorption/dissipation, and response time.

Clamping voltage is the voltage that will cause the MOV to conduct electricity to the ground line. A lower clamping voltage indicates better protection. There are three levels of protection in the UL rating, 330V, 400V, and 500V. Generally, a clamping voltage more than 400V is too high.

Energy absorption/dissipation is how much energy the surge protector can absorb before it fails. A higher number indicates greater protection. Average protection is within 200 to 400 joules while better protection is greater than 600 joules.

Response time is the time it takes for a surge protector to activate. Because the surge protector is reacting to an electrical force, there is a slight delay in the surge protector's response. Better surge protectors should respond within one nanosecond.

B. TYPICAL FAILURE MODES

The minimum performance standards for surge protectors are listed in UL 1449. Those surge protectors that meet the criteria are usually listed as transient voltage surge suppressors. UL 1449 can assist in determining failure modes.

Most failures occur when the surge protector is made of inferior quality components. Inferior components can easily overheat, setting the entire surge protector on fire. Additionally, the effectiveness of a surge protector can and will decreases over time. Therefore, the older a surge protector becomes, the more likely it will fail to protect against power surges.

Other common failures occur when a simple power strip or multi-line extension cord is sold to look like a surge protector. Because the product does not contain surge protection components, the appliances attached to the power strip/extension cord, as well as the power strip itself, is vulnerable to the increased voltage associated with a power surge.

C. CONCLUSION

Surge protectors function and fail in many different ways. Therefore, when dealing with losses associated with surge protectors, it is necessary to understand how the surge protector functions, its effectiveness, and whether it complies with UL 1449.

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