Novaris – Global solutions in Lighting and Surge protection

To Filter or Divert?

The difference between surge diverters and surge filters

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Novaris™ White Paper:

To Filter or Divert?

The difference between Surge Diverters and Surge Filters.

Novaris is a global leader in lightning and surge protection, with headquarters in Australia, we research, design and manufacture lightning and surge protection exceeding IEC and AS/NZ standards. Phillip Tompson explains the differences of two primary products for protecting your installation, structure or equipment. Surge diverters and surge filters have many applications and both have their advantages for specific uses throughout a structure, installation; ensuring that your equipment and you are protected from direct and indirect lightning strikes and power quality surges.

Introduction

This report details the differences between *surge filters* and *surge diverters* with respect to protection against lightning induced surges on mains power lines.

Lightning strikes commonly cause surges of several thousand volts to appear across mains power lines. Surges of these magnitudes can cause catastrophic damage to electronic equipment. Surge protectors are designed to clamp surge voltages to a value that electronic equipment can safely endure. This value is called the *let-through voltage* or *clamping voltage* of the surge protector.

The let-through voltage is the most important measure of performance of a surge protector. Obviously the lower the let-through voltage, the better chance connected equipment has of surviving a surge.

Australian and international standards provide us with standard testing procedures for measuring let-through voltages. The most common test (and the one used in this report) is the 3kA 8/20us, 6kV 1.2/50us combination wave test.

This test involves injecting a combination of voltage and current surges into the protector and measuring the resulting voltage across the terminals of the protector.

This report shows that surge filters have a far lower let-through voltage than surge diverters, and explains why this is the case. It also covers other advantages that surge filters have over surge diverters.

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Surge Diverters

Surge diverters are connected in parallel. They consist of surge arresting components, usually metal oxide varistors (MOVs) and gas arresters. They work by diverting surge energy to ground. A typical let-through voltage waveform for a surge diverter is shown in Figure 1 below:

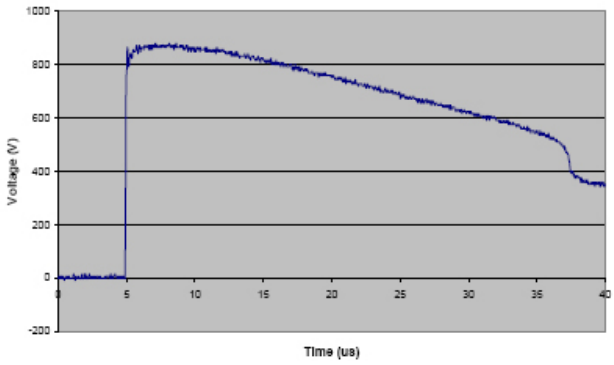

Figure 1 Typical let-through voltage of a surge diverter

The let-through voltage shown here is just under 900V. Whilst this is low enough to protect most equipment, more sensitive electronic equipment would still be damaged by a surge of this magnitude. Surge diverters that employ other components such as Silicon Avalanche Diodes (SADs) can have lower let-through voltages (as low as 600V); however this is generally at the expense of the reliability and lifetime of the surge diverter.

Surge Filters

Surge filters are connected in series. They employ three-stage protection consisting of surge diverters at the input and output, and a low-pass LC filter in the middle. The low pass filter not only suppresses surges, but also provides some filtering against harmonic noise. In the event of a surge, the majority of the surge energy is diverted to ground by the stage 1 surge diverter. As a result, the voltage at the input to stage 2 is clamped.

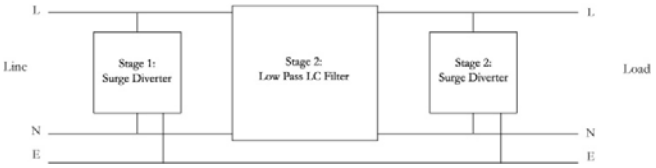

Figure 2 Surge filter configuration

The low-pass filter is high impedance to the surge and so it produces a large voltage drop across it. This leaves only a small surge for the stage 3 surge diverter to deal with. Typical values would be a 900V let-through voltage for stage 1 and a 600V drop across stage 2. This leaves only 300V (900 – 600 = 300) at the output of the filter. A let-through voltage this low will protect even the most sensitive of electronic equipment.

A typical let-through voltage waveform for a surge filter is shown in Figure 3 below:

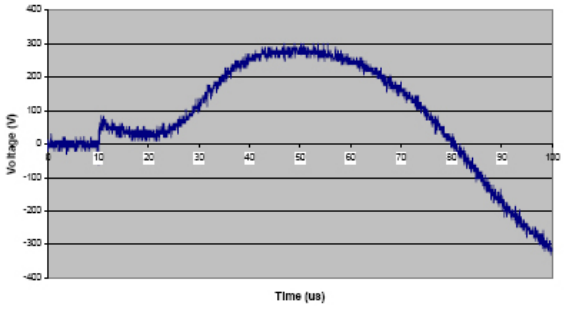

Figure 3 Typical let-through voltage of a surge filter

Advantages of Surge Filters

Beside the fact that surge filters have a remarkably lower let-through voltage, they have other advantages over surge diverters.

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Effect of shunt-connected leads

Because surge diverters are connected in parallel, the let-through voltage experienced by the connected equipment depends not only upon the performance of the surge diverter, but also on the inductance of the connecting leads.
Figure 4 illustrates this principle:

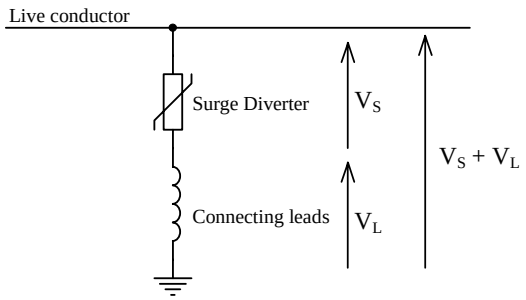

Figure 4 Effect of shunt-connected leads

Even if the inductance of the connecting leads is low, the extremely fast rise time of a lightning induced surge will create a very large voltage across them. Figure 5 (below) shows the let-through voltage of a surge diverter measured at its terminals, and also at the ends of 400mm leads.

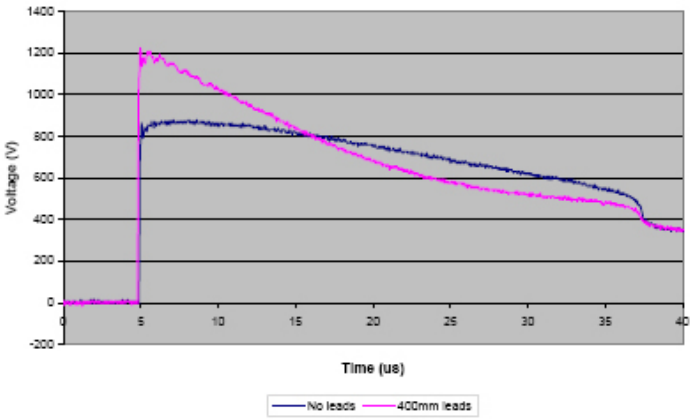

Figure 5 Let-through voltage of a surge diverter with and without connecting leads

This shows that in a practical situation, the actual let-through voltage experienced by connected equipment can be around 400V greater than that stated in the technical specifications for the surge diverter. This problem is not experienced with surge filters because they are connected in series. The manufacturer establishes the length of all shunt-connected leads. This means:

- The filter can be designed to minimise the lengths of connecting leads, therefore minimising the let-through voltage of the filter.
- The performance of the filter is not installation dependant.
- The let-through voltage experienced by connected equipment in practical situations is always the same as that stated in the technical specifications for the filter.

Lifespan and reliability

Eventually, surge-diverting components are fatigued by repetitive and/or substantially sized surges. Because surge filters have three stages to a surge diverter's one, they tend to have a much longer lifespan, as well as increased reliability due to component redundancy. Novaris have performed extensive laboratory tests on surge filters that show the stage 1 surge diverter absorbs around 95% of the surge energy. This leaves only 5% of the surge energy for the stage 3 surge diverter to absorb. In all Novaris surge filters, the stage 3 surge diverter is generously rated. This provides a second line of defence should the stage 1 surge diverter fail. An additional advantage of the stage 3 surge diverter in a filter is that it protects against surges produced by connected equipment. This is particularly important when multiple loads are connected.

Conclusion

Surge filters provide far superior protection against lightning induced surges on mains power lines. Unlike surge diverters, their performance is not installation dependant. On top of these points, they have a longer lifespan and are more reliable than surge diverters.

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