SPD Design Tips for Fusing Surge Design Elements (TVS or MOV)

Surge Protectors may use fuses as the means of protecting the product or components within the product. Fuses are also used to limit the current that can affect the device being protected.

When fusing is used the designer or user of the product must understand the results of this design decision.

Two basic concepts are used :
1. Component fuse in series with an (TVS or MOV)
2. Fuse in series with the total product including TVS.

The purpose of the fuse is to clear the component or product in the event of, either a TOV which drives the SPD to failure, with a very high fault current, or a surge beyond the (TVS or MOV) rating.

When this type of event occurs, the fuse will develop an arc voltage that can be additive to the suppression voltage. This arc voltage and suppression voltage will or can be be impressed across the load to be protected.

The arc voltage can be significant, in fact much greater than the suppression voltage from the (TVS or MOV) . This arc voltage is also dependent upon the fuse element construction.

Fuses use two basic element constructions, wire and/or ribbon. Ribbons elements are usually notched. (This should be known when selecting a fuse)

When comparing both types of fuse element construction, it is found that a wire element can produce arc voltages up to 3x compared to that of a ribbon.

Therefore it is very important to understand the effect of the Fuse element used in SPD design. Although this is an application issue it must be considered and understood.

Following are oscillograms for a product with a fuse in series with an TVS or MOV. An 8/20 pulse is applied to open the fuse. As the current pulses increases there is burn back of the fuse and an increase in the total voltage which significantly exceeds the voltage protection requirements of the load.

This example is to illustrate the affect with a pulse, a similar result would occur with a TOV and resulting protective component (TVS or MOV) failure and a failure of the equipment to be protected.

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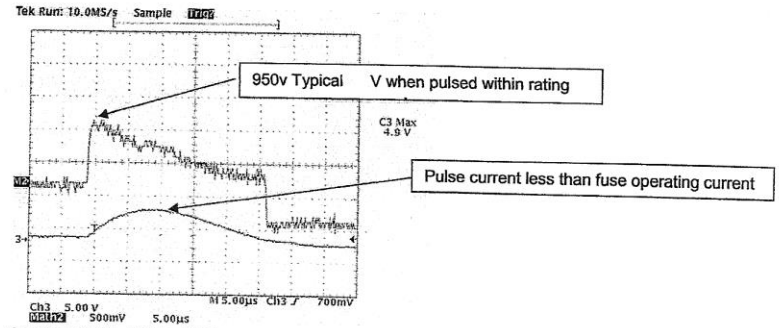
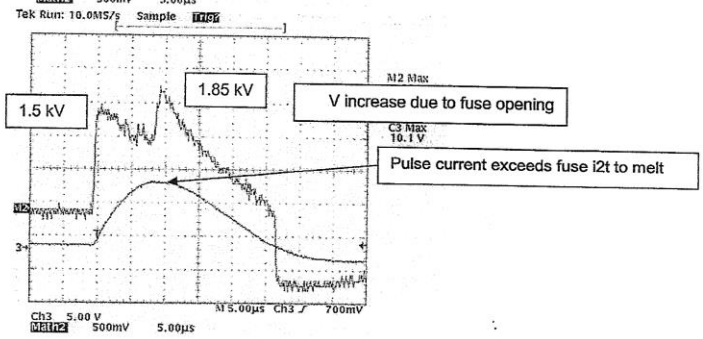
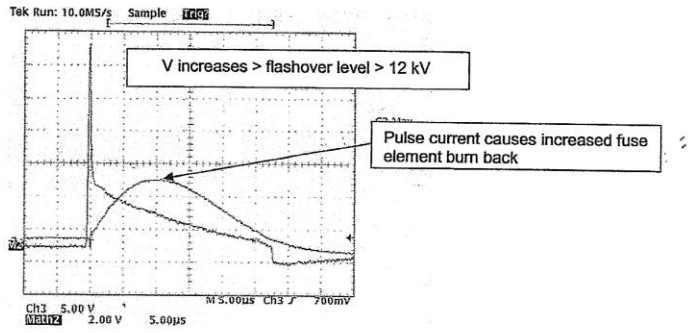


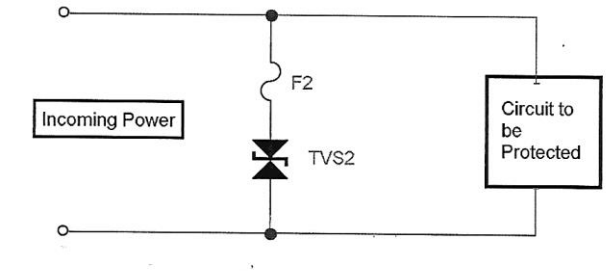
Case 1
This first view shows what occurs if the pulse is within the limits of the fuse



Case 2
This second view shows what can happen if the pulse exceeds the current rating of the fuse and it starts to open and the voltage rises.



Case 3
This third view shows what occurs if the fuse opens because the pulse current is much greater than the fuse rating. This causes a very high voltage because of the fuse arc voltage.



If fused in the manner of Case 1-3 it can produce voltages as shown

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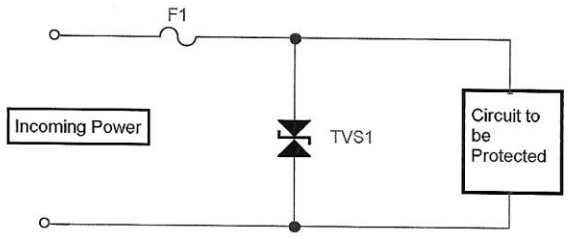

If however the fuse is placed in this manner the fuse opening will not affect but will disconnect the load.

The reason for this Brief is to alert the designer or user that the placement of fusing must be carefully considered and applied.