

# White Paper

## Silicon SPDs: Commodity Diode Connections

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Silicon avalanche diode based SPDs (surge protection devices) are increasingly being recommended to protect expensive and sensitive electronic equipment from lightning and surges. This is due to their superior performance characteristics. Silicon diode based SPDs feature

- 1) faster response times
- 2) lower clamping voltages versus other technologies and
- 3) non-degrading performance in their low-level transient suppression function.

However, **not all silicon avalanche diode based SPDs are the same.**

SPD design and manufacturing standards can dramatically affect suppressor performance. Areas such as component matching and lead lengths are often overlooked. Lead lengths will be discussed in this article and a future paper will address component matching because off-the-shelf silicon diodes can vary in performance as much as 30%.

Although off the shelf diodes can be matched, it typically is not done because of the amount of time and cost involved. Fortunately, diodes can be manufactured to match if specific criteria and design control processes are in place.

### Lead Lengths Lead To Superior Performance If Designed Correctly

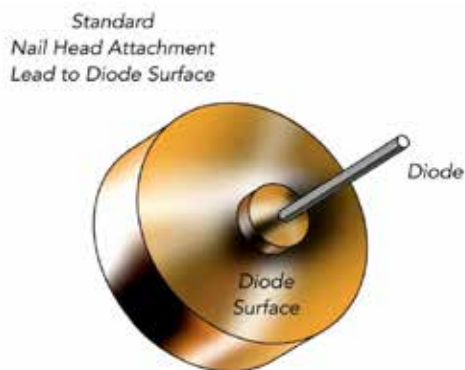


Figure 1

Diode lead connect lengths will affect the overall performance of any SPD. Standard off-the-shelf diodes have axial leads extending from each end of the diode cell. A lead length of 2 cm can increase the clamping voltage of the individual cell by as much as four times. If many of these leaded diodes are installed in series (typical application) to obtain higher voltage ratings, the overall clamping voltage will be significantly increased. The standard means for attaching axial leads to the diode cell is by using a nailhead on the end of the lead, which is then soldered to the cell.

There are three problems with this standard method of attachment.

- 1) The nail head is small and therefore the surface where it attaches to the cell is small.
- 2) The majority of a surge current is forced through a small portion of the diode cell.
- 3) The small surface affords limited heat sink capability. This will cause spot heating in the cell reducing diode performance. Additionally, if the manufacturing process is not controlled properly there can be imperfections in the diode cell. If the nail head is attached over one of these imperfections a premature failure of the cell will occur.

Transtector's designs have overcome these problems by controlling the cell manufacturing process to eliminate imperfections and by developing a custom lead attach process.

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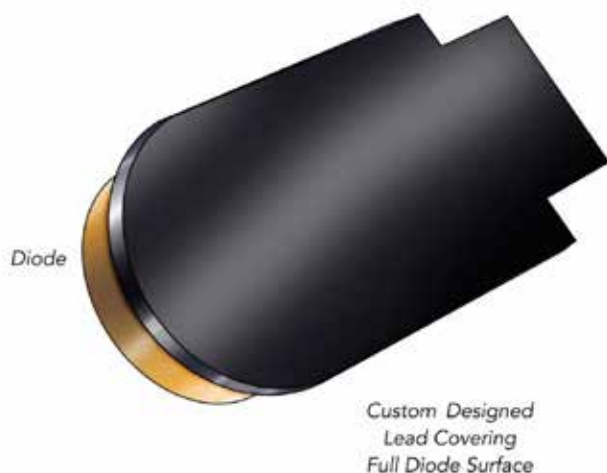


Figure 2

This innovative connect design allows for equal surge current distribution through the cell as shown in Figure 3 and is also a better heat sink to draw the heat away from the diode.

## Summary

Silicon diode based suppressors are proven to protect sensitive electronics better than other technologies. However, the way the diodes are assembled, connected and manufactured makes a significant difference in how well they perform. It is much more than just putting components in a box.

Since 1967, Transtector has been developing higher performance specifications and control processes that are used to provide the highest quality, highest performance, tightly-matched suppressor diodes. The use of customized components and design assures maximum SPD performance and can mean improvements of up to 35% in protection versus commodity diode construction.

Standard lead attachments show surge current being concentrated in a small area of the diode which may cause premature failure.

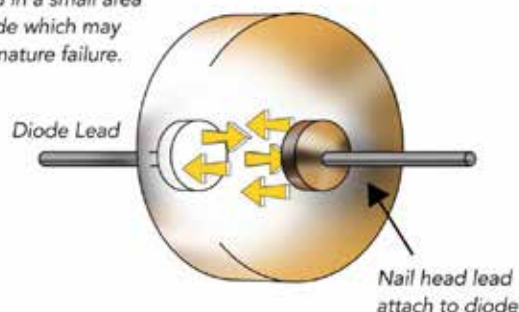


Figure 3

Figure 4



Please contact us for questions or further information on this topic.

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