"The Leading Edge of Technical Obsolescence" - The Selenium Suppressor

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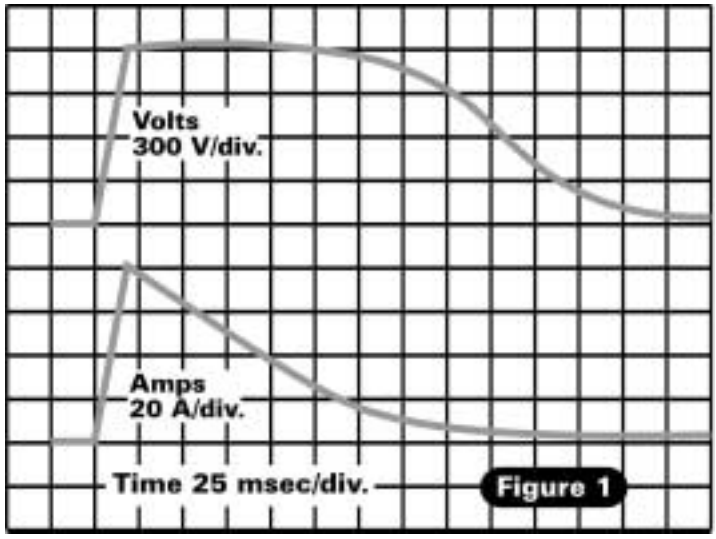
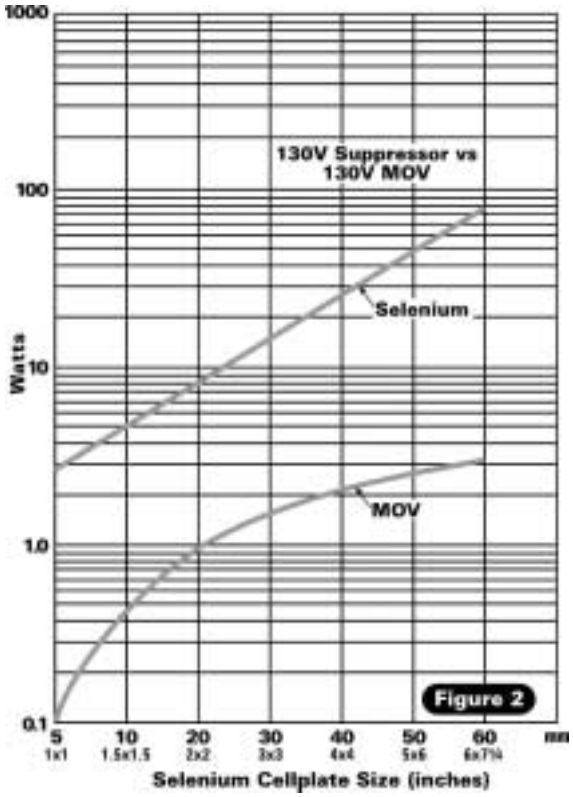
Selenium is a naturally occurring element that has been present on the earth since the beginning of time. Most people know it's an essential nutrient, but it has also been used as a semiconductor in both rectifiers and suppressors for many years. As a rectifier, selenium's popularity has faded in favor of the less-expensive silicon rectifier. However, demand for selenium suppressors still continues to grow.



Vp = 1240 Volts Ip = 80 Amps for a 15 cell 6X10" suppressor

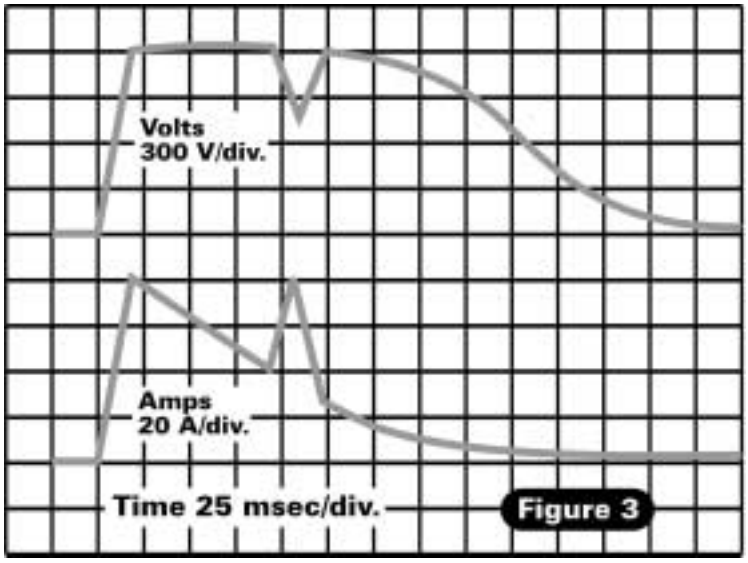
Because of its own, unique properties, the selenium suppressor has been able to remain viable in the market.



Special clamping capabilities have enabled it to find its own niche as a "transient voltage suppressor." It is more ideally suited than MOVs or silicon suppressors for some applications because of its ability to dissipate power continuously and handle long surges. *(See Figure 1.)*

The selenium suppressor is able to absorb energy levels in excess of its rated capability while maintaining its clamping characteristics on the next cycle. Because it is layered onto an aluminum plate, its energy capabilities will follow that of a heatsink curve. This heatsinking capability allows steady state power dissipation up to 40 times that of the MOV. From a 130 Volt suppressor, the selenium product allows steady state dissipation of 2.5 – 80 watts versus the MOV which allows only .1 to 2.5 watts. *(See Figure 2.)*

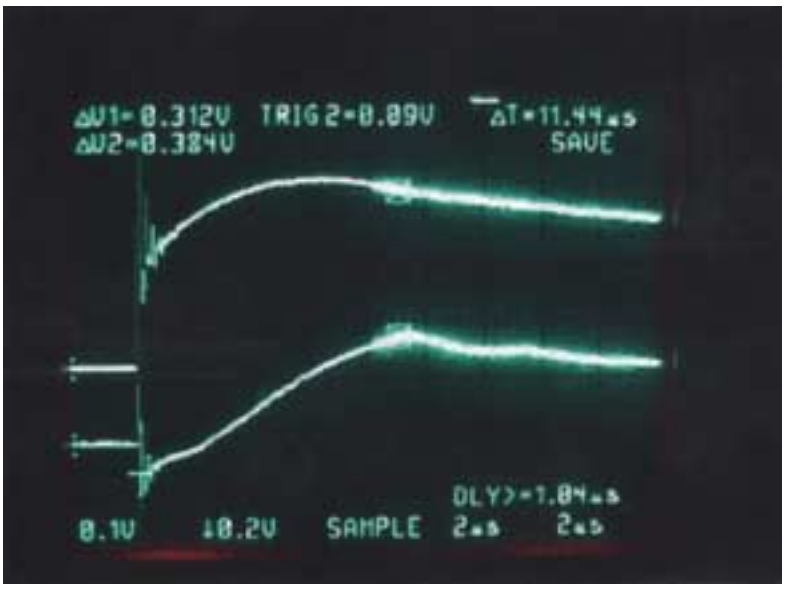
Selenium's crystalline structure gives it the unique ability to continue functioning after an energy burst in excess of its rating (based on short pulse widths – *see Figure 3*). Harris Semiconductor concurs, "These cells are built by developing the rectifier elements on the surface of a metal substrate which gives them good thermal mass and energy dissipation healing characteristics which allow the device to survive energy discharges in excess of the rated values…"[1] The function of the selenium suppressor is comparable to a pressure relief valve - when the pressure rises, the relief valve opens, releases the pressure, and then resets itself.



Vp = 1240 Volts Ip = 80 Amps for a 15 cell 6 X 7¼" suppressor

Most suppressors are capable of handling high currents at short pulse widths (in the micro-second range). By comparison, the Selenium suppressor can handle currents in the milli-second range, making it a more robust unit. It has a typical response time of less than 1.0 µsec (*see Figure 4)* and is capable of handling pulses with long decay times as seen in large D.C. motors or any inductive loads with L/R ratios in the 100 milliseconds range.

3" X 3" (3 Cells In Series)



ΔV_1 = 1mV = 1V = 312V
ΔV_2 = 1mV = 1V = 384 Amps
2 microsecond per division
*Response time as shown is approximately 1 microsecond

Figure 4

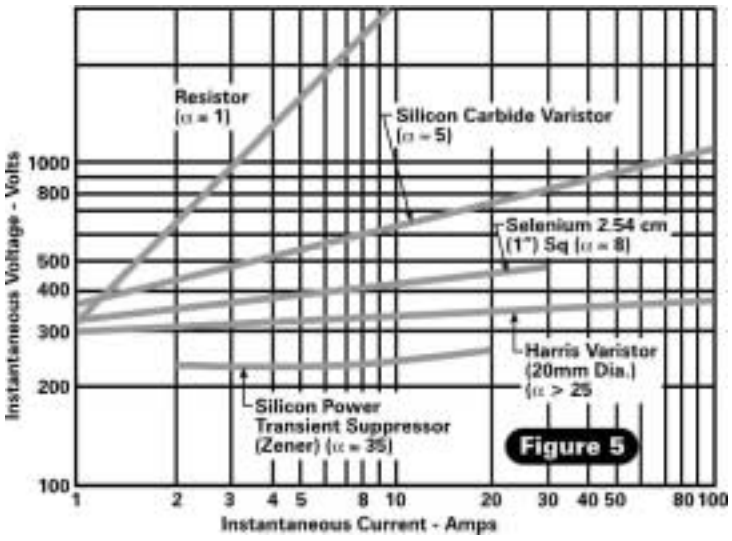
[1] Harris Corporation, *Transient Voltage Suppression Devices*, 1990

Typical businesses currently using the selenium suppressor include power conditioning companies and manufacturers of generators and AC controllers. Present applications for the selenium suppressor include:

- On the D.C. side of a rectified generator output
- Across the SCRs on large controllers
- Across D.C. motors
- On transformers (for line to line suppression)
- Power conditioning (i.e. from power strips to service entrance)

Selenium suppressor cell plates can be manufactured in sizes varying from 1" X 1" to 12" X 16" and can function at a temperature of 0° C to 55° C ambient without any derating. The voltage of a selenium suppressor cell starts at 26 VRMS or 22.5 VDC per cell plate. A 75-volt maximum per cell must be kept due to the dielectric ceiling of the cell. The capacitive nature of the plate allows for it to be put in series to attain higher voltage levels.

As silicon gained favoritism over selenium, the selenium industry that survived did so on the premise that the product was "the leading edge of technical obsolescence." Although not used as widely as it once was, selenium has some unique characteristics that make it the best choice for some applications. (*See Figure 5.)*[2]



For some devices, an MOV or a TVSS is better suited, and for others, a combination of suppressors is best. However, to the surprise of many Electrical Engineers, the capabilities unique to the selenium suppressor have enabled it to retain a firm place in today's market.

Contributions

1. Harris Corporation, *Transient Voltage Suppression Devices*, 1990
2. Harold Wood, Consultant, Former Owner of CKE

[2] Harris Corporation, *Transient Voltage Suppression Devices*, 1990