SUPPRESSION

FIGURE 113

INSTANTANEOUS VOLTAGE (V) vs INSTANTANEOUS CURRENT (A)

Resistor ($\alpha=1$)
Silicon Carbide Varistor ($\alpha=5$)
Selenium 2.54cm (1")sq ($\alpha=8$)
Varistor(20mm dia.) ($\alpha>5$)
Silicon Power Transient Suppressor ($\alpha=35$)

FIGURE 114

STANDBY POWER DISSIPATION (PER UNIT) vs PERCENT OF RATED VOLTAGE

$\alpha=35$
Diode or Cluster
Varistor
1" Selenium
Silicon Carbide
$\alpha=25$
$\alpha=8$
$\alpha=4$

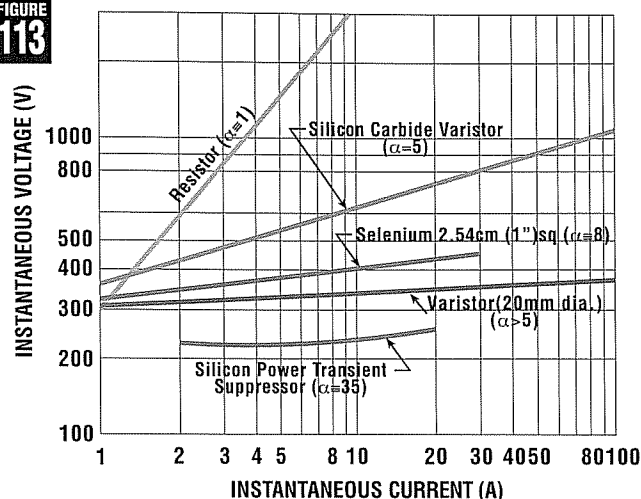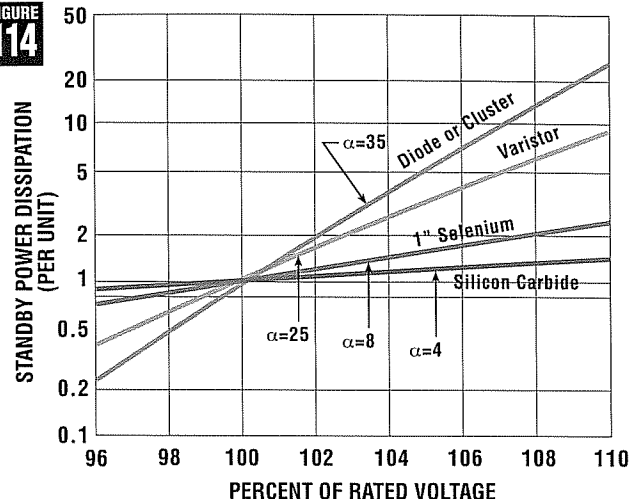*Curves used with permission form Littelfuse*

Comparison Synopsis

Figures 113 & 114 show the characteristics of transients suppressors and compares their abilities to first suppress transients and also their ability to handle elevated or so called "swell voltages".

Figure 113 shows the devices ability to clamp transients. The resistor is the first element and as would be expected the current draw is a direct correlation to the voltage applied. Hence an Alpha of 1. The term Alpha represents the non-linearity of the device.
With the resistor, any percent change in voltage equals the same percent change in current.

As the Alpha of the transient suppressor increases so does the degree of non-linearity of the device. That is to say, for a large change in current there is a small change in voltage.
The transient suppressors are "voltage dependent variable resistors". As the voltage increases, the resistance or impedance of the device is inversely affected, and decreases exponentially. This is the basic concept on how a Transient Suppressor works. As a transient voltage spike increases, the Suppressor changes it's impedance and draws a near short circuit in parallel to the system being protected. In doing this the Suppressor device will clamp the transient spike to a safe level for the system.

Figure 114 represents how the Suppressors handle over voltages. The higher the Alpha, the higher the current draw, for small changes in voltage. This also corresponds to larger power to be dissipated, and since the high alpha devices are small in size and low average power rated, they are unable to handle over-voltages (swell voltage).

Summary

Each suppressor has it's unique niche market and advantages. If the user is better able to understand the strengths of each different type, utilizing combinations can improve performance.

The characteristics that have to be matched are the speed of response and clamping or VI characteristics.

Examples

An application where there is an inductive load that has a back EMF with pulse width of approximately 400 milliseconds and peak current of 50-100 amps, can utilize several large body MOVs in parallel, a couple of Selenium Suppressors in parallel, or a Silicon Carbide assembly.

Another example is an op-amp feeding a capacitive load. Using a MOV will work in this circuit, however a TVSS device would be more economical and better suited.

These are just a couple of examples and there are many more where knowledge of the different types of Suppressors will enable the designer to enhance the performance of the systems as it pertains to transient protection.

SUPPRESSION

Product Features	Applications

TVSS:
- **Fast response time, sub picosecond**
- Board mountable
- High clamping ratio
- Low standby (leakage) current

- Telecommunications
- Data transmission
- Power supplies
- Electrostatic discharges

MOV:
- **High surge rating on short pulses**
- Fast response time pico-second range
- Low standby (leakage) current
- Cost effective for low average power applications
- High clamping ratio
- Board mountable, (Larger devices available)

- Appliances
- Power supplies
- Computers
- Motor controls
- Microelectronics
- Telecommunications

Arrester Disc:
- Available in several standard voltages
- Can be put in series to attain required voltage
- Meets IEC standard IEC60099-4
- High surge capability, and capacity

- AC transmission or transformation equipment
- Can be enclosed in either porcelain or silicon rubber housing

Silicon Carbide Varistor:
- **Capable of handling long pulses, 100-400 milliseconds**
- Fast response time 5-10 nanoseconds
- High body temperature operation, continuous 110°C
- Large mass device and consequently high energy

- Discharging lifting magnets
- Exciter field protection
- Insulation protection

Selenium Suppressor:
- **Multi-crystalline structure that enables a "self healing" characteristic**
- Fast response time < 1microsecond
- Inherent heatsink design, subsequently high energy device

- Inductive load protection
- Synch motors protection
- Diode/SCR protection