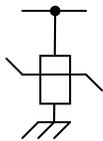


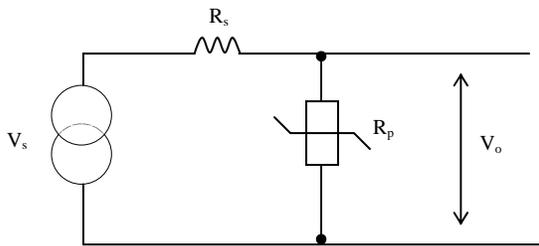
Surge Protective Device Working Principle

LPS Surge Protective Device (SPD) are designed divert transient to ground and limit excess voltages. Although lightning impulses has the most destructive effect of transient voltage but the most common sources of transient voltage is by utility grid switching, electrical accidents, switching of large capacitor banks on utility line or loads from nearby industry. By incorporating LPS SPD into the power system, electrical and electronic equipment can be protected.

SPD must at least contain a non linear device parallel to the protected circuit to earth as shown below:



Its equivalent circuit will be:



Therefore the out put or clamping voltage will be

$$V_o = \frac{R_p V_s}{R_s + R_p}$$

Where V_s is the surge source, R_s is the surge source impedance and R_p is the resistance of non linear device. From the equation, the lower the R_p , the lower V_o , hence the better protection. However R_p cannot be too low because it is parallel to the circuit. In power circuit, power current will flow though the device. Hence the lower the resistance, the higher the current. Too low resistance will short the circuit. In order to solve the problem, the device must be voltage dependant. When apply a normal voltage to the device, the device resistance is very high which is equivalent to open circuit. When transient occurs, the device will change its resistance to very low value and short circuit the over voltage. However, the device dynamic resistance $\frac{dv}{di}$ at that particular moment is very low, and is able to block the normal voltage being shorted to ground.

The Voltage limiting non-linear component used in LPS SPD to divert surge current is Metal Oxide Varistor (MOVs). MOVs are voltage-dependent resistor with a symmetrical V/I characteristic curve whose resistance decreases with increasing voltage. When connected in parallel, it forms a low-resistance shunt when voltage increases and thus prevents any further rise in the over voltage. MOVs have exceptional current handling capability combined with response time of less than 10 nanoseconds make it an almost perfect protective device.

LPS SPD provides common and differential modes of protection. Common mode transients appears between each line and earth whereas differential mode transient appears as a difference between two lines, independent of their potential differences to earth. High potential to earth created by common mode transients can cause insulation breakdown and arc-over thereby damaging the electronic components whilst the differential mode transient can cause over current and damage I/O ports and power supply circuits. The protective components in LPS SPD are connected line-to neutral (L-N), line-to-ground (L-G), and neutral-to-earth (N-G). Hence the single-phase units provide 3 modes of protection while the 3-phase units provide 7 modes of protection.

The nominal rated voltage for LPS SPD is 240V while maximum continuous operating voltage (MCOV or U_C) is 275V. The MCOV is the maximum r.m.s. voltage which may be continuously applied to the SPD mode of protection. It is 15% higher than the nominal voltage of the system. If lower or same as the nominal voltage is selected, the MOVs may conduct more frequently or continuously causing the SPD to be non-durable. However this higher MCOV has also resulted in a slightly higher corresponding clamping voltage and let-through voltage but it is still within the limits of the protected equipment as recommended by CBEMA Standards.

To prevent fire hazards, the LPS SPD has *Thermal Cut Out* and is housed in a metal enclosure. The *Thermal Cut Out* is specially designed to prevent thermal runaway of MOV. When the sustained power dissipation of the MOVs exceeds the dissipation capability, it could lead to a cumulative increase in the temperature with possibilities of initiating fire. However once the internal temperature rises to a dangerous level, the *Thermal Cut Out* in LPS SPD will disconnect the MOVs from the circuit hence eliminating thermal runaway. As further precaution of fire hazards, all LPS SPD are housed in metal enclosures that will not deform or hinder the operation of the *Thermal Cut Out* and is fail-safe.

As MOVs degrades as results of exposure to the transients, the SPD shall have a reasonable surge capacity in respect to the panel current to give a reasonable life span. In general the larger the panel's current, the higher the surge capacity will be required. At the main incoming a higher surge capacity will be required compared to the distribution panels because a larger cable will have lower impedance and lesser surge attenuation.

The LPS SPD is connected in parallel to the power system and has to be monitored. All LPS SPD models are complete with LED to provide the user with visual monitoring of the suppression status. The 3-phase models are incorporated with a buzzer to provide the user with audible monitoring on the suppression status. For remote monitoring on suppression status and power supply status of the LPS SPD, all the 3-phase models have Form C Dry Contacts. For critical installations, the LPS SPD RM Series has redundant modules and full isolation. The redundant modules ensure continuous protection during any module damage while the in-built fuse switch enables full isolation of individual modules.

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