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Selecting Surge Suppressors for Relays, Contactors and Starters

What is the purpose of a surge suppressor?

What are the differences between the different types of surge suppressors?

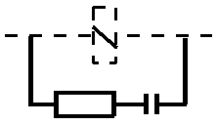
Surge Suppressors are used to suppress the high voltage spike that is generated when a relay or contactor coil is de-energized. The electromagnetic field collapsing across the coil generates a voltage spike in the wires of the control system. Without the suppressor, the surge can reach 8 to 10 times the rated coil voltage and can propagate through the system causing electronic controls to go to unwanted states and filling counters with erroneous numbers.

Electronic controllers (such as PLC's) usually switch the loads at the AC voltage zero cross over point which eliminates voltage surges. In PLC controlled systems, a voltage surge would be caused only when another input device (i.e. push button or limit switch) energizes the load.

If electronic controls (such as PLC's) are being used to control a load that is not being switched on at its zero cross over point, surge suppression should be used on the switching device by attaching a surge suppressor directly across the coil terminals.

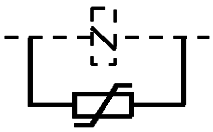
Application Examples:

RC SURGE SUPPRESSORS



The RC Surge Suppressor uses a resistor and a capacitor to reduce the surge range of 120 VAC to about 350 VAC maximum. The capacitor is used to absorb the voltage spike. The resistor controls the rate of capacitor charging when the coil is turned off and to limit the coil's inrush current when the coil is turned on. The voltage surge is suppressed smoothly in about 3 cycles of a 60 Hz signal. The voltage surge is dissipated in about three cycles. The drop out time of the coil does not increase when using this type of suppression because the resistance characteristics are properly engineered into the design of the RC suppressor.

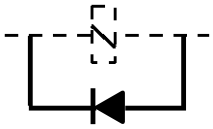
Metal Oxide Varistors (MOV) or VARISTOR SUPPRESSORS



The MOV Suppressor chops the AC or DC voltage surge into a square wave that can contain noise and does not control the voltage change with respect to time (dv/dt).

However, the voltage change with respect to time can cause some electronic devices to change state. The voltage surge is usually limited to 3 times the voltage rating of the suppressor (300% of the rated coil voltage). Drop out time of the coil does not increase when using this method of suppression.

DIODE SUPPRESSORS



The Diode Suppressor suppresses the DC voltage from a DC Voltage coil very smoothly by recirculating the voltage through the coil. The energy caused by the voltage spike would be dissipated by the coil itself. Because of this, the coil drop out time is usually increased from 3 to 10 times the usual drop out time when using a diode type of suppressor. When using an external diode surge suppressor, the voltage is clamped at voltage rating of the coil plus about 0.7V that the diode drops. The voltage spike tends to taper off gradually as the voltage spike is suppressed by the diode.

Some DC coils have a built-in or internal diode suppressor (integrated diode design). The diode used inside the coil is a bidirectional diode that will clamp the voltage to about 2.5 times the rated coil voltage (around 65V for a 24V DC coil). Coils using the integrated diode design have a faster coil drop out time than those coils using an external diode surge suppressor. This is because the voltage spike is suppressed very quickly, in one quick spike, rather than a gradual tapering off of the voltage spike.

Mounting & Logistics of Suppressors

RC, Varistor (MOV) and Diode suppressors are commonly sold as field installable accessories for contactors. These field installable surge suppressors may be designed for mounting to the coil terminals (A1-A2), or as stab-in or plug-in. Terminal mounted suppressors do not consume additional panel space as with the Sprecher + Schuh CA7 contactors and CS7 relays (Fig. 1). Sprecher + Schuh CA8 mini-contactors and CS8 relays are designed to accept the stab-in or plug-in designs (Fig. 2). Some contactors can be ordered with factory installed diodes internal (integrated) to the coil (Fig. 3). The newest innovation in surge suppression is integrated as a factory standard, as with Sprecher + Schuh CA6-EI design contactors and most recently the 24VDC electronic coil CA7 contactors and CS7 relays.

Fig. 1; Terminal mounted surge suppression

Fig. 2; CA8 with pluggable RC Link (CRC8)

Although contactors with internally mounted diodes can be ordered with one simple catalog number, they may not be stocked with the specific coil voltage and configuration you want. Field installable diodes are usually stocked and ready to ship. Functionally, the only difference between internal and external mounted diodes on DC coils is milliseconds of response time during drop-out (reference the technical specifications for the respective device for more details).

Fig. 3; CA6 Contactor come equipped with pre-mounted surge suppression

Summary:

Using surge suppressors on AC coils have a negligible effect on the coil's dropout time. Using an MOV or RC surge suppressor will not increase coil drop out time (RC suppressors provide the smoothest surge suppression). However, the MOV suppressor on both AC and DC coils will clamp or 'flat top' the voltage at 3 times the voltage rating of the coil.

Using a Diode surge suppressor on DC coils is the most commonly used method to suppress voltage spikes caused by de-energizing the coil and the resulting voltage spike. The Diode surge suppressor will clamp the voltage level that is very close to the coils' nominal or rated voltage. However, the diode suppressor can add additional time to the drop out time of a coil. An MOV surge suppressor can be used on DC coils and the MOV type will not lengthen the drop out time of the DC coil.

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