ILLINOIS CAPACITOR, INC.
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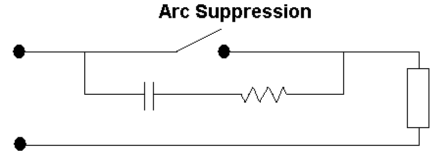
RC SNUBBERS (SMPS)

Snubbers are energy-absorbing circuits used to suppress the voltage spikes caused by the circuit's inductance when a switch, electrical or mechanical, opens. The most common snubber circuit is a capacitor and resistor connected in series across the switch (transistor).


Arc Suppression

The design procedure is as follows:

If you assume the source has negligible impedance, the worst-case peak current in the snubber circuit is --

$$I_{PK} = \frac{V_0}{R_S} \quad (1)$$

R_S = snubber resistance
V_0 = open circuit voltage

and the circuit dv/dt is determined from the following:

$$I_P = C\, dv/dt \quad (2)$$

substituting (1) into (2)

$$dv/dt = V_0 C/R_S$$

The energy stored in the capacitor is : $E = 1/2\, C(V_0)^2$

Ohm's Law says that the snubber resistance is equal to:

$$R = V_0/I$$

I = switching current
V_0 = open circuit voltage

The amount of energy the snubber resistance is to dissipate is the amount of energy stored in the snubber capacitor. It is recommended that you choose a capacitance value that causes the resistor to dissipate one half the wattage rating of the resistor.

$$P = 1/2\, C(V_0)^2\, 2f$$
$$= C(V_0)^2 f$$

Where f = switching frequency
$2f$ = number of transitions per cycle

$$C = P/f(V_0)^2$$

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The snubber capacitance has to meet two requirements. First, the energy stored in the snubber capacitor must be greater than the energy in the circuit's inductance.

$1/2\ C(V_0)^2 > 1/2\ LI^2$ Where V_0 = open circuit voltage
I = closed circuit current
$C > LI^2/(V_0)^2$ L = circuit inductance

Secondly, the time constant of the snubber circuit should be small compared to the shortest on time expected, usually 10% of the on time.

$RC < T_{on}/10$ Where T_{0n} = shortest on-time expected
R = snubber resistance
C = snubber capacitance