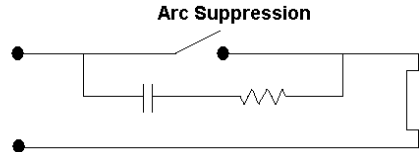


RC SNUBBERS (SMPS)

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).



The design procedure is as follows:

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

$$I_{PK} = \frac{V_0}{R_S} \quad (1) \quad \begin{array}{l} R_S = \text{snubber resistance} \\ V_0 = \text{open circuit voltage} \end{array}$$

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:

$$R = V_0 / I \quad \begin{array}{l} I = \text{switching current} \\ V_0 = \text{open circuit voltage} \end{array}$$

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.

$$\begin{aligned} P &= 1/2 C(V_0)^2 2f & \text{Where } f &= \text{switching frequency} \\ &= C(V_0)^2 f & 2f &= \text{number of transitions per cycle} \end{aligned}$$

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



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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_{on} = shortest on-time expected

R = snubber resistance

C = snubber capacitance



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