

# R-C Networks

## Application & Resistance Selection

September 5, 2018

### What causes a transient/voltage spike?

When the current to an inductive device is interrupted, the collapsing magnetic field tries to continue that same current by generating voltage. If no other load or suppressor is in the circuit, electrical potentials many times the normal operating voltage will be created.

### Problem

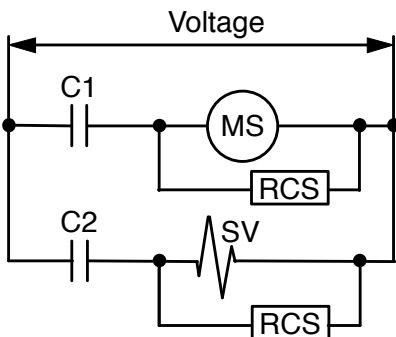
When these transients/voltage spikes occur they can generate issues with components in control circuits:

1. Arcing across contacts resulting in shorter contact life.
2. High enough voltages to damage solid-state components in other control hardware.
3. Momentary activation of solid-state inputs or outputs (random false trips).



### Potential solution

To suppress the transients/voltage spikes generated by inductive loads, the R-C Network filter should be connected in parallel with and as close to the inductive load as possible.



By placing the R-C Network filter in parallel, when the inductive load is disconnected from the supply voltage, the transients/voltage spike generated is dissipated as heat in the resistor, capacitor and coil of the inductive load. Without the R-C Network the transients/voltage spike travels through the control circuit looking for a path to arc over or a component to go through. Not good.

In general any R-C Network of the proper voltage or higher connected in parallel with the coil of the inductive load is better than nothing. It still passes the current and works to dissipate the energy as heat, but possibly not as effectively.

### Picking the right voltage

An R-C Network will work on a DC circuit as well as an AC circuit. The operating voltage of the R-C Network simply needs to be equal or greater than the voltage of the device the R-C Network is being connected to.

If the combination of the R-K Network and varistor are being used, be sure to pick a model where the varistor voltage rating is greater than the voltage of the device it is being connected to.

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### Picking the right resistor

A simple formula can be used to approximate the resistor value in the R-C Network for solenoids, contactors and single-phase motors:

“R” = Device Effective Resistance

“V” = Device Operating Voltage

“I” = Device Full Load Current

$$R = V/I$$

### Examples:

If you know the full load or steady state current of the device, you have all of the information to determine the resistance.

If your inductive load is defined in Watts, you will need to calculate the steady state current. To do that:

“I” = Device Full Load Current and

“W” = Wattage of the inductive device

“V” = Device Operating Voltage

Or you can use  $R=V^2/W$

$$I = W/V$$

$$R = V^2/W$$

- For a 25 watt solenoid operating at 120VAC, the coil current is:

$$25W/120VAC = 0.208 \text{ Amps } (I=W/V)$$

$$R = E/I = 120VAC/0.208\text{Amps} = 576\Omega$$

Chose an R-C network with either a 470 $\Omega$  (L)

R-K Part Number: **RCS1L-6**

- For a 25 watt solenoid operating at 24VAC, the coil current is:

$$25W/24VAC = 1.04 \text{ Amps } (I=W/V)$$

$$R = E/I = 24VAC/1.04\text{Amps} = 23\Omega$$

Chose an R-C network with a 22 $\Omega$  (B) resistor

R-K Part Number: **RCS1B-6**

The calculations seldom match standard resistor values. Pick the resistor with the closest or lower value for the best suppression.

### Voltage Series

1 - 130 VAC Max with Varistor

2 - 130 VAC Max with Varistor

3 - 250 VAC Max with Varistor

7 - 150 VAC Max with Varistor

The addition of a varistor (MOV) will provide better performance by limiting the voltage spikes to the clamping voltage of the varistor. Always pick a varistor that has an operating or nominal voltage rating that is higher than the operating voltage of the device it is being connected to.

If you are completely confused at this point, just us an **RCS1A-6** or **RCS1A-6V** on 120VAC for control voltages equal to or less than 120VAC/VDC. For 240VAC applications you can use the **RCS2A-6** or the **RCS3A-6V**. These are R-K's two most popular R-C Networks.