Voltage balancing resistors

 Ideally when capacitors are placed in series the voltage across each capacitor should be distributed evenly across the capacitors. This does not always occur as intended due to the variations in the leakage currents of the capacitors. The variations in leakage current can lead to some of the capacitors having voltages across them that could exceed their voltage ratings. Exceeding the voltage ratings of a capacitor will compromise the reliability of the capacitor and could have other severe and dangerous consequences. It is therefore important that this situation be avoided in any application. This is particularly important where high voltage electrolytic capacitors are used.
 One way to overcome any potential voltage imbalance is to have capacitors with capacitance values within 5% of each other. This would help minimize the voltage imbalance from occurring without needing to have balancing resistors.
 Electrolytic capacitors however cannot be easily supplied with tolerances less than 10%. For these types of capacitors balancing resistors should be utilized.
 The value of the balancing resistor can be approximated by the following formula:

 $R = 10/C$

 where
 C= Capacitance in uF.
 R= Resistance in mega-ohms.

To calculate the Balancing resistor value more accurately do the following:

1. Determine the leakage current of the capacitor.
2. Calculate the DC resistance value of the capacitor using the formula
3. Balancing resistor value will be 10% of the calculated DC resistance value.

$$R_{DC} = \frac{\text{Rated voltage}}{\text{Leakage current}}$$

4. Balancing resistor wattage rating is calculated by determining the amount of current flowing through the balancing resistor multiplied by the voltage across the resistor.

When a series- parallel combination is utilized it is recommended that each capacitor have a balancing resistor placed across it.