

## Maximize SWaP Savings and Performance with Low ESR Capacitors

The US military continues to significantly increase its spending on directed energy weapons. These high-power microwave and laser technologies continue to demand more power in smaller sizes to fit on mobile land, sea and air-based platforms. The same holds true for advanced Radar and power management systems. When trying to “feed” these power-hungry products, the type of capacitor used will significantly impact performance, reliability, and size.

Ceramic, polymer, hybrid, aluminum electrolytic, tantalum...the list goes on. There are several capacitor technologies to consider when designing cutting-edge high-power products. Each technology has its own unique advantages and disadvantages which gives a designer a lot to consider, but the capacitor ESR should be one of the key specifications to be mindful of.

ESR is the “Equivalent Series Resistance” of the capacitor. As current flows through the capacitor, there is a voltage drop proportional to the resistance of the capacitor as given by the equation Voltage Drop = I(Amps) x ESR(Ohms)

As applications demand higher currents, the voltage drop attributable to the capacitor plays a much larger role. When determining how much capacitance is needed in a given application, we multiply the current by the pulse width, then divide by the allowable voltage droop. A capacitor with high ESR will have a high voltage drop, therefore the application will require a higher capacitance value to overcome the droop attributed to the ESR.

Beyond the additional capacitance needed, higher ESR caps generate more heat. As currents become extremely high in high power applications, this heat needs to be managed by the addition of heat sinks, or even costly active cooling systems. Low ESR capacitors help minimize cooling needs as they generate less heat.

In order to maximize SWaP savings and optimize system performance in high power/high current applications, low ESR capacitors play a critical role in achieving this goal. As capacitor options are evaluated, designers should pay special attention to how the ESR compares among various capacitor technologies.

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