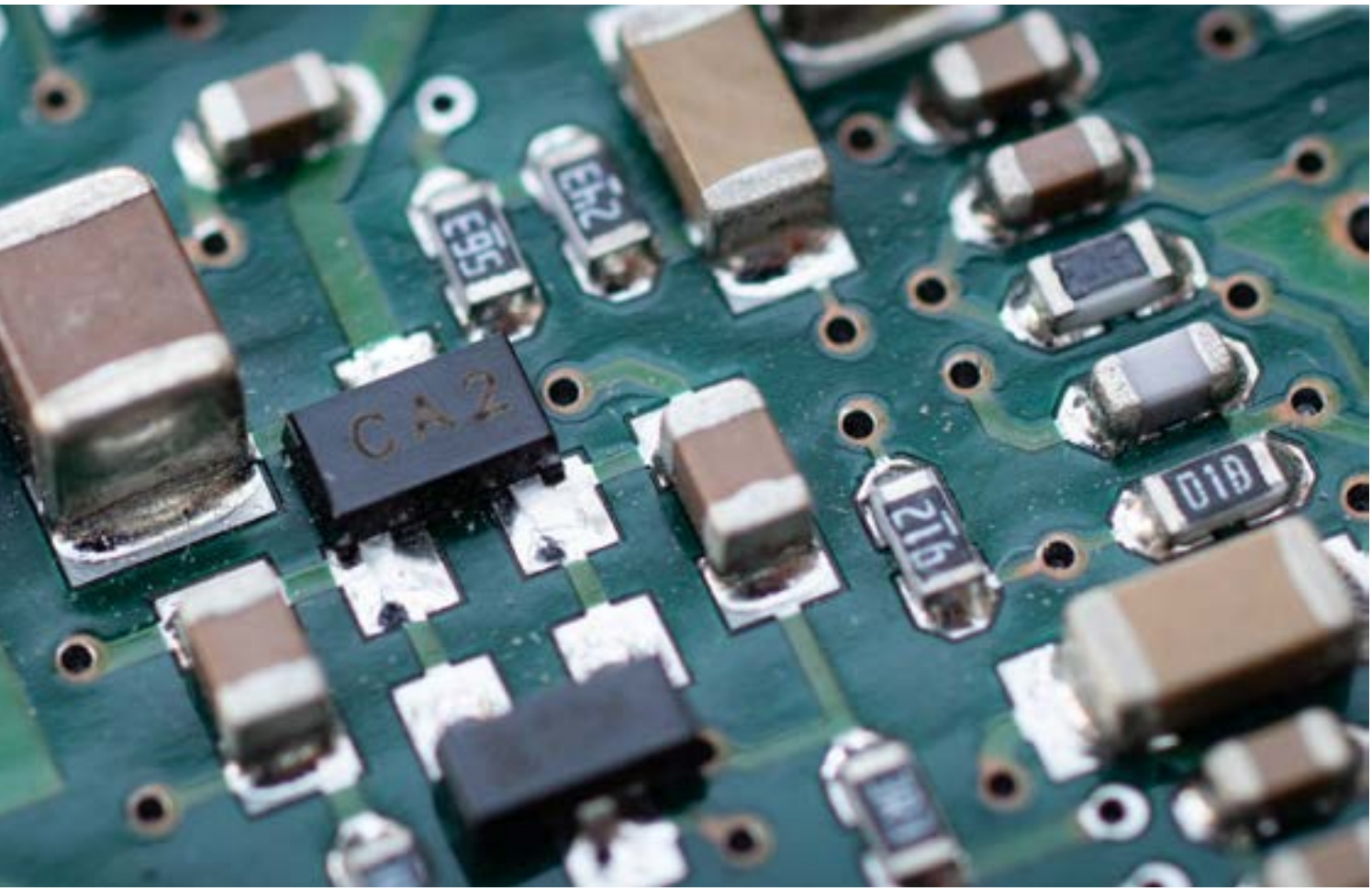
HIGH Q CAPACITORS FOR RF POWER



The generation of RF energy is critical for a wide range of technologies including magnetic resonance imaging (MRI), semiconductor manufacturing, industrial lasers, and wireless charging systems that require high-frequency current and minimal instances of power loss. For example, with an industrial laser, the RF plasma excitation, which is when electrons are broken off an atomic bond and plasma forms, requires RF sources ranging from 1kHz to 40.68MHz depending on the energy required, and a CO2 laser RF power supply that contains a standard source at 13.56MHz, 81MHz, or 125MHz.

These applications requiring high-frequency current face the challenge of power loss in resonant circuits, which is an issue because maintaining efficiency within a power supply is key to optimizing performance. At the component level, power loss is accounted for by considering equivalent series resistance (ESR), which is the measurement of the non-ideal electrical resistances in series with a capacitor. The higher the ESR, the higher the losses in the capacitor.

An example of a circuit that provides greater efficiency by generating a specific frequency is a LC, or "tank", circuit. Within a tank circuit, capacitors store energy in an electric field and impede changes in voltage while inductors store energy in a magnetic field and impede changes in current. When put together in a circuit, capacitors and inductors have energy bouncing back and forth, or oscillating. The right combination of capacitance and impedance determines the frequency where the energy oscillates, which is known as the resonant frequency. By enabling a specific frequency in a desired range, power loss can be minimized in applications requiring high frequency.

To help RF and electrical engineers ensure high performance and reliability of resonant circuits required for high-frequency applications, Knowles Precision Devices offers High Q multilayer ceramic capacitors (MLCCs). These MLCCs are designed and tested to overcome the challenges of developing high-frequency devices that require minimal power loss. Let's take a closer look at how this is done.

High Q MLCCs – The Key to Improving Circuit Performance

To help electrical and RF engineers overcome these challenges with resistance, especially in high-frequency applications, Knowles Precision Devices offers a range of High Q MLCCs. To understand how High Q MLCCs can help decrease power loss and mitigate issues with excessive heat generation in high-frequency applications, let's first discuss what Q factor (quality factor) measures. Q factor is a figure of merit used to rate and compare MLCCs. The Q of a resonator is expressed as the ratio of stored versus lost energy per oscillation cycle. Overall losses through a resonator increase as Q factor drops and will increase more rapidly with frequency for lower values of resonator Q.

MLCCs built with High Q material will have a low εr value and are generally built in the pF range with the goal of mitigating power loss. For example, if a standard C0G, which is a stable Class I dielectric, is used in an MLCC, the MLCC can operate at higher frequencies and will be less inclined to overheat. Therefore, selecting High Q components such as MLCCs is important for devices and applications requiring the generation of RF energy. Knowles Precision Devices offers MLCCs based on a wide variety of High Q dielectrics, including ultra-low ESR, high temperature, high power, ultra-stable, and leaded options.

Learn more about ESR and Q Factor and explore some of our High Q MLCC options.

Learn More

If you need help selecting from our portfolio please contact us and we can guide you through the selection process.

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