The First 3-terminal Ceramic Gap Capacitor

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Decoupling capacitors play a vital role in high-frequency circuits and have various applications, including power supply bypassing, filtering, equalization, compensation, and noise suppression. In these high-frequency scenarios, the impedance of the capacitors is crucial, as the equivalent series inductance (ESL) can limit their effectiveness. Multi-layer ceramic capacitors (MLCCs) are the industry standard because of their high capacitance, compact size, and ease of use. However, the physical construction of MLCCs introduces ESL, which can reduce their effectiveness at high frequencies.

Over the years, there have been many improvements to multilayer ceramic capacitors (MLCCs) aimed at reducing equivalent series inductance (ESL). These improvements include various package sizes, electrode designs, and chip arrays. One of the most significant advancements is the development of the 3-terminal capacitor, also known as the X2Y capacitor, which effectively lowers ESL by minimizing "mounting inductance." Mounting inductance refers to the inductance that arises from the interaction between the capacitor and the printed circuit board (PCB) to which it is connected. This factor is one of the key differences between 2-terminal and 3-terminal capacitors.

Another class of capacitors that have extremely low ESL are single-layer capacitors (SLC). SLCs have excellent performance at very high frequencies because the inductance associated with the device electrodes (or leads) can be reduced to near zero. However, at least two challenges arise with the use of SLCs. The first is that high capacitance is difficult to achieve with only one capacitive layer, with capacitance being limited by how thin this layer can be made. The second is that SLCs require wire bonding in order to be used in typical printed circuit board designs.

New advancements in capacitor designs, including the gap capacitor by Quantic Eulex, have begun to address these limitations. The gap capacitor achieves similar performance to the SLC, due to its ultra-thin, single capacitive layer, but eliminates the need for wire bonding, due to its surface mount design. Despite the excellent ESL of the 2-terminal gap capacitor, it is still limited by mounting inductance. The industry's first 3-terminal gap capacitor by Quantic Eulex achieves the best of both worlds, leveraging the high-frequency performance of the SLC, while achieving the extremely low mounting inductance of the 3-terminal capacitor, all within a surface-mountable package.