CHOOSING A HIGH Q CAPACITOR; ADVANCED CONSIDERATIONS

Dissipation Factor (DF) of a capacitor is comprised of 2 main components:

1. Dielectric Loss which is a property of the dielectric material, and
2. Effective Series Resistance (ESR) which is primarily a function of resistance of the capacitor's electrodes and terminations and the interfacial resistance between them.

The magnitude of each of these components varies with frequency (and temperature in cases of non-NP0 dielectrics).

"Traditional High Q" generally refers to a capacitor which employs a porcelain type dielectric which has a very low Dielectric Loss but must be fired at a high temperature (about 1300 degrees C) which necessitates the use of electrode materials with high melting points, such as various Palladium Silver alloys, which have very low resistance at frequencies up to about 10 MHz and increase moderately with frequency and temperature.

"Low ESR" refers to another subset of High Q capacitors which employ dielectrics which fire at temperatures low enough to allow use of pure Silver electrodes, but which may have slightly higher Dielectric Loss than that used for traditional High Q. However, the pure silver electrodes have lower resistance than the alloy used in traditional High Q, which is particularly important at higher frequencies where most of the conduction occurs at the surface of the electrodes, in effect reducing their thickness and increasing their resistance, making it more important to start with the lowest possible resistance. The combined effects of these factors yields a capacitor which may not have as high a Q as the traditional at the low end of the frequency spectrum but which will be decidedly better at the high end.

The decision as to which cap to use for a given circuit is not an easy one. We do present "Performance Curves" which may be helpful, but keep in mind that these are only typical and may not be applicable to every situation as they are based on data derived from a chip in a particular test fixture as opposed to a real circuit which has its own factors such as resistance and/or inductance which will affect the capacitor's performance as will the resistance inherent in the connection of the cap to the board, the material of the board itself and the position of other components and conductors relative to the capacitor. The two most general rules of thumb are:

1. Minimize circuit resistance in series with the capacitor.
2. Look at the "Low ESR" units first for higher frequency use.

The best solution is almost always to test the capacitor in your circuit before finalizing the parts list. MCI will be happy to supply samples for this.