Filter design uses image parameters

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Reference 1 gives low-cost image-parameter design techniques for LC lowpass filters. Filter design using a low number of circuit elements results in reduced costs for both parts procurement and manufacturing. The technique applies to highpass filters. You derive a composite highpass filter by using m-derived terminating half-sections with one or more constant-k interior full sections. Classic image-parameter design used m-derived half-sections with m=0.6 for best passband impedance matching (in other words, high input and output return losses). The design uses a value of m=0.5 for the terminating half-sections. This value provides sharper close-in selectivity while maintaining passband return losses that are satisfactory for most applications. Figure 1 shows the normalized schematic for the composite highpass filter. It uses midseries, m-derived, terminating half-sections with m=0.5, plus two interior constant-k full sections. The 3-dB cutoff frequency, $f_0$, is 31.2 MHz, and source and load impedances, $Z_0$, are 50W. Reference levels of filter inductance and capacitance are as follows:

You obtain the actual inductance and capacitance values for the highpass filter by denormalization; in other words, by multiplying the normalized inductances and capacitances in Figure 1 by $L_0$ and $C_0$, respectively. Figure 2 shows the actual component values for a dissipationless highpass filter. Table 1 gives the parts list for the filter. Table 2 gives the measured amplitude response for the composite highpass filter. The results indicate inductor unloaded Qs of approximately 100. As the passband frequency approaches 100 MHz, some modest shape degradation occurs. You can reduce the degradation by using microstrip construction with surface-mount components. You can trim the filter's cutoff frequency by spreading or squeezing the turns of the toroidal inductors. (DI #2533)

REFERENCE