PC Board Layout Tips

The relatively long propagation delay and higher insertion loss tend to make SAW components more sensitive to the effects of RF feedthrough than their L-C counterparts. The implications of the higher insertion loss are relatively straightforward to comprehend. For example, if the SAW filter is capable of achieving an ultimate rejection of 55 dBc and the insertion loss of the device is 25 dB, the total isolation required on the PC board is 80 dB. While this may appear to be quite difficult, the techniques recommended in the following section will allow you to achieve these results with adequate margin.

The effects of propagation delay on SAW filter performance as it relates to RF feedthrough suppression are less intuitive to comprehend. To gain some insight into this problem, it is best to examine the SAW filter's response in the time domain. A typical SAW filter impulse response is shown in Figure 1.

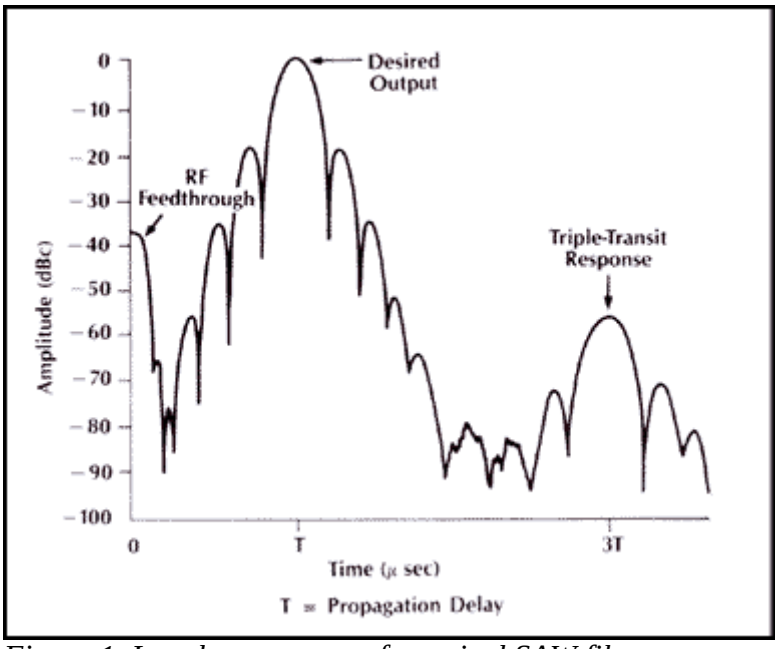

Figure 1. Impulse response of a typical SAW filter

The desired filter output is located at a delay of T µsec. The actual value of T or the SAW propagation delay may he anywhere from 0.5 µsecs to over 20 µsecs depending on the bandwidth and shape factor of the desired response. The time domain sidelobes distributed on either side of the main lobe are not spurious signals but rather they are the natural result of implementing a rectangular filter response in the frequency domain. Since the RF feedthrough or leakage propagates instantaneously in comparison to the SAW energy, it presents itself at T = 0 on the time scale. The level of this RF feedthrough signal in Figure 1 has been exaggerated for clarity. The detrimental effects of RF leakage in the frequency domain are two-fold. First, it serves to degrade the ultimate rejection of the SAW filter by virtue of direct coupling of energy from the input of the filter to its output. The second effect is not so obvious but is equally detrimental. Since the RF feedthrough is actually a time spurious signal, its energy will interfere with that of the desired SAW output, causing periodic ripple in the amplitude, phase and group delay response of the filter. The periodicity of this ripple is equal to the reciprocal of the time separation of the RF feedthrough and the peak of the desired output, or in this case, the reciprocal of the SAW filter's delay. Both of

these detrimental effects are illustrated in Figure 2 below.

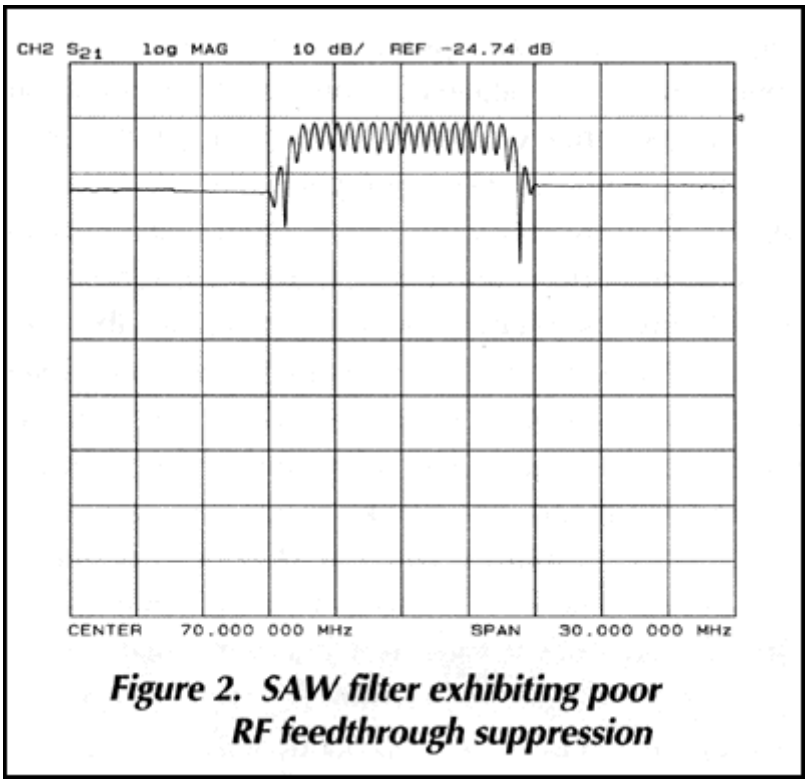

Figure 2. SAW filter exhibiting poor RF feedthrough suppression

The same SAW filter is pictured in Figure 3 with the RF feedthrough suppressed to an acceptable level. Note that the amplitude ripple is almost non-existent and that the ultimate rejection is nearly 60 dB.

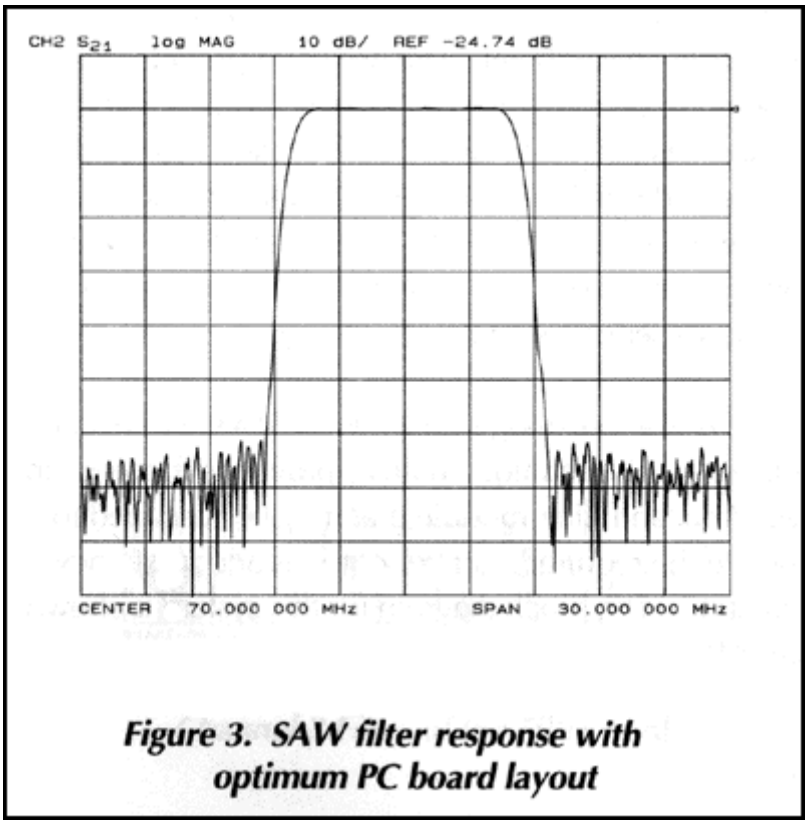

Figure 3. SAW filter response with optimum PC board layout

Optimum PC Board Layout

The following diagram details some recommended steps to take when configuring a PC board to extract the optimum performance from the SAW device. One concept is paramount. The input and the output port must be isolated from one another to the greatest extent possible. In some extreme applications, the PC card can be mounted to a metal septum or compartment to form isolated cavities for each port and its accompanying impedance matching elements.

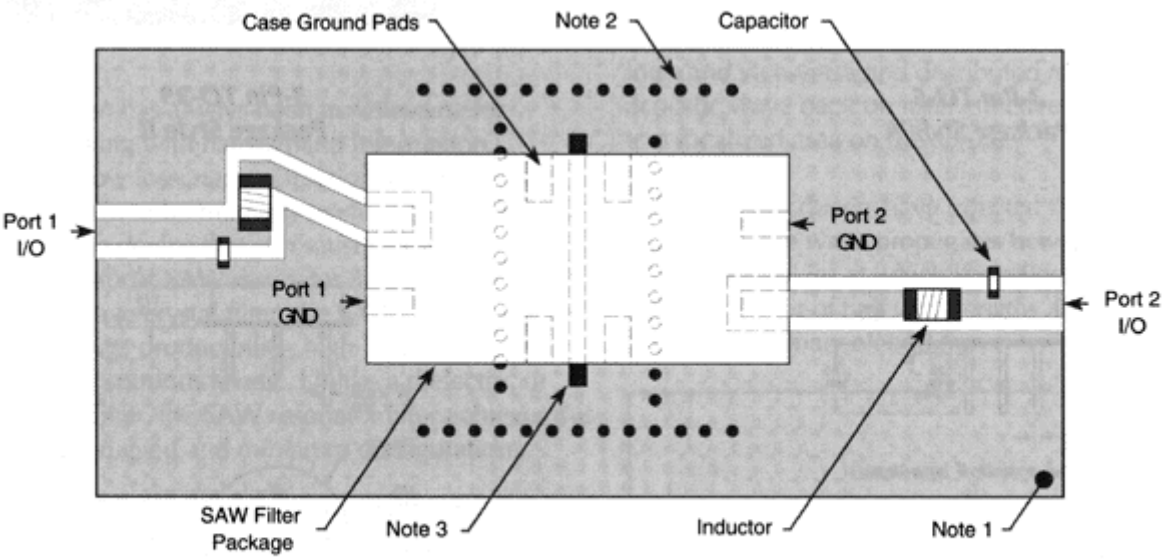

Figure 4. Optimum layout for a SAW package

Notes

1. A ground plane should he present on both the top and bottom of the PC board.

2. Plated-through via holes connecting the top and bottom ground planes should be distributed as shown. Note how the two vertical rows of via holes are offset from one another to increase the isolation.

3. A plated-through slot, isolating the input port from the output port, should be added to minimize RF leakage through the dielectric layer of the PC board.

4. The case of the SAW device must be in direct contact with the ground plane and should not be offset from the board. The case ground pads should be soldered to the ground plane.

5. If a device is going to be matched externally, there are several important techniques that can be used to minimize the crosstalk between the matching components.

a. Place the matching components on the input port perpendicular to those on the output port. This is especially important for inductors.

b. Place the input and output matching components as far apart from one another as reasonably feasible.

c. If possible, mount the input and output matching components on the topside and underside, respectively, of the PC board

d If necessary, RF-shielded matching components can be obtained from various manufacturers to minimize crosstalk.

e. To maximize performance, a metal shield or septum can be placed between the input matching components and the output matching components to prevent electromagnetic energy from radiating to the other side through the free space. This shield is often incorporated as part of the PC board