EE475 Laboratory #3

Building and Testing a High-Frequency Low-Pass Filter

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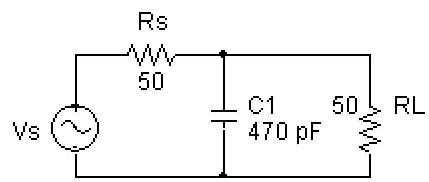
A simple low-pass filter was designed to provide more than 20 dB of attenuation at frequencies above 100 MHz, and less than 1 dB of attenuation below 5 MHz. The filter would be supplied with a 50 Ω source and terminated with a 50 Ω load. A first-order filter was designed using a capacitor.

The capacitor was chosen such that the -1 dB attenuation point would be around 10 MHz. The -1 dB attenuation point for this circuit occurs when the voltage ratio is .891, using the following relationship:

-1 dB = $20 \cdot \log(|V_{out}/V_{in}|)$ which implies $|V_{out}/V_{in}| = .891$

Using voltage divider methods, $V_{out}/V_{in} = 50/(100+j2500\omega C)$.

Setting the magnitude of this ratio to .891 and choosing a -1 dB cut-off frequency of 10 MHz yields a capacitor value of about 530 pF. Using a higher cut-off frequency such as 15 MHz requires a capacitor value of 350 pF. A standard capacitor value of 470 pF was chosen and used in the final design. This yields a –1 dB cutoff around 11 MHz.



Simple Low-Pass Filter

The voltage transfer coefficient was measured and is displayed in the graph below. The low-pass filter meets the specifications, except at high frequencies. Above frequencies around 600 MHz, the attenuation becomes more than -20 dB. This is caused by the inductance that dominates at these high frequencies. Lowering this inductance will bring the attenuation back below -20 dB. The easiest way to lower the inductance is to bend the coax connector so it is closer to the board. Another solution would be to get a *longer* connector that fits the board better—one that does not need to be bent.