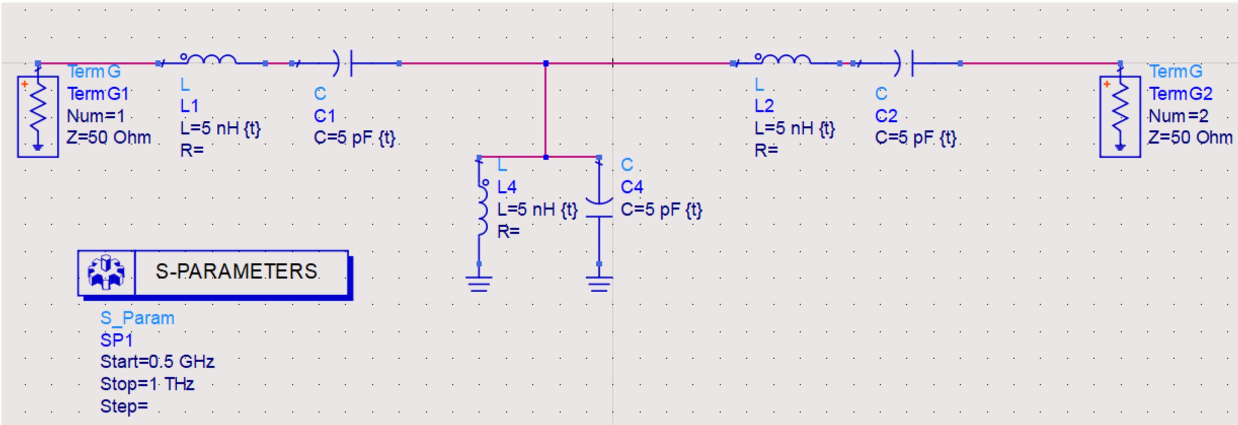
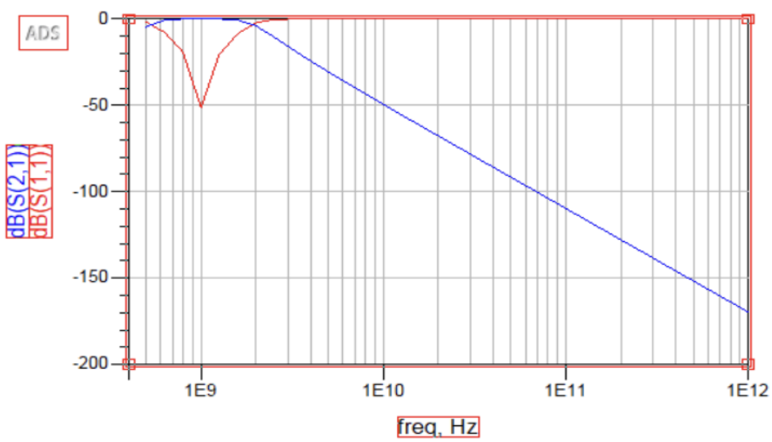
Resonant Frequency Analysis on ADS



The circuit above is designed to analyze the resonant frequency of a bandpass filter. When an inductor and capacitor are in series, they create a short circuit at the resonant frequency (because the inductive and capacitive reactances cancel each other out: the capacitor leads by 90 degrees, and the inductor lags by 90 degrees). Consequently, their effects cancel each other at resonance, resulting in zero voltage. Similarly, when an inductor and capacitor are in parallel, they act as an open circuit at resonant frequencies.



From the graph, the resonant frequency is calculated at approximately 1 GHz using the formula: f_resonant = 1/(2*pi*sqrt(L*C)), L = 5 nH, and C = 5 pF

At this frequency, there is a sharp dip in S11, indicating minimal reflection and maximum power transfer, as expected for a series LC circuit acting as a short at resonance, and parallel LC acting as an open. Similarly, S21 shows the passband behavior of the filter, acting as a bandpass filter near 1 GHz. After the resonant frequency, the series and parallel LC circuits cause attenuation in S21, explaining why S21 decreases after 1 GHz. This behavior is due to the transfer functions 20dB roll-off characteristics beyond resonance.

By modeling the system as three transfer functions—each representing different stages of the circuit—the resulting equivalent transfer function produces a parallel-series bandpass filter. This transfer function accounts for the observed attenuation in the frequency response.