Lecture 3

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- Frequency Dependence (Impedance)
  - Capacitor

$$Z_c = \frac{1}{j\omega C}$$

  - Inductors

$$Z_L = j\omega L = SL$$

  - Note, for capacitors impedance decreases with frequency, while it increases with frequency for inductors
- DC Coupling
  - Amplifier stages are directly connected together
  - High-frequency gain decreases ("rolls off") due to unwanted ("parasitic") capacitances and inductances
- AC Coupling
  - Input-coupling capacitors are sometimes referred to as DC-blocking Capacitors
  - Improved isolation between stages because the capacitors "block" DC current/voltages ($Z_c = 1/j\omega C \to$ infinite impedance at $\omega = 0$)
  - Impacts the low-frequency response
- Impact of Parasitics (Stray Inductances/Capacitances)
  - Stray inductances/capacitances (often called "parasitics") result from non-ideal properties of materials:
    * Integrated circuits, chip packages, printed circuit boards, cables, ...

- High-frequency gain reduction from:
  * Capacitors in parallel with the signal path
  * Inductors in series with the signal path
- Computer-based simulations are used for complex models and circuits

- Half-Power Bandwidth
  - $P_o = (AV_{\text{inRMS}})^2/R_L \rightarrow P_o = P_{max}/2$ when$A = A_{max}/\sqrt{2}$
  - By convention, the frequencies f_H and f_L at which $P_o = P_{max}/2$ are referred to as half-power frequencies or -3db frequencies
    * Note: $20\log\left(A_{max}/\sqrt{2}\right) = 20\log(A_{max}) - 20\log\left(\sqrt{2}\right) = A_{max(\text{dB})} - 3.01\text{dB}$
  - Amplifier bandwidth: $B = f_H - f_L$