EE40
Lecture 18
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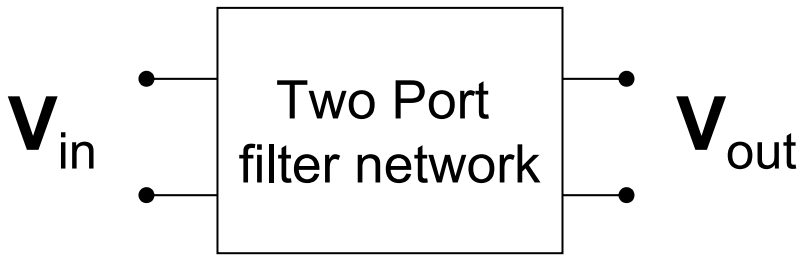
3/07/08

Reading: Chap. 6: Filters, two-terminal elements, Bode plots.

Transfer Function

- Transfer function is a function of frequency
  - Complex quantity
  - Both magnitude and phase are functions of frequency

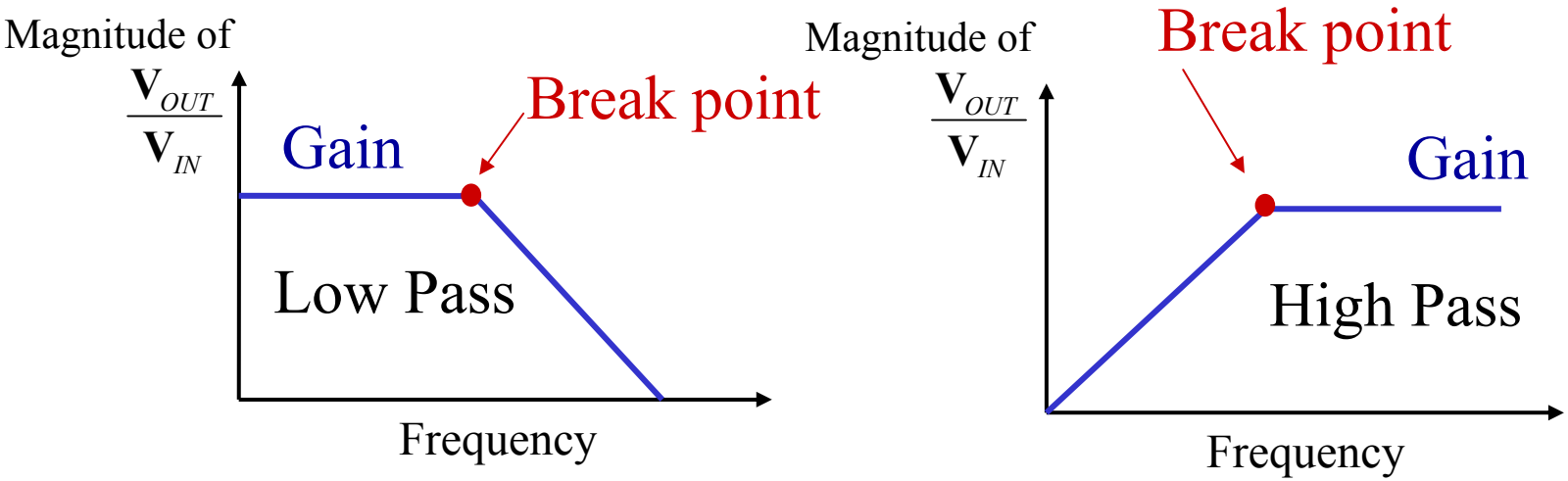


$$\mathbf{H}(f) = \frac{\mathbf{V_{out}}}{\mathbf{V_{in}}} = \frac{V_{out}}{V_{in}} \angle \left(\theta_{out} - \theta_{in} \right)$$

$$\mathbf{H(f)} = H(f) \angle \theta$$

Frequency Response

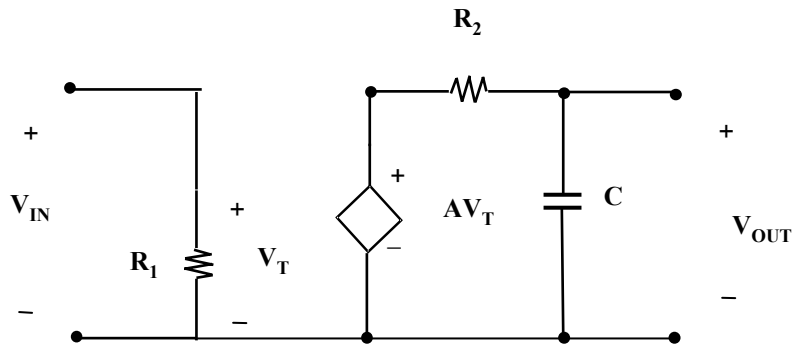
- The shape of the frequency response of the complex ratio of phasors $\mathbf{V}_{OUT}/\mathbf{V}_{IN}$ (i.e. both the magnitude and the phase) is a convenient means of classifying a circuit behavior and identifying key parameters. We will soon discuss quick and dirty ways of approximating this shape via a piecewise linear approximation based on asymptotes, as in the magnitude plot approximations below:



Only positive frequencies need be considered, since the plots for negative frequencies can be inferred from this

FYI: These are usually log of the ratio vs log frequency plots

Example Circuit



$$TransferFunction = \frac{\mathbf{V}_{OUT}}{\mathbf{V}_{IN}}$$

$$\frac{\mathbf{V}_{OUT}}{\mathbf{V}_{IN}} = \frac{AZ_c}{Z_R + Z_c}$$

$$\frac{\mathbf{V}_{OUT}}{\mathbf{V}_{IN}} = \frac{A(1/jwC)}{R_2 + 1/j\omega C)} = \frac{A}{(1 + j\omega R_2 C)}$$

A = 100

R_1 = 100,000 Ohms

R_2 = 1000 Ohms

C = 10 uF

Filters

- Filters are circuits designed to retain a certain frequency range and discard others
  - *Low-pass*: pass low frequencies and reject high frequencies
  - *High-pass*: pass high frequencies and reject low frequencies
  - *Band-pass*: pass some particular range of frequencies, reject other frequencies outside that band
  - *Notch*: reject a range of frequencies and pass all other frequencies

Common Filter Transfer Function vs. Freq