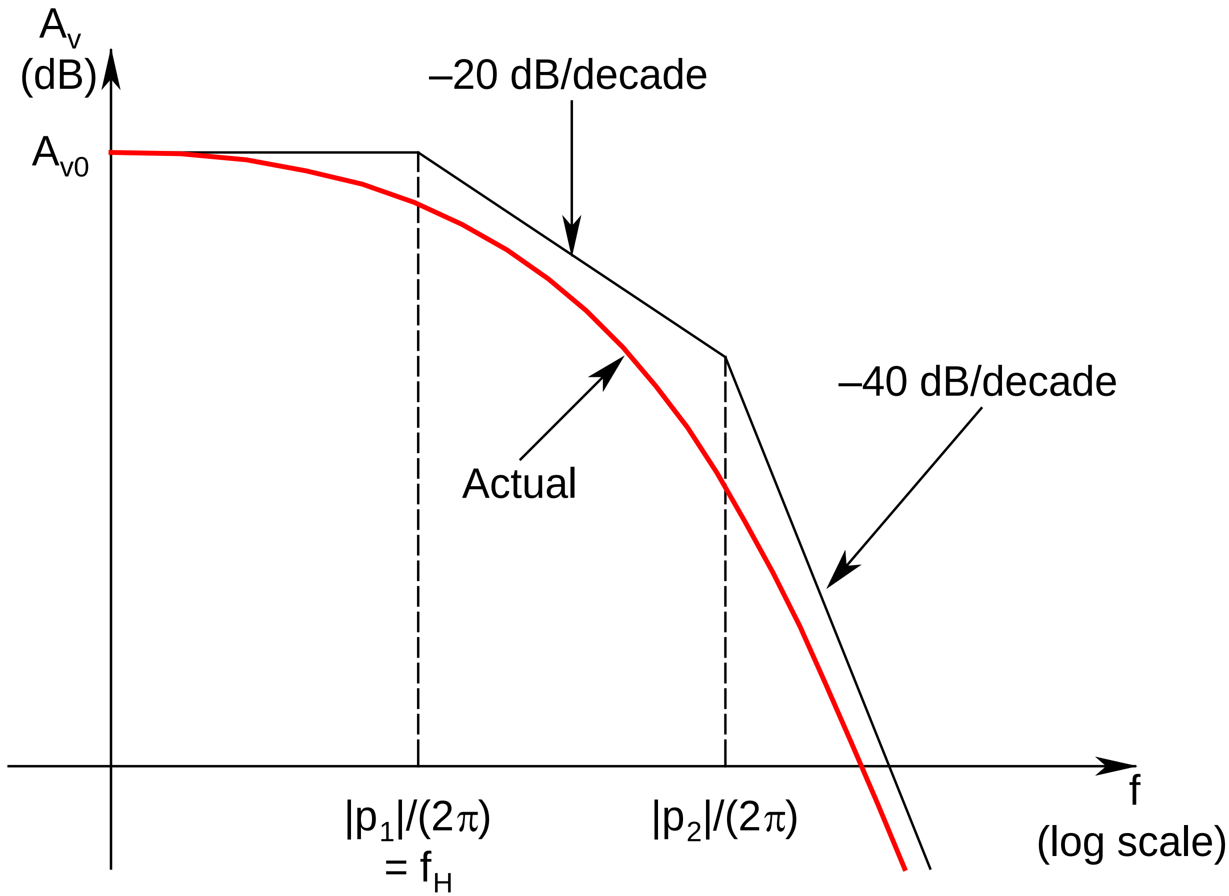
- ***DPA***:
  - The ***smallest pole*** [***Dominant Pole*** (DP)] is ***at least 10 times away from its nearest pole***
  - This is an ***excellent approximation for practical analog circuits***
- ***Apply this approximation*** and ***assume p_1 to be the DP*** and ***at least 10 times away from p_2*** [***Non-Dominant Pole*** (NDP)]
- The ***pole frequencies*** are $|p_1|/(2\pi)$ and $|p_2|/(2\pi)$
- ***Note***: $|p_1|/(2\pi)$ is the ***Upper Cutoff Frequency*** (f_H)



Bode Plot of the Frequency Response of a 2-Pole System

- ***2-pole system***
- ***For frequencies till the first pole p_1, gain remains constant at its midband value of $20\log_{10}A_{v0}$***
- ***Beyond this***, the ***gain rolls off at –20 dB/decade till the second pole p_2 is encountered***
- ***After this***, the ***gain rolls off at –40 dB/decade***, and ***eventually crosses zero***
- ***Beyond this***, the circuit actually ***attenuates the input signal instead of amplifying it*** (***gain magnitude drops below unity***)

- ***It's assumed that z_1 is >> $|p_2|$***
- ***Task remains to find p_1 and p_2***
- ***Under DPA***, Eq.(2) can be simplified as:

  $D(s) \approx 1 - s/p_1 + s^2/p_1p_2$ (4)
- ***Comparing*** Eq.(4) with the ***denominator*** of Eq.(1):

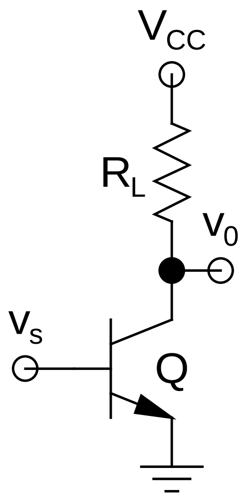
$$p_1 = -\frac{1}{\left(R_S \,||\, r_\pi\right)C_\pi + \left[\left(R_S \,||\, r_\pi\right) + R_L + g_m\left(R_S \,||\, r_\pi\right)R_L\right]C_\mu}$$

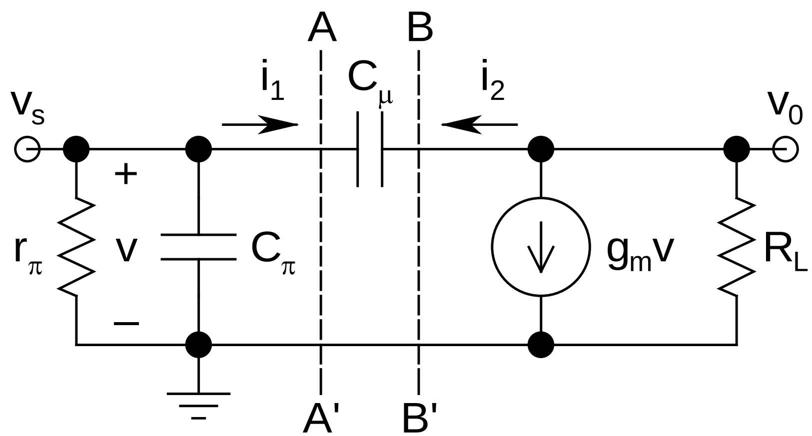
$$p_2 = -\left(\frac{1}{R_L C_\mu} + \frac{1}{\left(R_S \,||\, r_\pi\right)C_\pi} + \frac{1}{R_L C_\pi} + \frac{g_m}{C_\pi}\right)$$

- In general, $|p_2| >> |p_1|$
- ***Ex.***: I_C = 1 mA, β = 200, R_S = 1 kΩ, R_L = 2 kΩ, C_π = 10 pF, C_μ = 0.5 pF

  $\Rightarrow$ ***DPF*** = 3.8 MHz, ***NDPF*** = 798.8 MHz, ***ZF*** = 12.3 GHz, and f_H = ***DPF*** = 3.8 MHz
- ***Note***: Even for a ***simple CE circuit***, the ***analysis is so cumbersome***, and the ***results are so complicated***
- ***Definitely not acceptable for routine application***, ***particularly for circuits having more than one active device***

- ***Miller Effect Approximation***:
  - ***Technique by which an input-output coupled circuit can be decoupled by removing the coupling element***
  - This ***removal*** is done by ***splitting*** it into ***two components*** - putting ***one in the input circuit***, and the ***other in the output circuit***
  - We take the ***same example*** as the ***CE circuit*** discussed earlier, but now ***without*** R_S





ac Schematic **High-Frequency Equivalent**

- ***Identify C_μ as the input-output coupling element***
- After ***application*** of the ***technique***, this ***coupling element*** will be ***removed*** by ***splitting*** it into ***two parts*** - ***one at input***, ***other at output***