Tutorial on Frequency Response

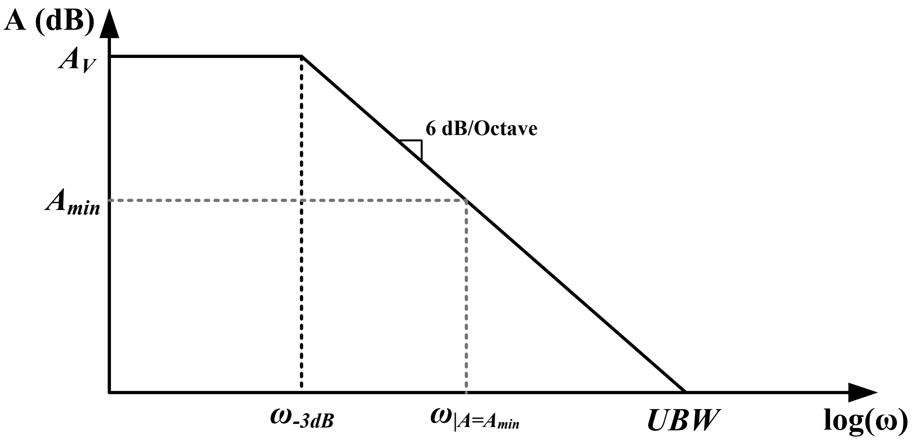
$$A_V = g_m R_o$$

$$\omega_{-3dB} = \frac{1}{C_o R_o}$$

At A = A_V,

$$\text{Gain Bandwith Product (GBW)} = A_V \cdot \omega_{-3dB} = \frac{g_m}{C_o}$$

We can also draw the Bode plot,



For a single-pole system, when $\omega > \omega_{-3dB}$, it is defined that A decreases 6dB/octave (which is not 100% true, see the appendix). This means A decreases by two when ω increases by two and GBW is a constant when $\omega > \omega_{-3dB}$.

At A = A_{min},

$$\text{GBW} = A_{min} \cdot \omega_{|A=A_{min}} = \frac{g_m}{C_o}$$

$$\rightarrow \omega_{|A=A_{min}} = \frac{g_m}{C_o \cdot A_{min}}$$

At A = 1 (i.e. 0dB),

$$\text{GBW} = 1 \times \text{Unity Gain Bandwidth (UBW)} = \frac{g_m}{C_o}$$

With the information above, you should be able to design the comparators.

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Appendix

For a single-pole system,

$$A(s) = \frac{A_V}{\sqrt{1 + \frac{s}{\omega_{-3dB}}}}$$

The magnitude is given by:

$$|A(j\omega)| = \frac{A_V}{\sqrt{1 + \left(\frac{\omega}{\omega_{-3dB}}\right)^2}}$$

$$\log\ |A(j\omega)| = \log A_V - \frac{1}{2}\log\left(1 + \left(\frac{\omega}{\omega_{-3dB}}\right)^2\right)$$

$$20 \cdot \log\ |A(j\omega)| = 20 \cdot \log A_V - 10 \cdot \log\left(1 + \left(\frac{\omega}{\omega_{-3dB}}\right)^2\right)$$

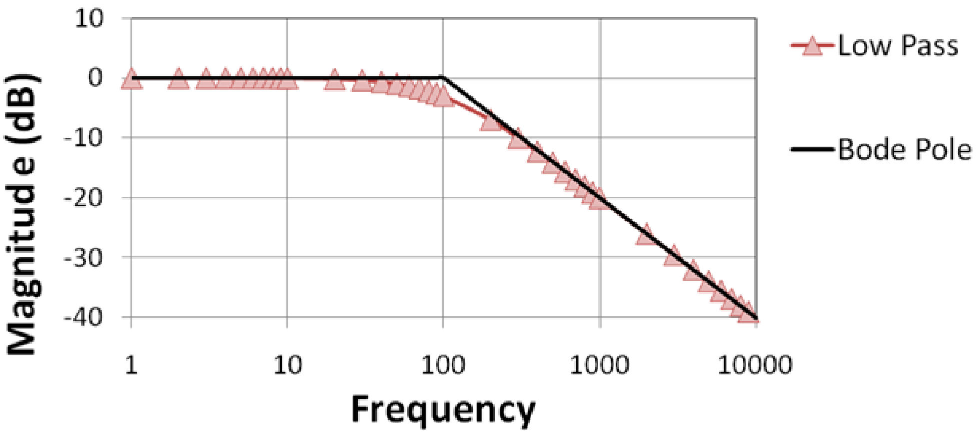
At $\omega = \omega_{-3dB}$, $$20 \cdot \log|A(j\omega)| = 20 \cdot \log A_V - 3\text{dB}$$

When $\omega >> \omega_{-3dB}$, $$20 \cdot \log|A(j\omega)| = 20 \cdot \log A_V - 10 \cdot \log\left(\frac{\omega}{\omega_{-3dB}}\right)^2$$

$$20 \cdot \log|A(j\omega)| = 20 \cdot \log A_V - 20 \cdot \log\left(\frac{\omega}{\omega_{-3dB}}\right)$$

which means when ω increases by 2, the gain decreases by 6dB.

The gain decreases by 6dB when $\omega >> \omega_{-3dB}$.



(From Wikipedia, http://upload.wikimedia.org/wikipedia/commons/c/cc/Bode_Low-Pass.PNG
Should be Bode Plot, not Bode Pole)

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