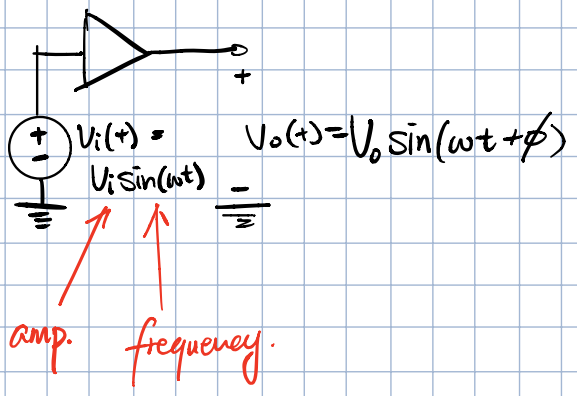
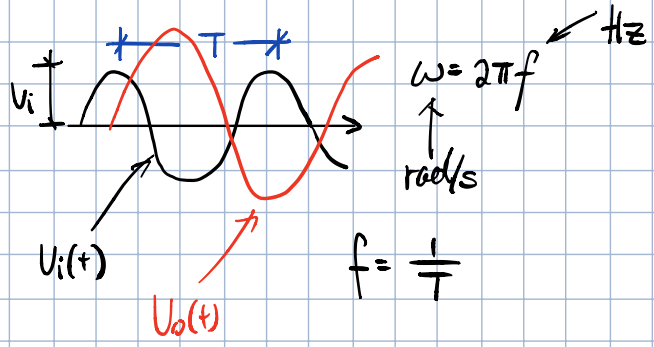
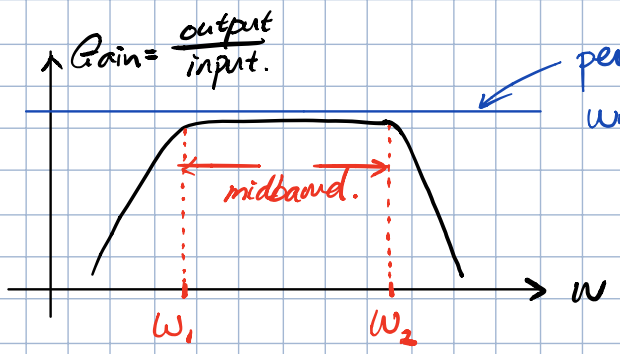
→ single time constant.

STC, Bode Plots

Frequency response of amplifiers.

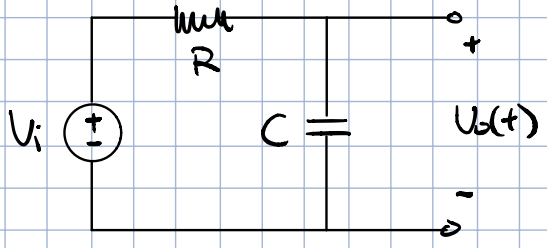




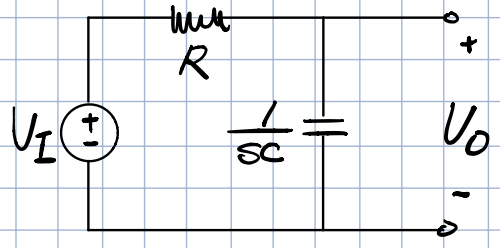


bandwidth (B.W.)

RC network. (STC) → single time constant.



Time domain cct.



Frequency domain cct.

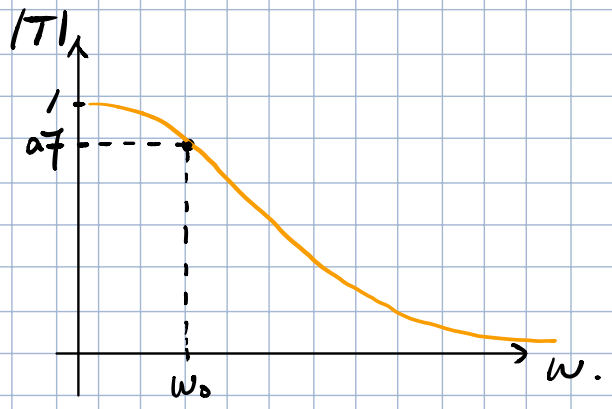
$\frac{V_o}{V_I}$ (transfer function) $T(s) = \frac{\frac{1}{sC}}{\frac{1}{sC} + R} = \frac{1}{1 + s/\frac{1}{RC}}$

for $s = j\omega$, $T(j\omega) = \frac{1}{1 + j\omega/\frac{1}{RC}} \rightarrow \omega_0 = \frac{1}{RC}$

$= \frac{1}{1 + j\omega/\omega_0}$

magnitude $|T(j\omega)|$ vs. ω

$$|T(j\omega)| = \frac{1}{\sqrt{1+\left(\frac{\omega}{\omega_0}\right)^2}}$$



$\omega = 0$, $|T(0)| = 1$

$\omega = \omega_0$, $|T(j\omega_0)| = \frac{1}{\sqrt{2}}$

$\omega = 10\omega_0$, $|T(10j\omega_0)| = 0.1$

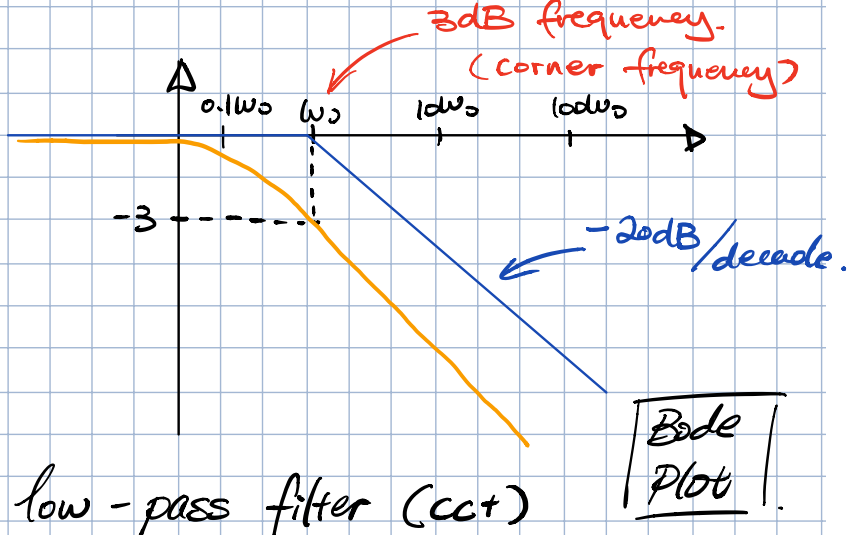
$\omega = \infty$, $|T(\infty)| = 0$

log. frequency scale.

$20\log 1 = 0$

$20\log \frac{1}{\sqrt{2}} = -3dB$

$20\log 0.1 = -20dB$

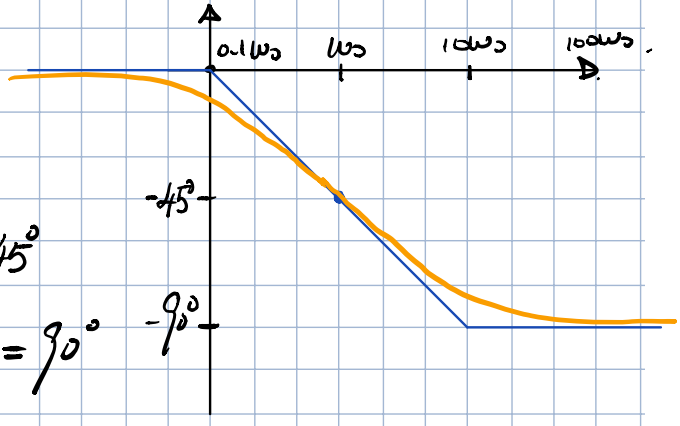


low-pass filter (cct)

Bode Plot

phase plot

$$\angle T(\omega) = 0^\circ - \tan^{-1}\left(\frac{\omega}{\omega_0}\right)$$

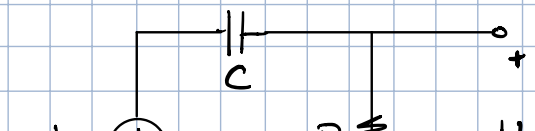


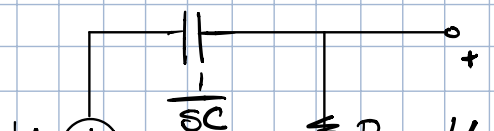
$\omega = 0$ $\quad \angle T(0) = -\tan^{-1}(0) = 0^\circ$

$\omega = \omega_0$ $\quad \angle T(\omega_0) = -\tan^{-1}(1) = 45^\circ$

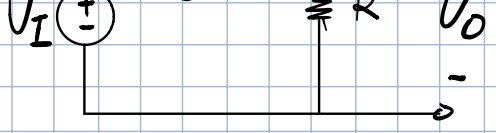
$\omega = 10\omega_0$ $\quad \angle T(10\omega_0) = -\tan^{-1} 10 = 90^\circ$

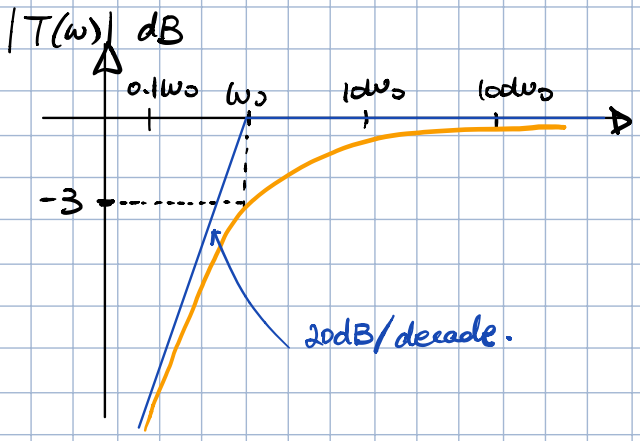
How about this?

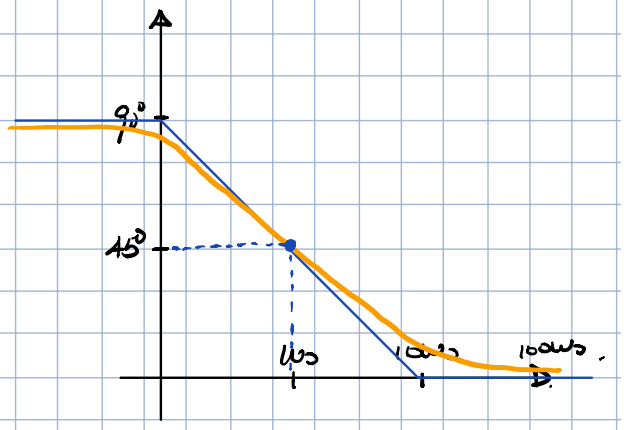





V_i
R
$V_2(t)$


V_I
R
V_O


|T(ω)| dB
0.1ω₀
ω₀
10ω₀
100ω₀
-3
20dB/decade.


90°
45°
ω₀
100ω₀