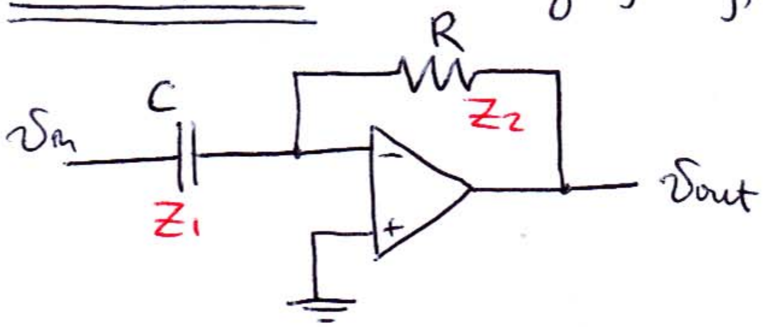
Example 1: stability of differentiator



Unstable if $\underbrace{GH}_{\text{appr. loop gain}} = -1$

Here $H = \dfrac{Z_1}{Z_2 + Z_1} = \dfrac{1}{1 + j\omega RC}$; $G = \dfrac{G_0}{1 + j\omega/\omega_0} \xrightarrow{\omega \gg \omega_0} \dfrac{G_0\omega_0}{j\omega}$

bare op-amp

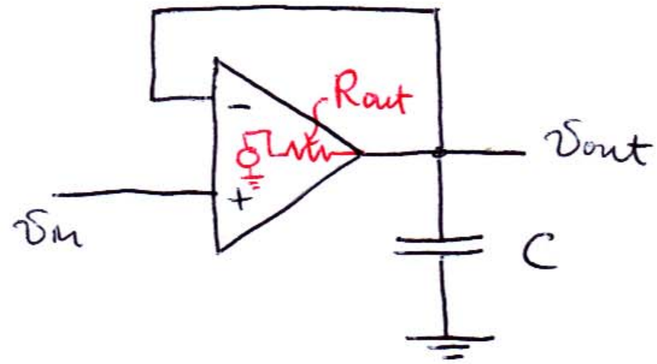
$$\Rightarrow \quad GH \approx \frac{1}{j\omega RC}\,\frac{G_0\omega_0}{j\omega} = -\frac{G_0\omega_0}{\omega^2 RC} \qquad \omega \gg (RC)^{-1}$$

We see that GH is headed to hit $GH = -1$ condition at

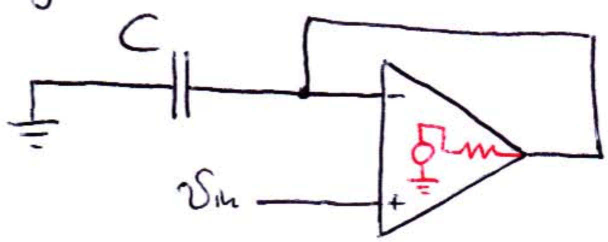
$$\omega = \sqrt{\frac{G_0\omega_0}{RC}}$$ ← freq. of expected "ringing" on the output

N.B. : check with measured behaviour in the lab.

Example 2 stability of voltage follower driving C

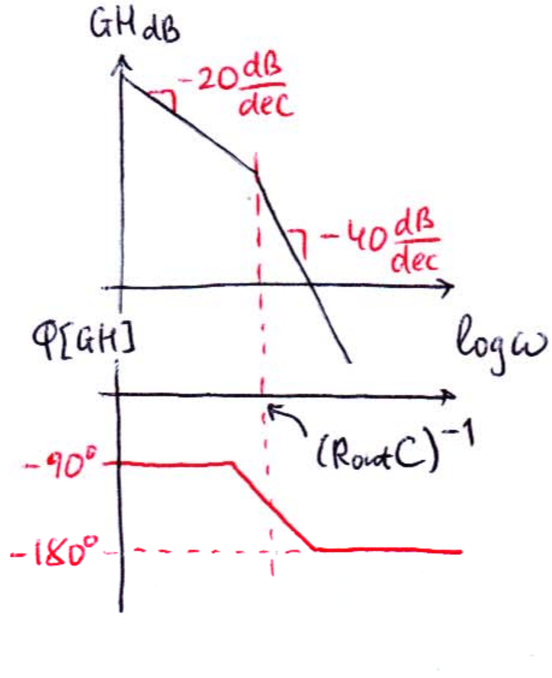


Rearrange circuit so that it looks as



The loop gain is $GH = \dfrac{G_0}{1+j\omega/\omega_0} \dfrac{Z_C}{Z_C + R_{out}}$

for $\omega \gg \omega_0$ $\quad GH \approx \dfrac{G_0 \omega_0}{j\omega} \dfrac{1}{1+j\omega R_{out} C}$



$\varphi[GH]$ hits $-180°$ eventually.

The question is whether $|GH| \lessgtr 1$ when that happens.

If $\omega_{CL} = \dfrac{1}{R_{out} C}$ is sufficiently large $\left(C \ll \dfrac{1}{R_{out} G_0 \omega_0} \right)$, the circuit is stable.

E.g. $C \ll 100pF$ for 741