Devoir 3

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1. Etude théorique

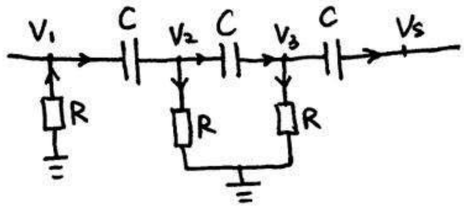
1. la fonction de transfert

Avec l'interrupteur I1 fermé, les diodes sont court-circuité

D'après cours, on a

$$H(j\omega) = \frac{V_s}{V_1} = \frac{A}{1 - A\beta(j\omega)}$$

Ici, β :



C = 10NF
R = 1KΩ

$$\begin{cases} \frac{0 - V_1}{R_1} = \frac{V_1 - V_2}{1/j\omega C} \\ \frac{V_1 - V_2}{1/j\omega C} = \frac{V_2 - V_3}{1/j\omega C} + \frac{V_2}{R} \\ \frac{V_2 - V_3}{1/j\omega C} = \frac{V_3}{R} + \frac{V_3 - V_s}{1/j\omega C} \end{cases}$$

D'après calcule, on a trouvé :

$$\beta(j\omega) = \frac{V_1}{V_s} = \frac{1}{1 + \frac{6}{j\omega CR} + \frac{5}{j\omega CR^2} + \frac{1}{j\omega CR^3}}$$

avec C=10NF
R=1KΩ

et A d'amplificateur est : $A = -\frac{R_2}{R_1} = -\frac{R_2}{R}$

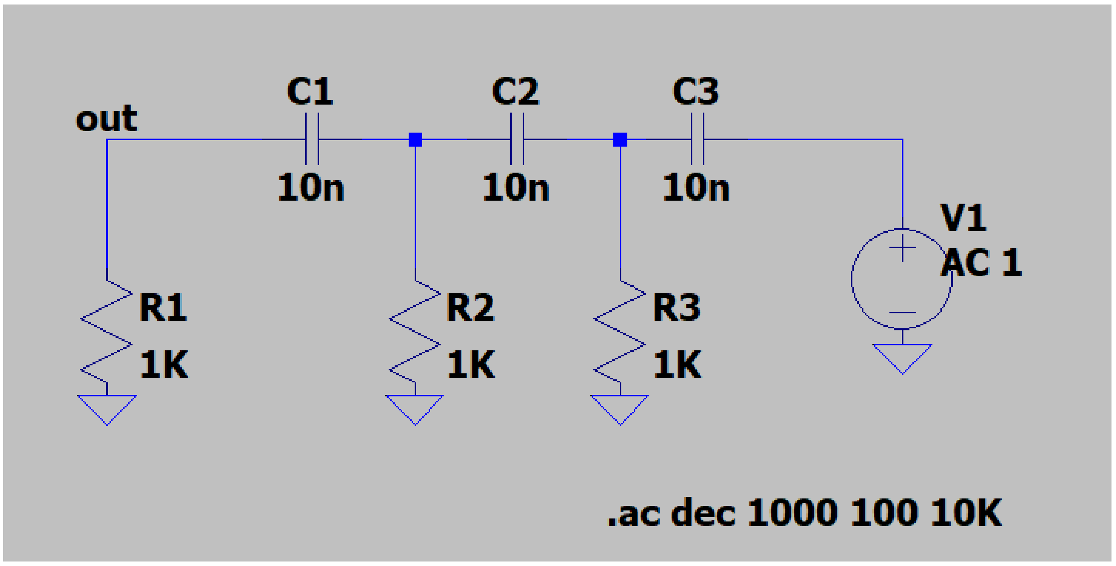
Alors, la fonction de transfert est :

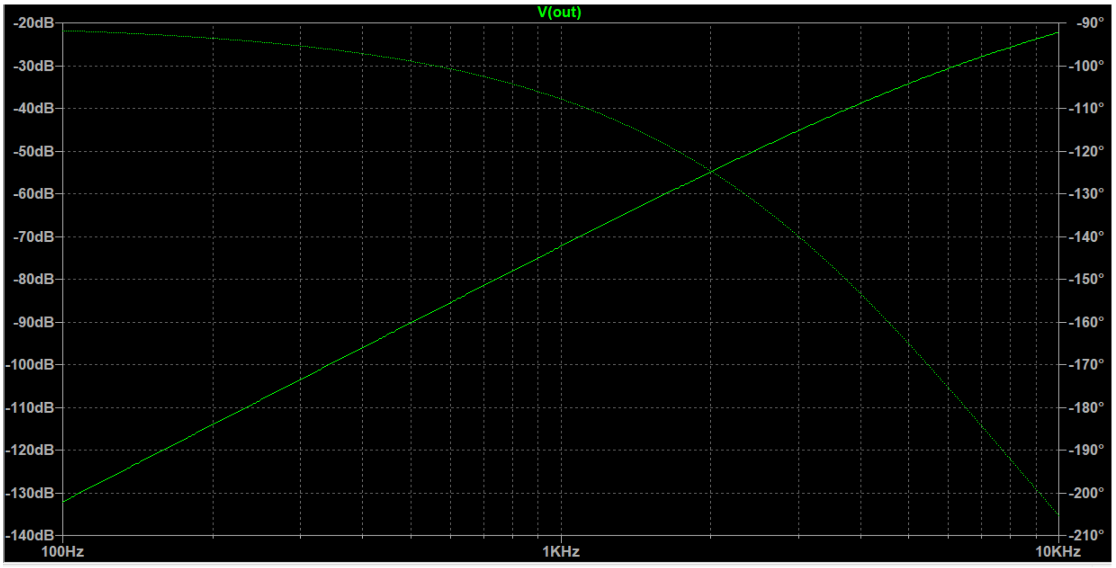
$$H = \frac{-\frac{R_2}{R}}{1 + \frac{R_2}{R}\left(\frac{1}{1 + \frac{6}{j\omega CR} + \frac{5}{(j\omega CR)^2} + \frac{1}{(j\omega CR)^3}}\right)}$$

avec C = 10NF
R = 1kΩ

2. Etude numérique

2. simulation du déphaseur RC :





3. F0 et le gain correspondant

① $\varphi(\beta(jw)) = -\arctan\left(1 - \frac{5}{(wCR)^2} + j\left(\frac{1}{(wCR)^3} - \frac{6}{wCR}\right)\right)$

$= -\pi$

Donc, $\frac{1}{(wCR)^3} - \frac{6}{wCR} = 0 \Rightarrow w = \frac{1}{CR\sqrt{6}}$

Alors, $w_0 = \frac{1}{CR\sqrt{6}}$

$f_0 = 1/\frac{2\pi}{w_0} = 1/2\pi RC\cdot\sqrt{6} = 1/2\sqrt{6}\,\pi RC$

$R = 1K\Omega$ et $C = 10nF$

Donc, $f_0 \approx 6497\ Hz$

② $A = \frac{1}{|\beta|} = 1/\left|\frac{1}{1 - \frac{5}{\frac{1}{6}}}\right| = 29$

Cursor 1

	V(out)		
Freq:	6.5012969KHz	Mag:	-29.237389dB
		Phase:	-180.03417°
		Group Delay:	24.815017µs

4. la stabilité

Cursor 1

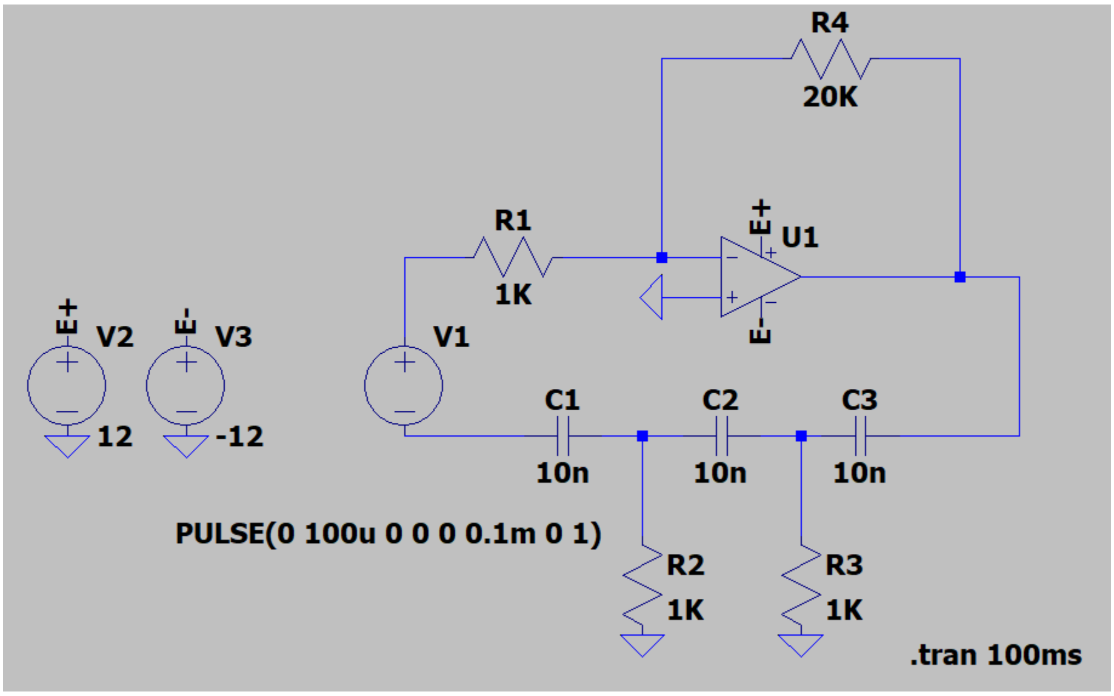
	V(out)		
Freq:	6.5012969KHz	Mag:	-29.237389dB
		Phase:	-180.03417°
		Group Delay:	24.815017µs

	V(out)		
Freq:	6.4863443KHz	Mag:	-29.278778dB
		Phase:	-179.90046°
		Group Delay:	24.864303µs

Par les deux séries de nombres, on peut calcule et obtient

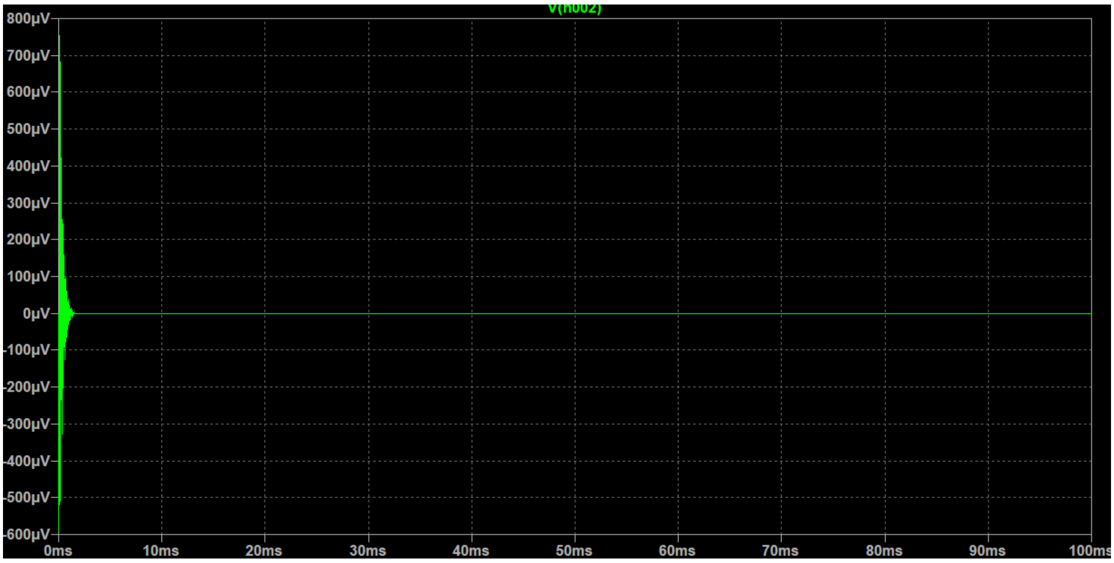
S=1.01.

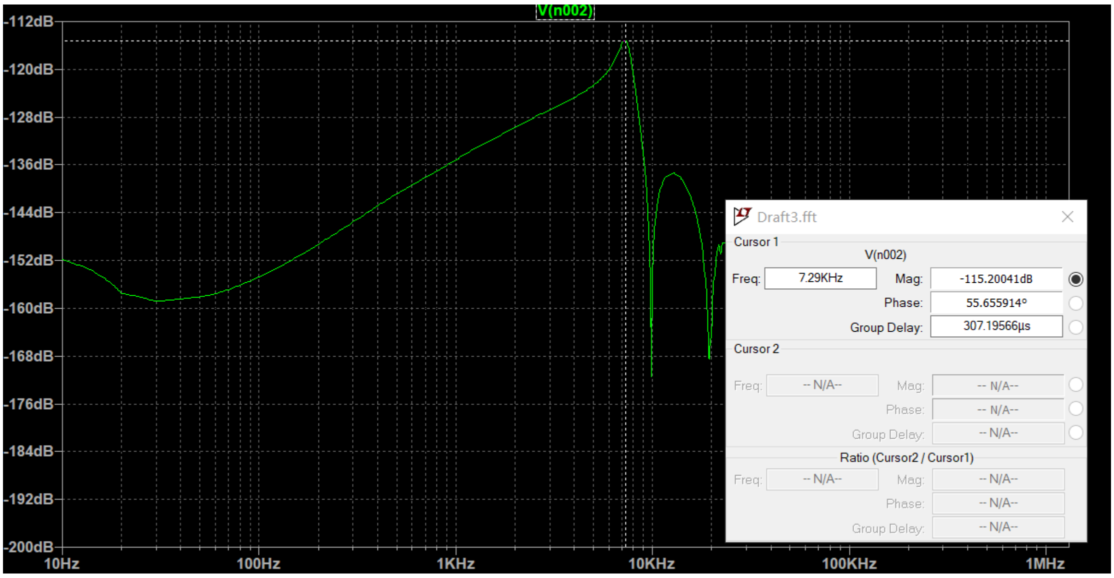
5. schéma complet



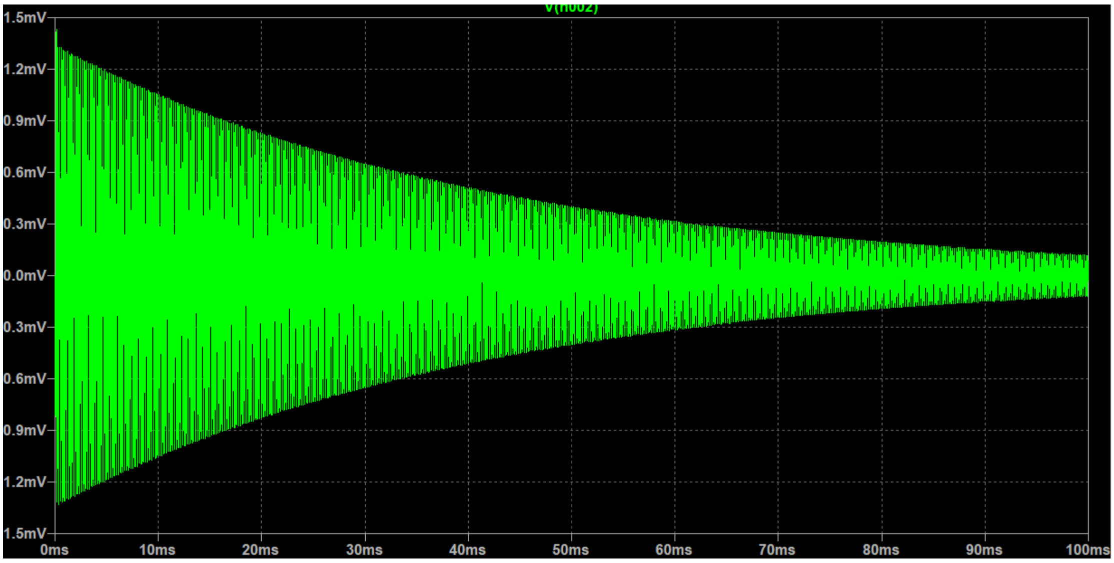
6. trois cas

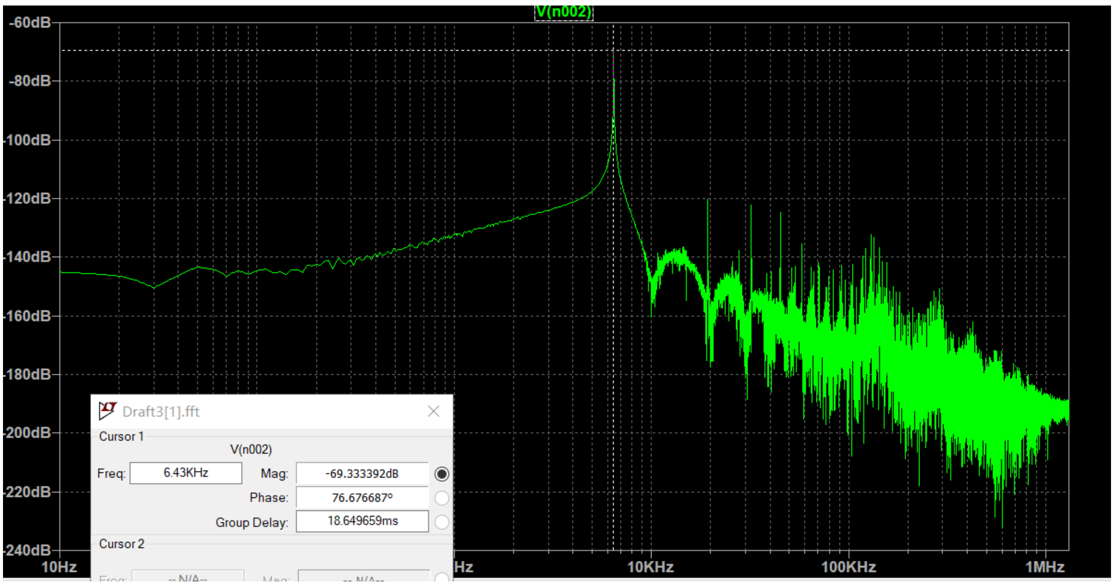
Cas 1 : R2=20KΩ, A β <1



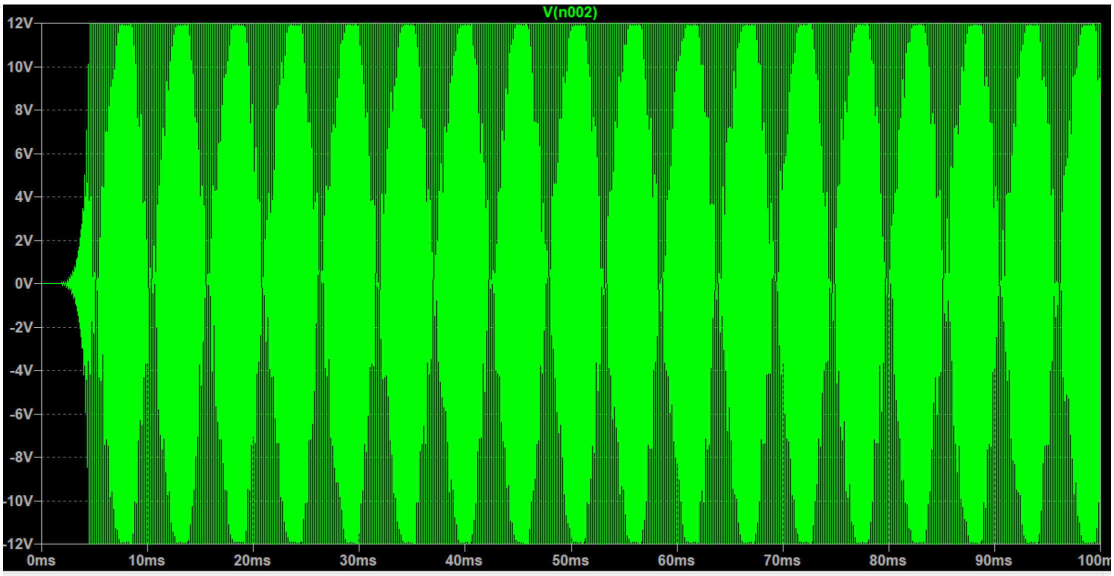


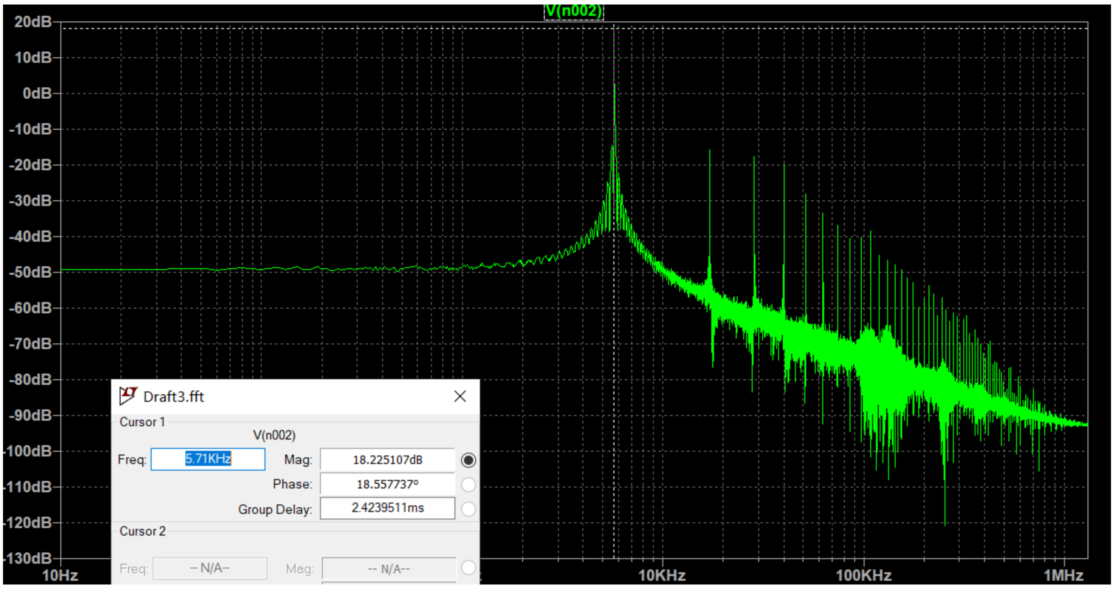
Cas 2 : R2=29KΩ, $A\beta=1$



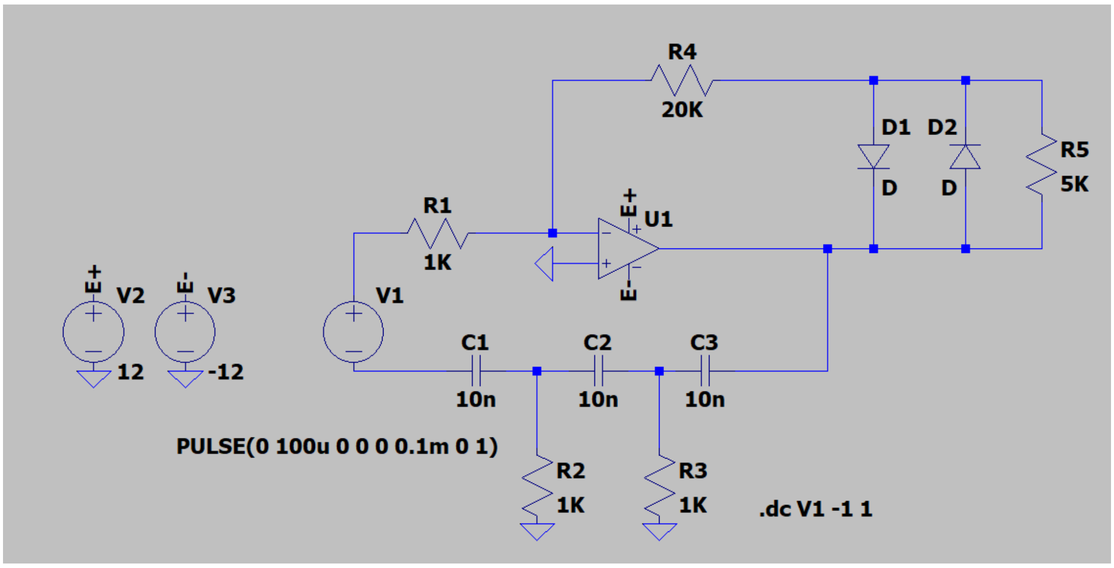


Cas 3 : R2= 40KΩ, Aβ=1





7. le schéma de l'amplificateur opérationnel seul, avec I1 ouvert



8. Simulation : bien linéaire