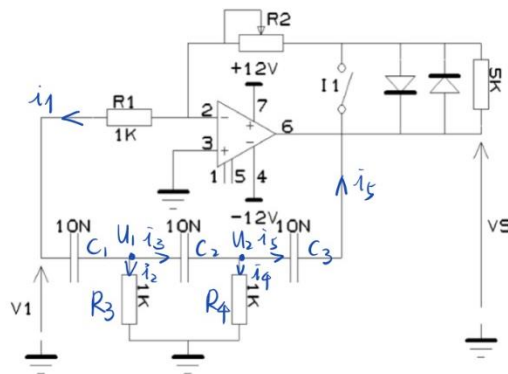


Devoir signaux

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I Étude théorique

1.



Soit $R_1 = R_3 = R_4 = R = 1k\Omega$
 $C_1 = C_2 = C_3 = C = 10nF$

$$i_1 = -\frac{V_1}{R} = j\omega C (V_1 - U_1) \Rightarrow U_1 = V_1 + \frac{V_1}{j\omega CR} = V_1 \left(1 + \frac{1}{j\omega CR}\right)$$

$$i_1 = i_2 + i_3 = \frac{U_1}{R} + j\omega C (U_1 - U_2) \Rightarrow U_2 = U_1 \left(2 + \frac{1}{j\omega CR}\right) - V_1$$

$$i_3 = i_4 + i_5 = \frac{U_2}{R} + j\omega C (U_2 - V_S) \Rightarrow V_S = U_2 \left(2 + \frac{1}{j\omega CR}\right) - U_1$$

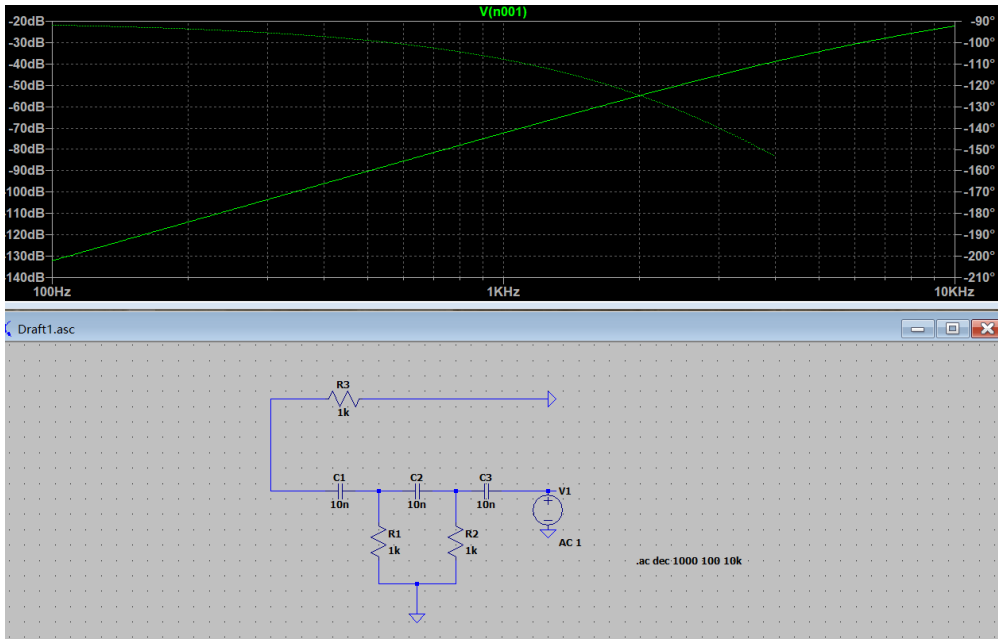
$$\begin{aligned} V_S &= \left[U_1 \left(2 + \frac{1}{j\omega CR}\right) - V_1 \right] \left(2 + \frac{1}{j\omega CR}\right) - U_1 \\ &= \left[V_1 \left(1 + \frac{1}{j\omega CR}\right) \left(2 + \frac{1}{j\omega CR}\right) - V_1 \right] \left(2 + \frac{1}{j\omega CR}\right) - V_1 \left(1 + \frac{1}{j\omega CR}\right) \\ &= V_1 \left[\left(1 + \frac{3}{j\omega CR} - \frac{1}{(\omega CR)^2}\right) \left(2 + \frac{1}{j\omega CR}\right) - \left(1 + \frac{1}{j\omega CR}\right) \right] \end{aligned}$$

$$\frac{V_1}{V_S} = \frac{1}{1 - \frac{1}{(\omega CR)^2} + \frac{6}{j\omega CR} - \frac{1}{j(\omega CR)^3}} = \frac{1}{1 - \frac{1}{(\omega CR)^2} - j\left(\frac{6}{\omega CR} - \frac{1}{(\omega CR)^3}\right)}$$

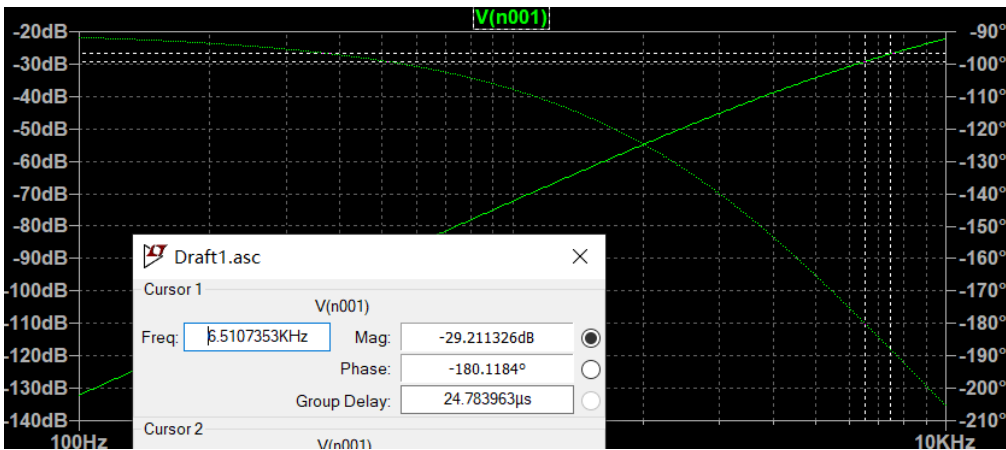
^
1
/
2
v

II Étude numérique

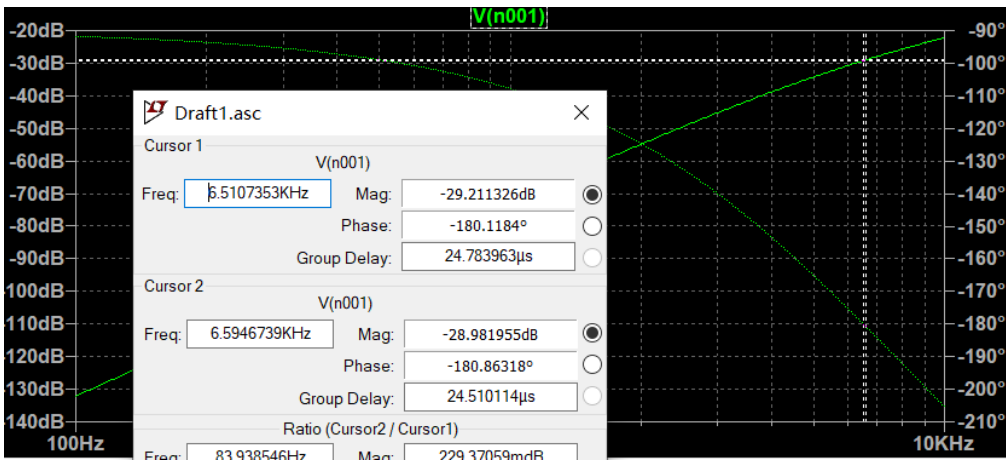
2.



$$3.F_0 = \frac{1}{2\pi\sqrt{6}RC} \approx 6.5\text{kHz}, A = \frac{1}{|\beta|} = 29.$$



4.



$$S(\omega_0) = \frac{d\varphi}{d(\omega R)} \Big|_{\omega=\omega_0} \quad \omega_0 = 2\pi f_0$$

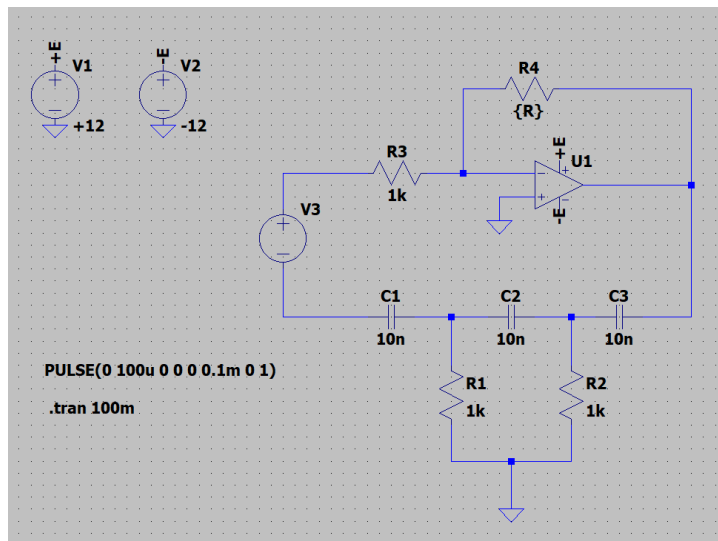
$$d\varphi = \frac{1}{1 + \left[\frac{(\omega CR)^2 - 1}{(\omega CR)^2 - 5\omega CR} \right]^2} \times \frac{12\omega R [(\omega CR)^3 - 5\omega CR] - [(\omega CR)^2 - 5][6(\omega CR)^2 - 1] CR d\omega}{[(\omega CR)^3 - 5\omega CR]^2}$$

$$S(\omega_0) = \frac{12\sqrt{6}}{29} \approx 1.01$$

D'après la simulation:

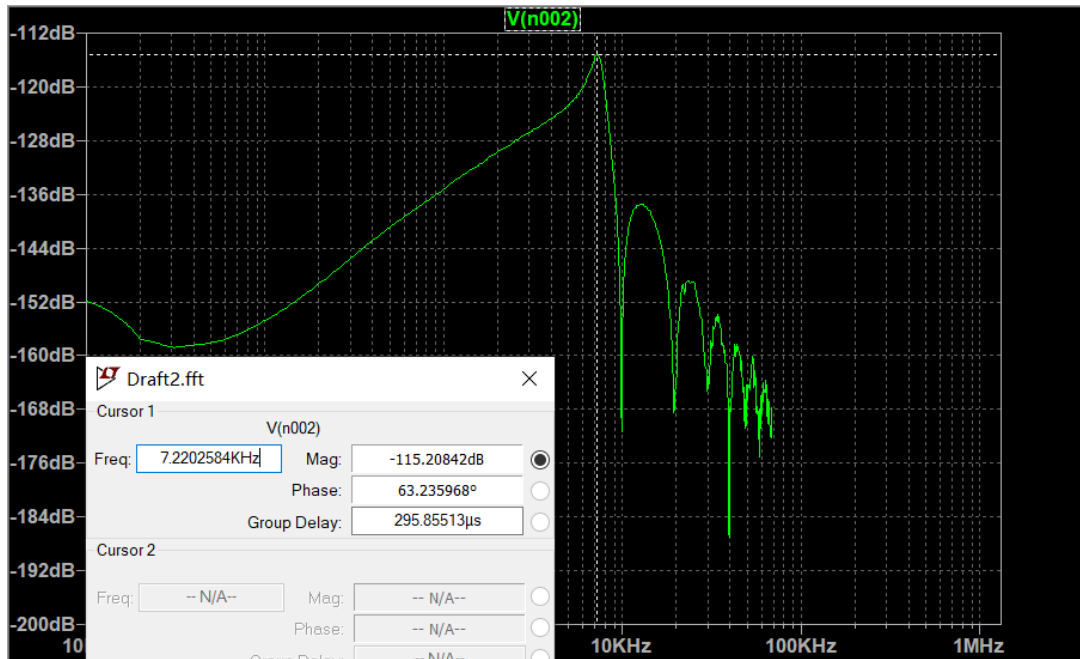
$$\left| \frac{d\varphi}{d\frac{\omega}{\omega_0}} \Big|_{\omega=\omega_0} \right| = \left| \frac{\omega_0}{2\pi} \frac{d\varphi}{df} \right| = \left| \frac{\omega_0}{2\pi} \frac{(-180.1184 + 180.8618) / 180^\circ \times \pi}{6510.733 - 6594.6739} \right| = 1.007$$

5.

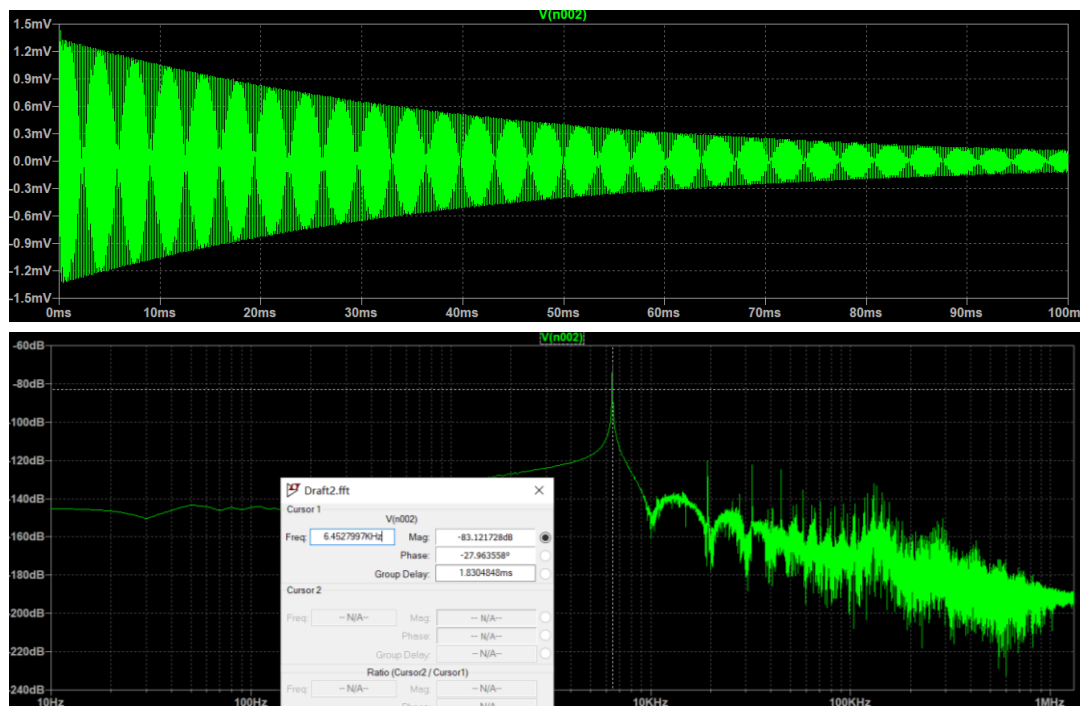


6.1 $A\beta < 1, R_2 = 20k$.

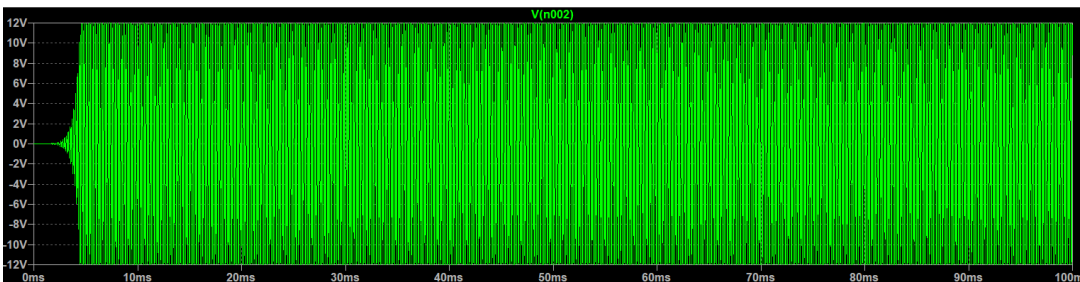


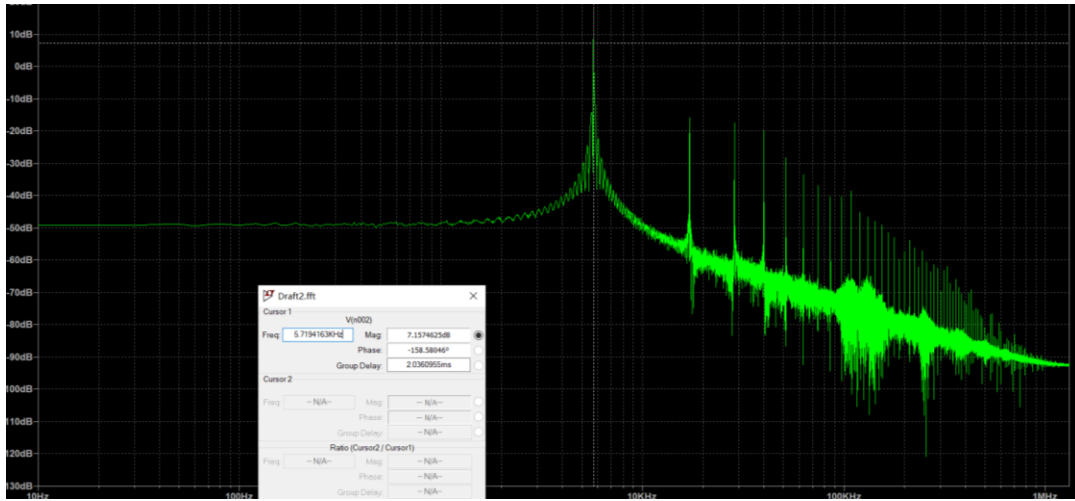


6.2 $A\beta = 1, R_2 = 29k$.

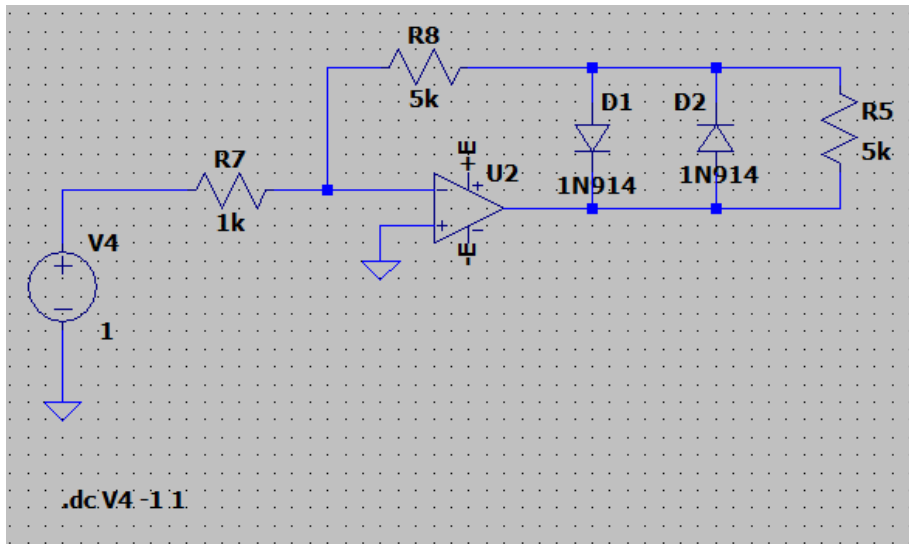


6.3 $A\beta > 1, R_2 = 40k$.

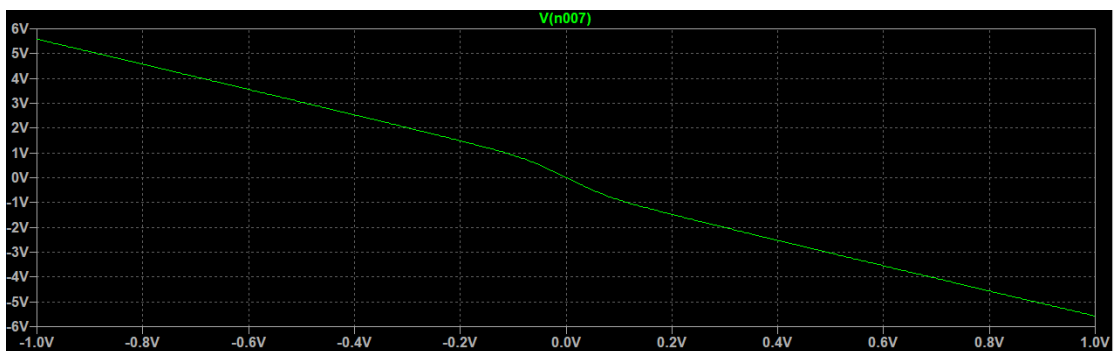


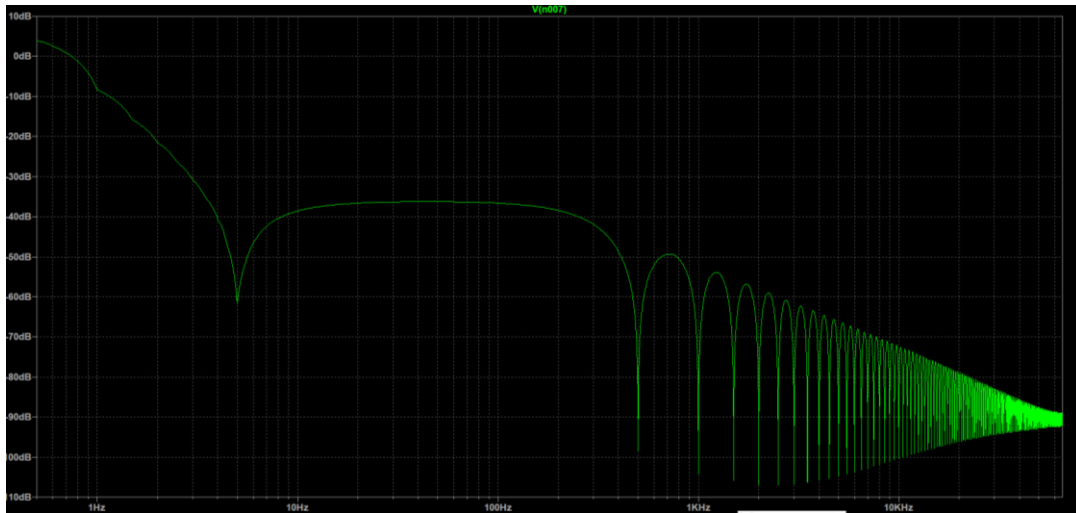


7.



8.





Le gain introduit par les dipodes n'est pas linéaire.