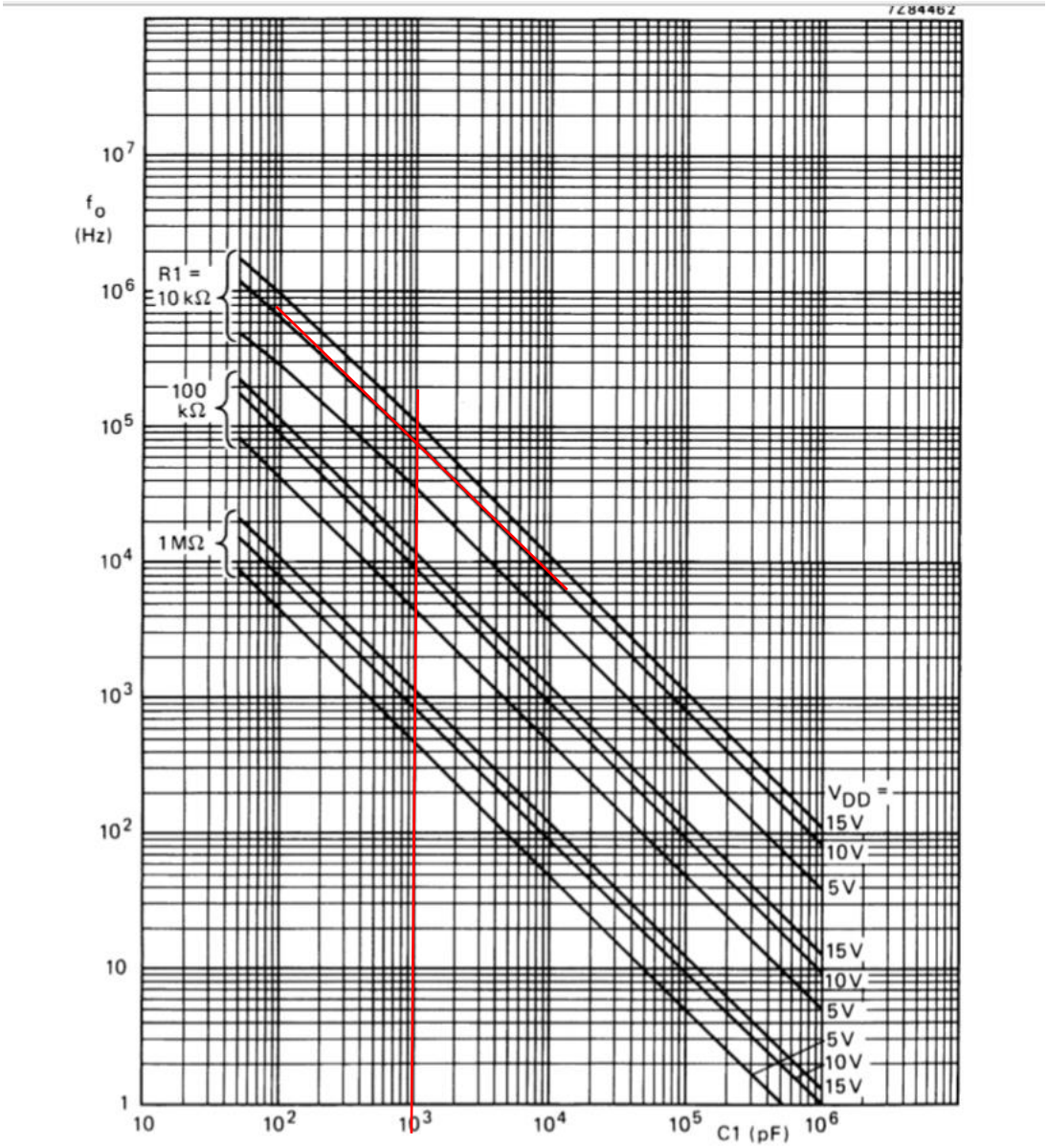
Étude de la PLL CD4046B

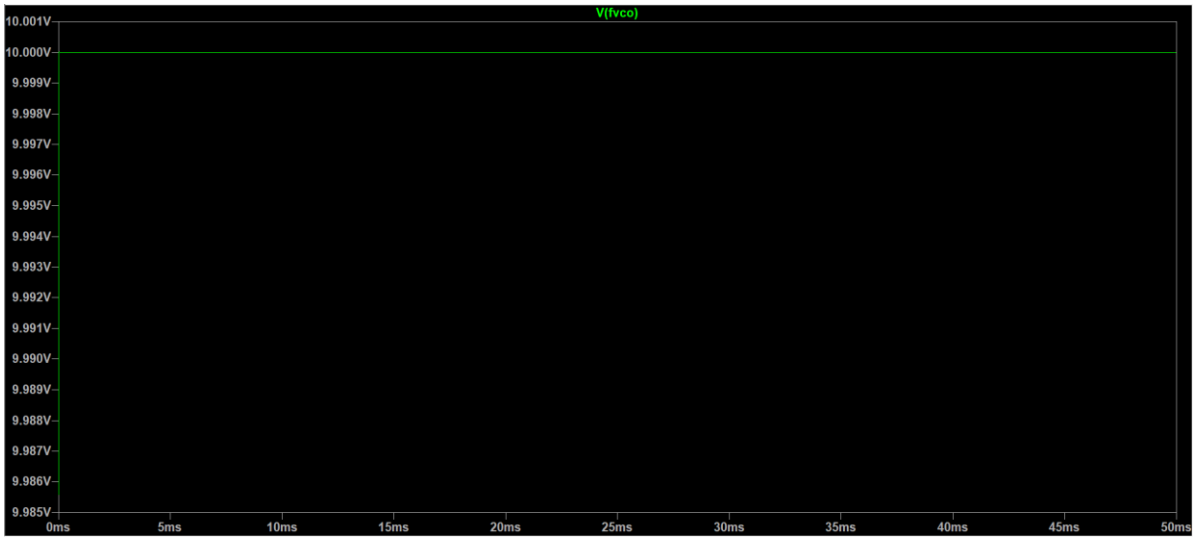
1 Caractérisation du VCO

1. C1=1nF, R1=10kΩ, R2 infinie, donc on choisit la figure 7

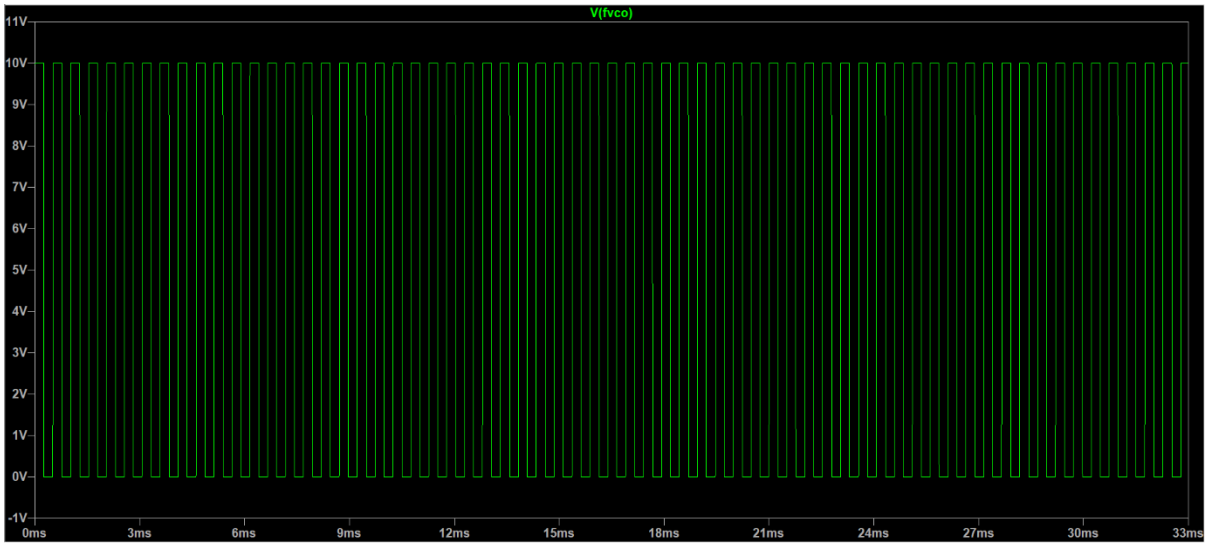


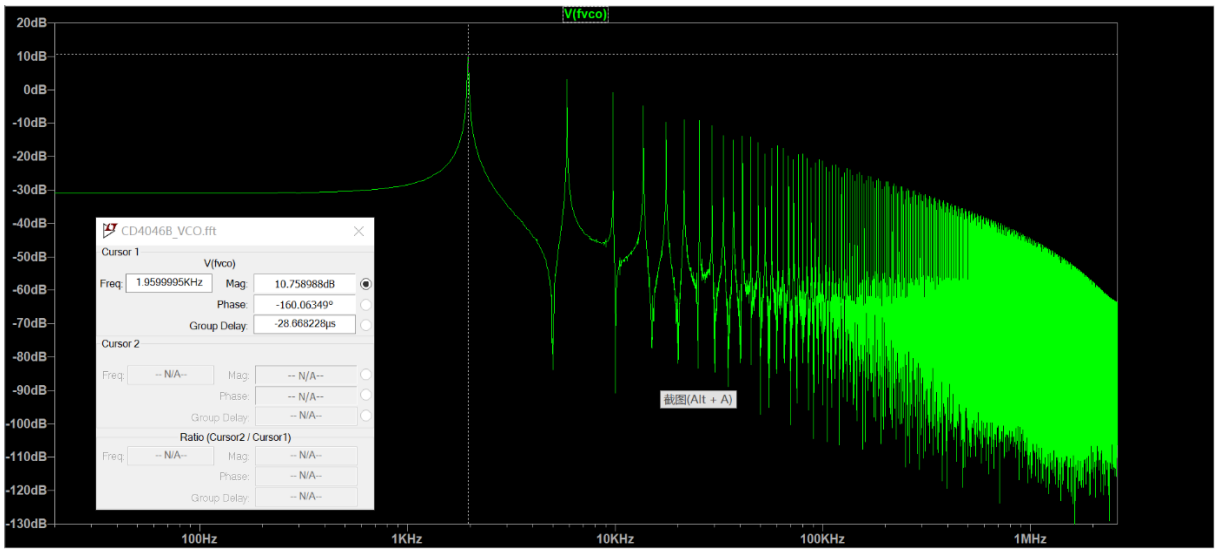
On peut voir que f0 = 75kHz, fmax = 2f0 = 150kHz, le plage de fonctionnement 150kHz

2. Quand V1=0V,



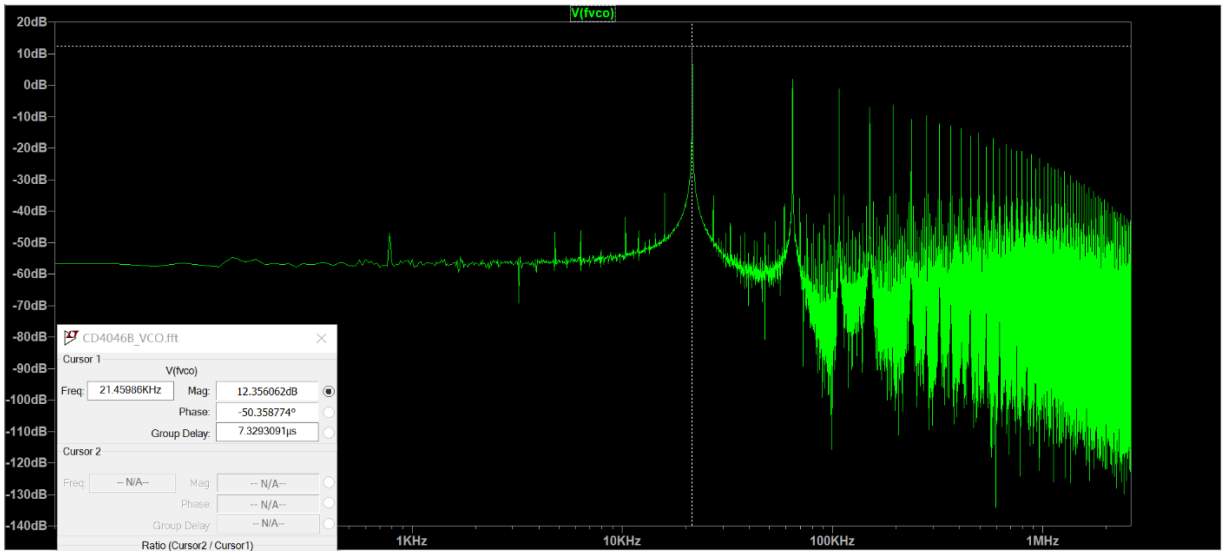
Quand V1=1V,





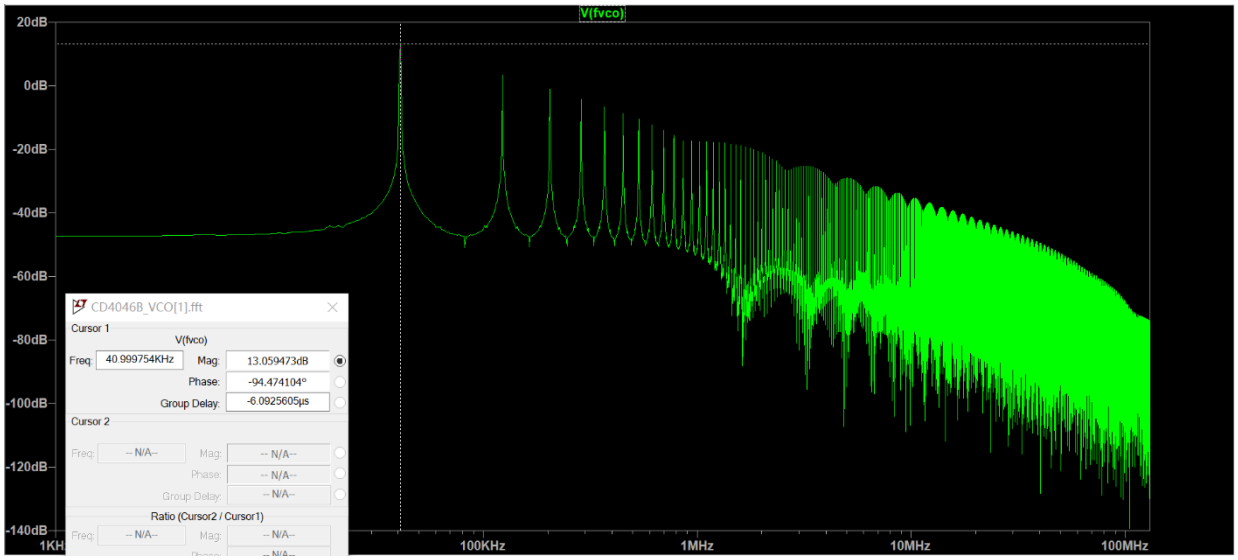
f = 1.96kHz, G = 10.76dB

Quand V1=2V,



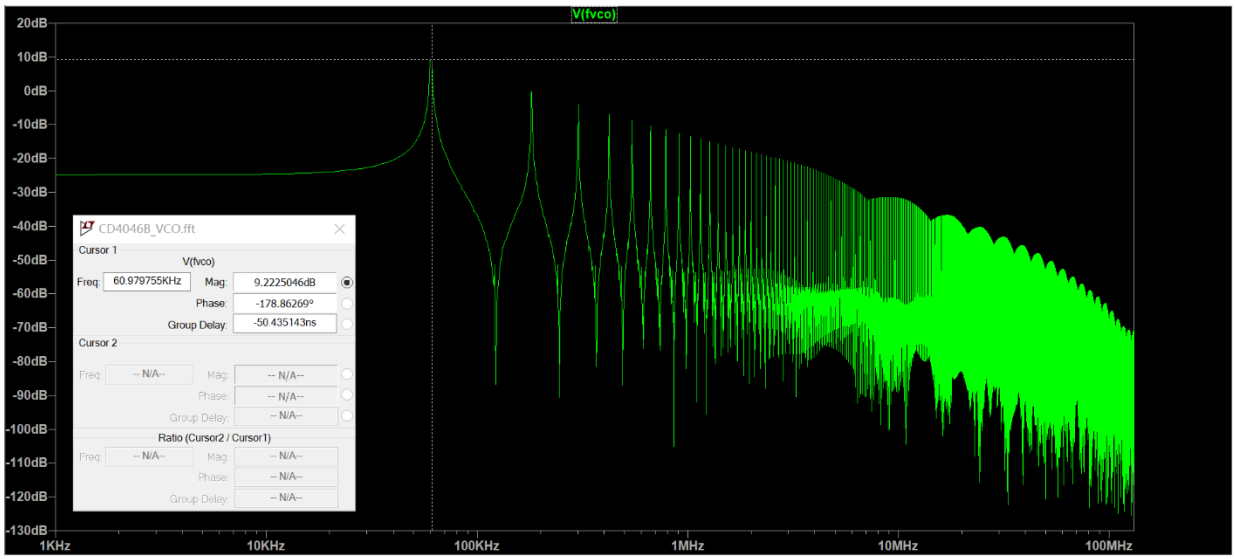
f = 21.46kHz, G = 12.36dB

Quand V1=3V,



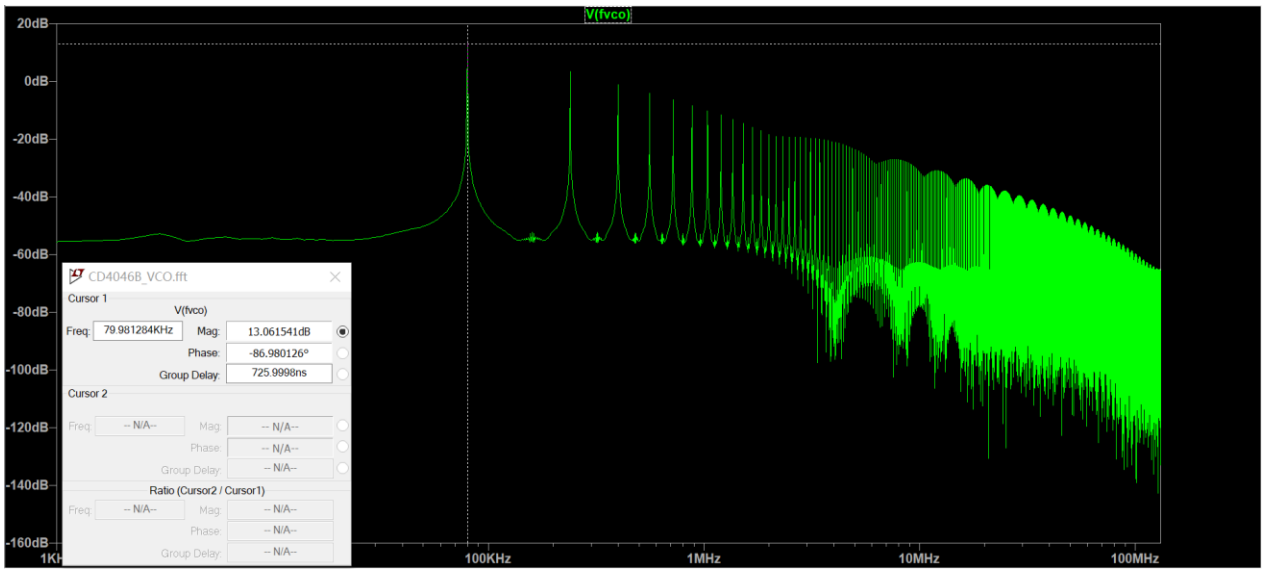
f = 41.00kHz, G = 13.06dB

Quand V1=4V,



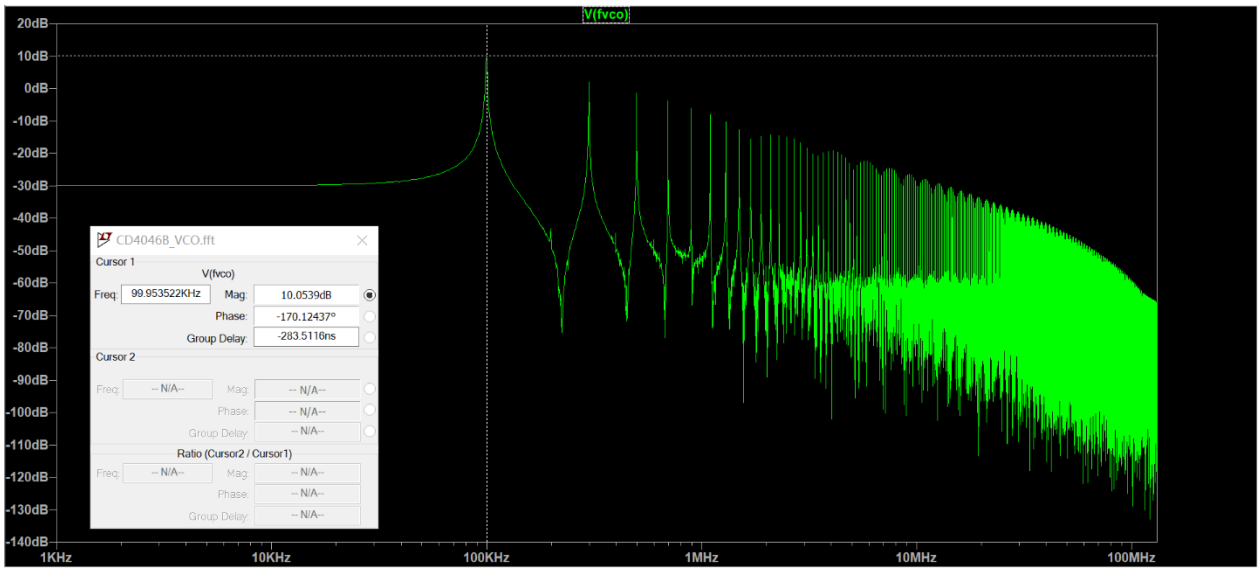
f = 60.98kHz, G = 9.22dB

Quand V1=5V,



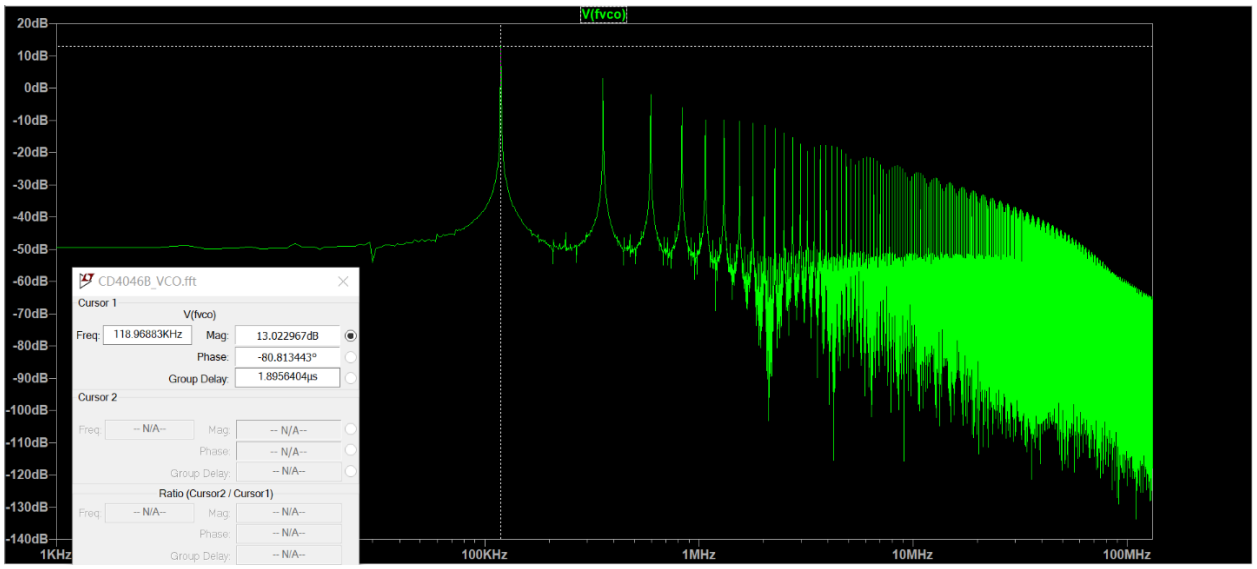
f = 79.98kHz, G = 13.06dB

Quand V1=6V,



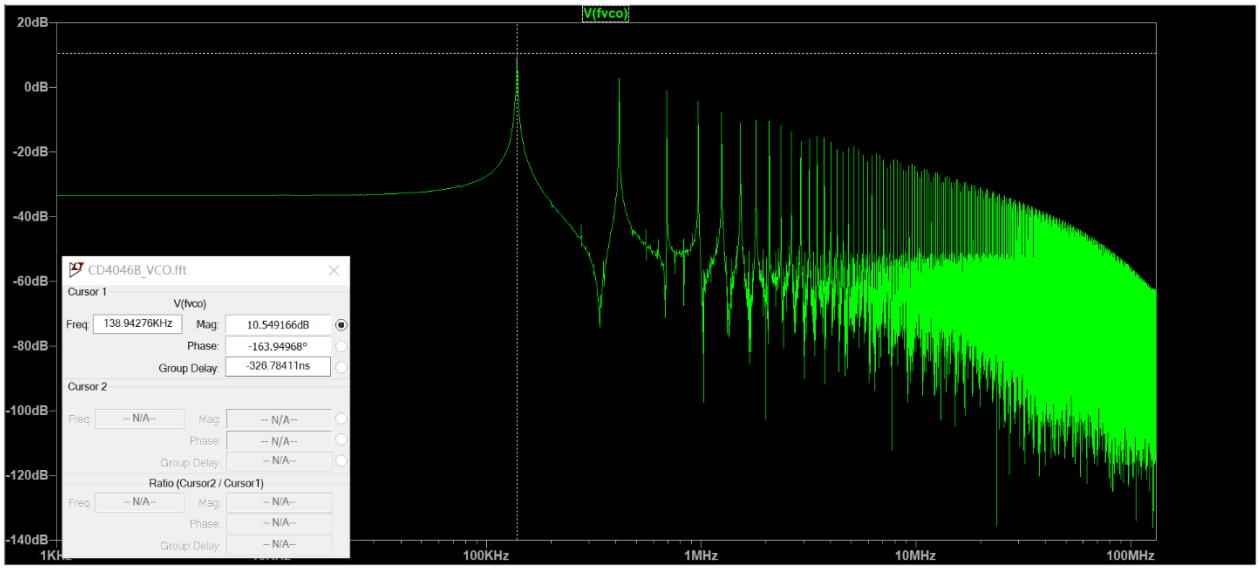
f = 99.95kHz, G = 10.05dB

Quand V1=7V,



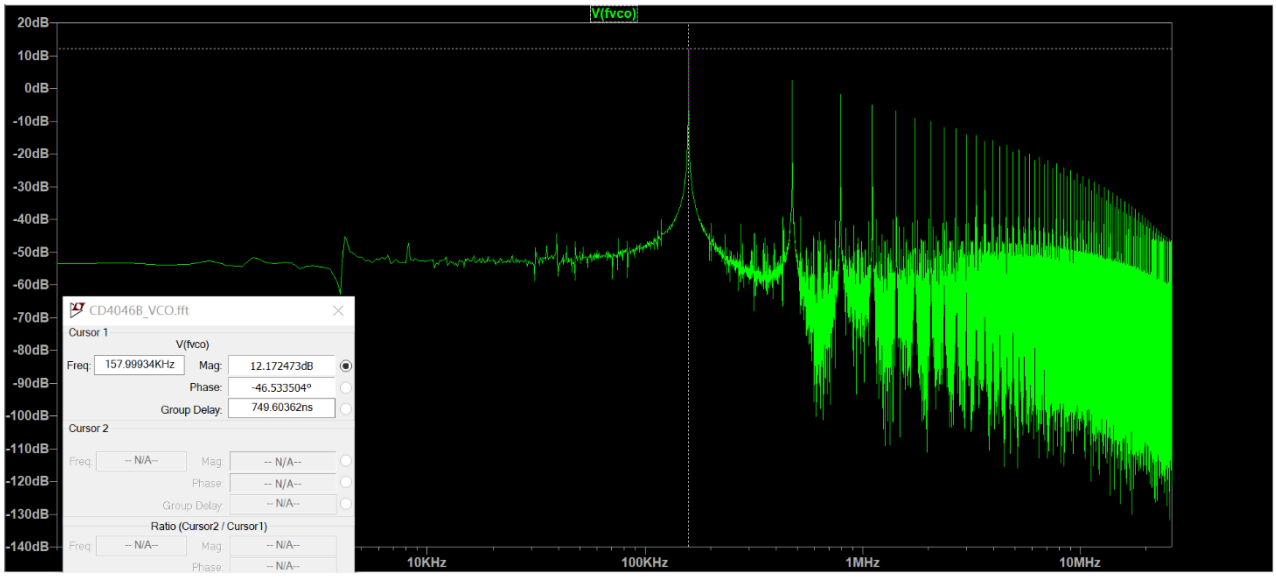
f = 118.97kHz, G = 13.02dB

Quand V1=8V,



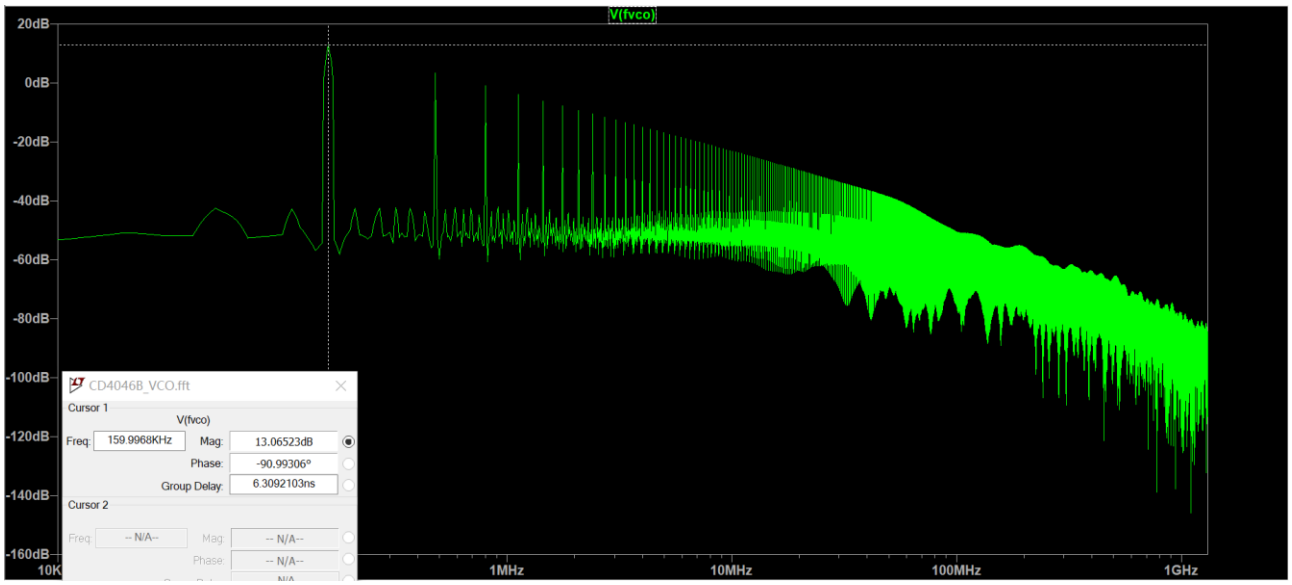
f = 138.94kHz, G = 10.55dB

Quand V1=9V,



f = 158.00kHz, G = 12.17dB

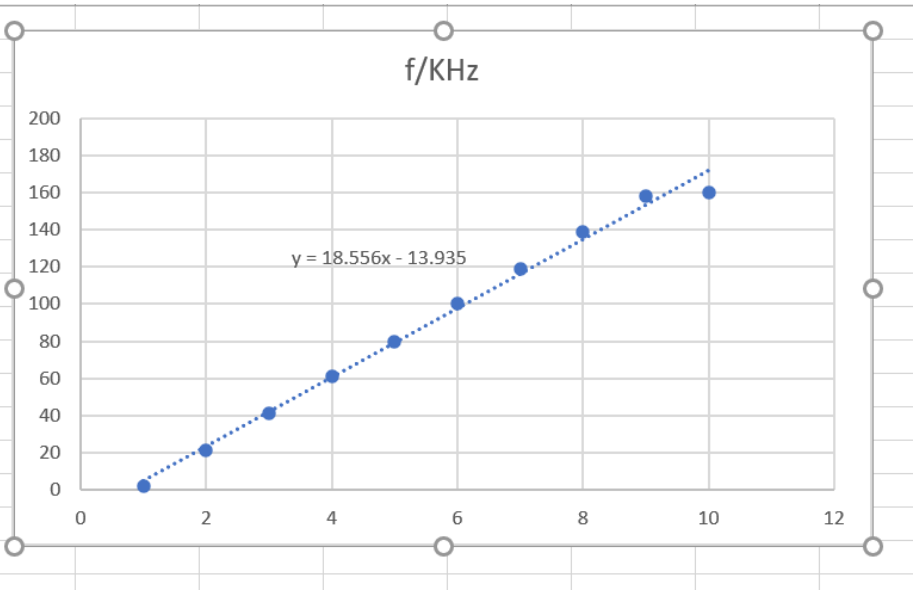
Quand V1=10V,



f = 160.00kHz, G = 13.07dB

On peut exprimer la relation entre V1 et f dans Excel

V1/V	f/KHz
1	1.96
2	21.46
3	41
4	60.98
5	79.98
6	99.95
7	118.97
8	138.94
9	158
10	160



Quand V1ϵ[1,9], la relation est linéaire. La relation est :f=18.556V-13.935

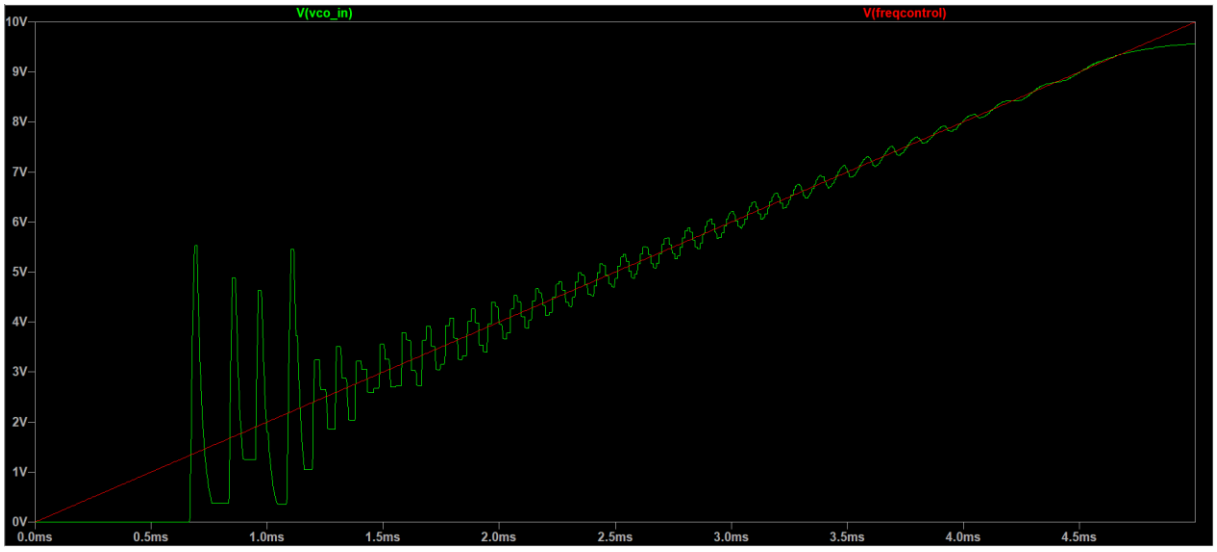
Quand V1ϵ[0,1], la relation est : f=1.96V

Quand V1ϵ[0,1], la relation est : f=2V+140

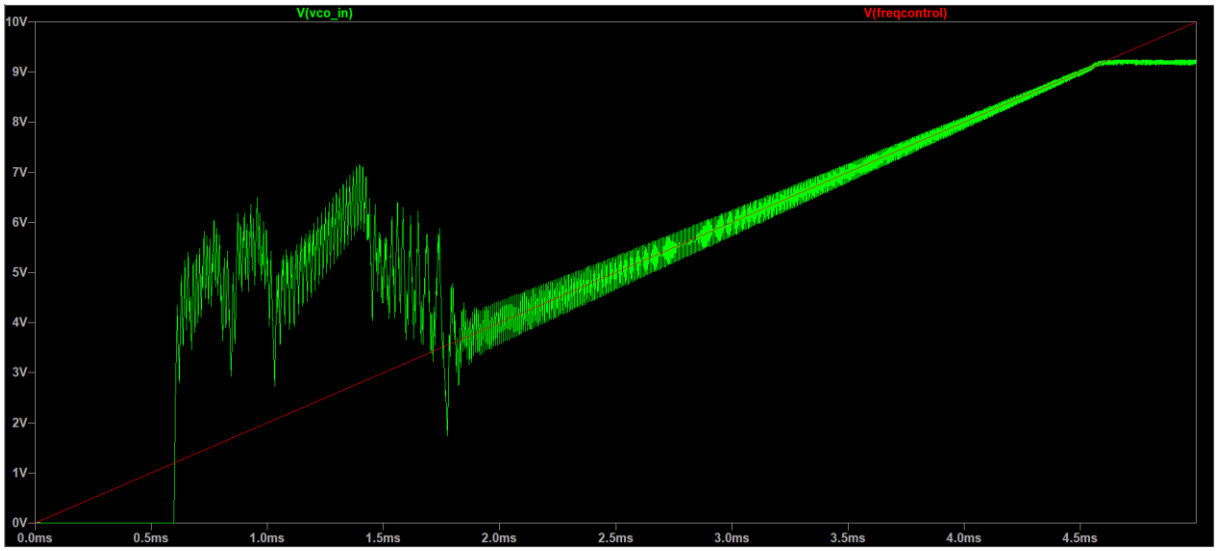
2 Mesure des plages de capture et de verrouillage

3. PC2 : C2 = 100nF

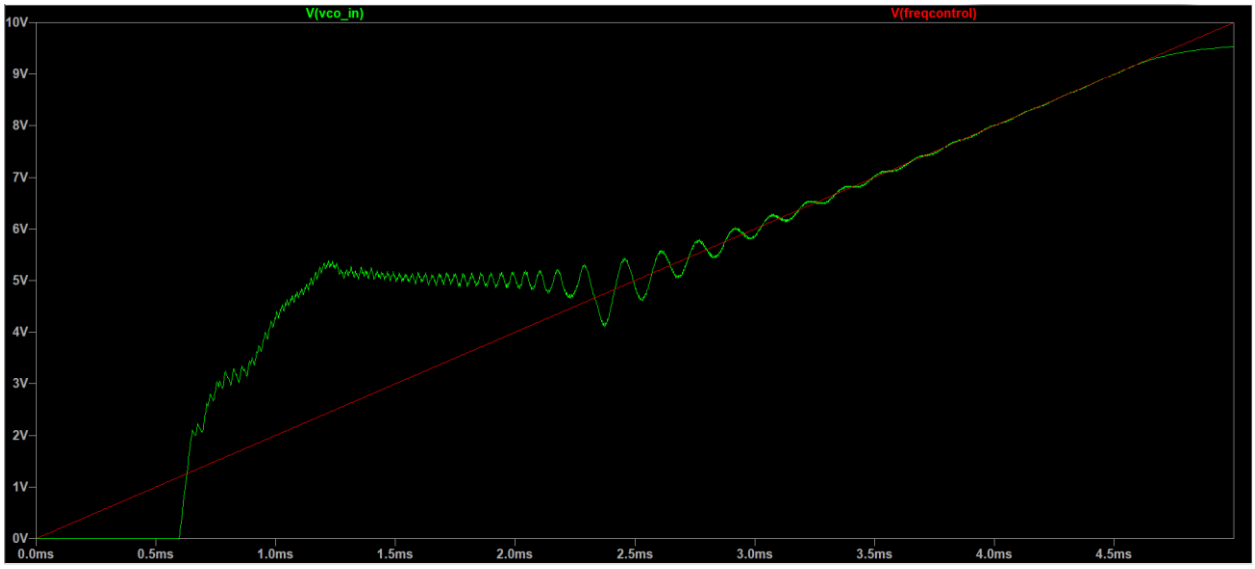
PC2 : C2 = 10nF



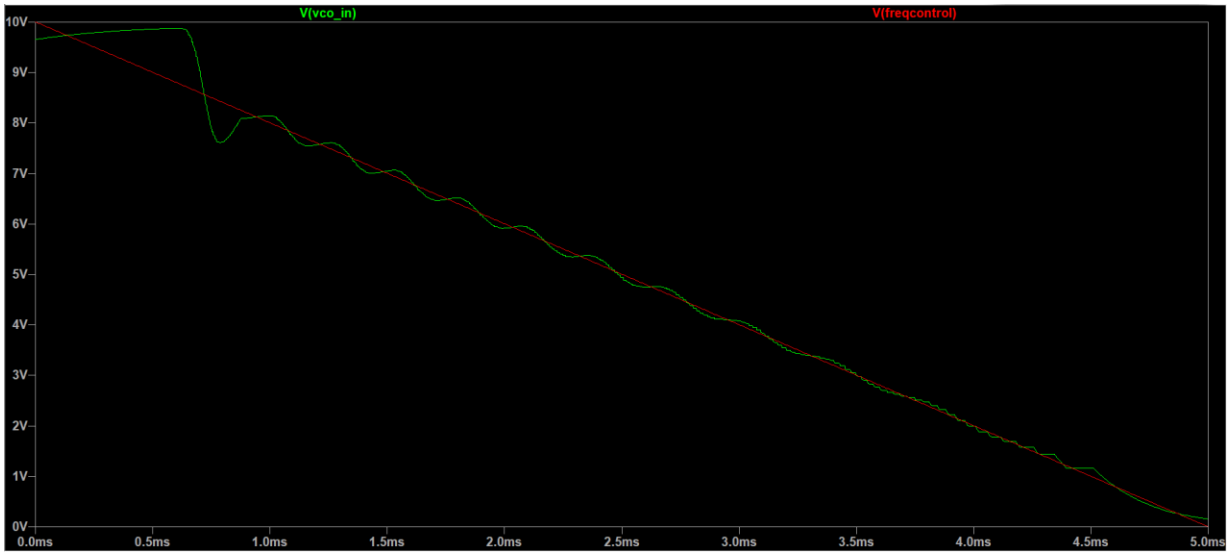
PC1 : C2 = 10nF



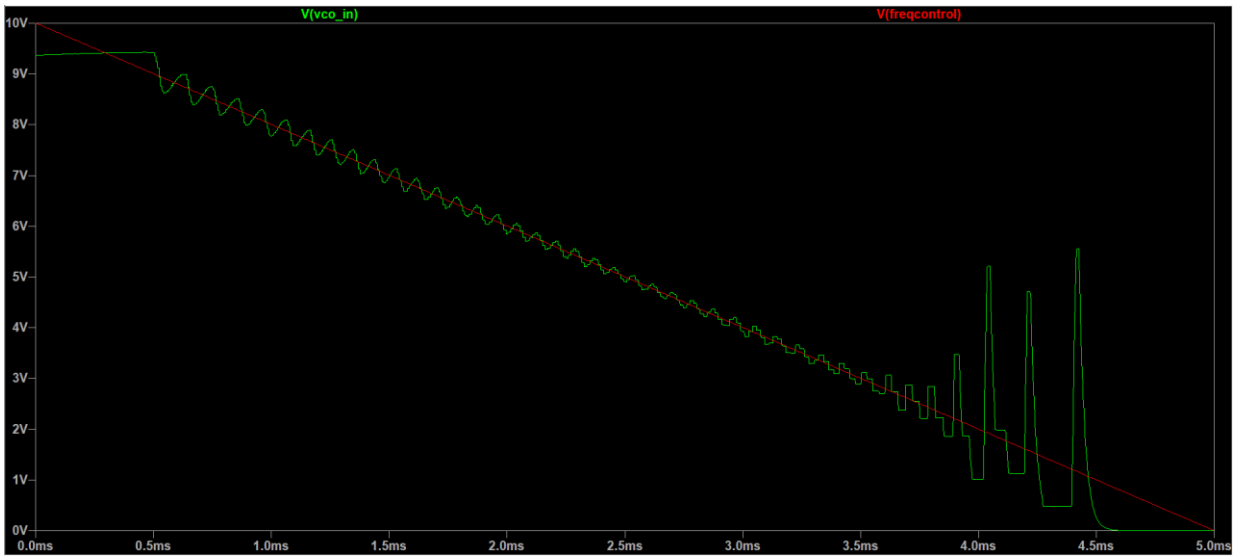
PC1 : C2 = 100nF



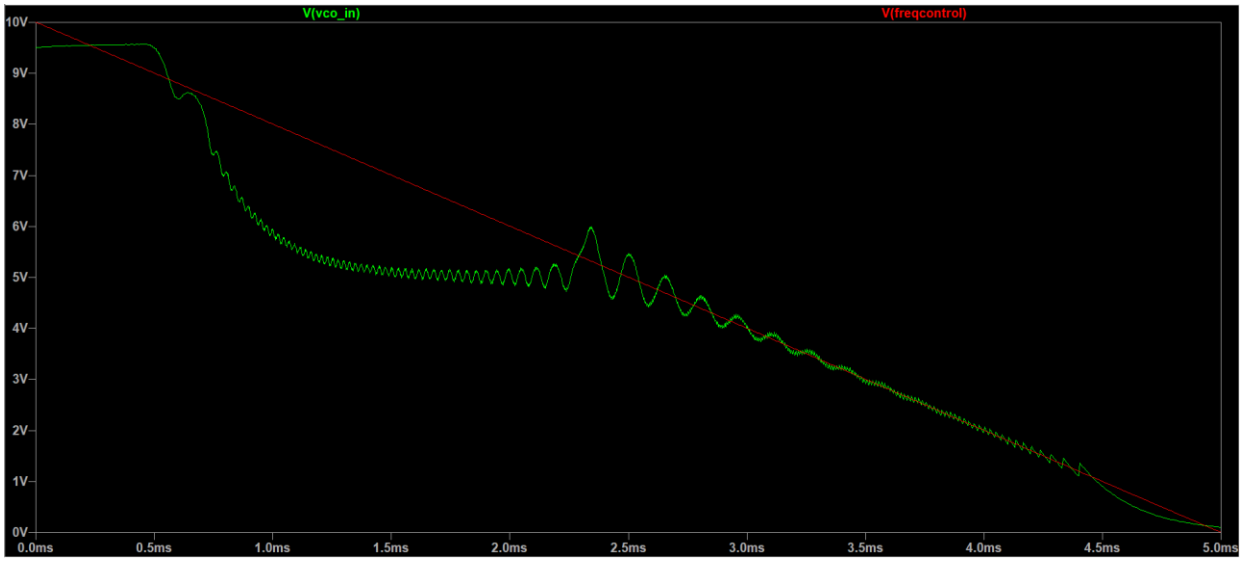
4. PC2 : C2 = 100nF



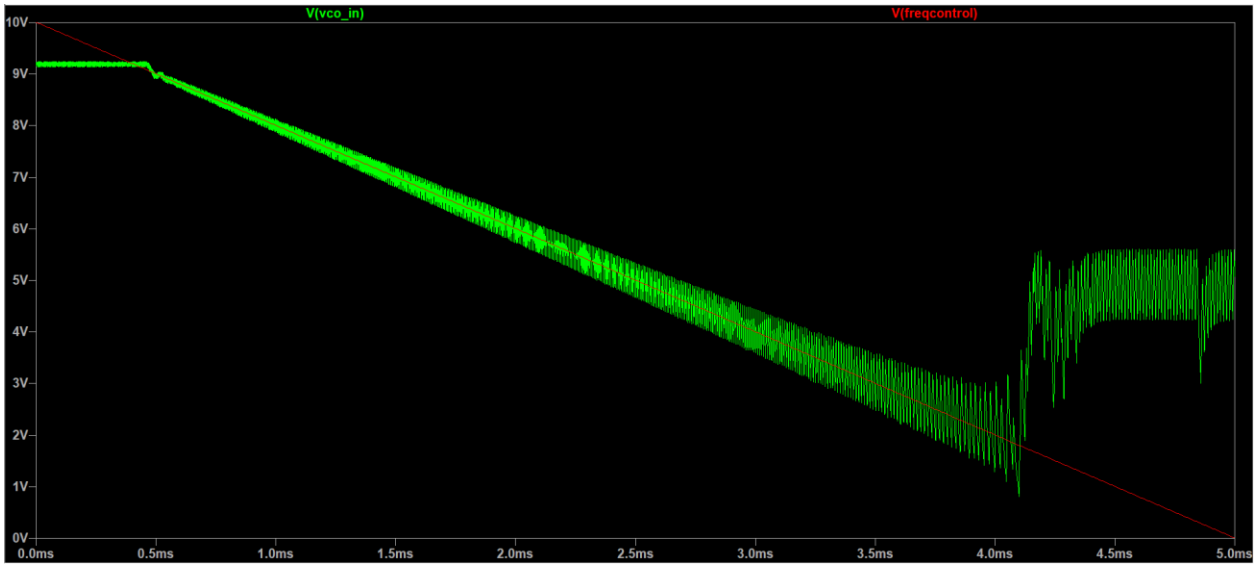
PC2 : C2=10nF



PC1 : C2=100nF



PC1 : C2=10nF



5. D'après la question 2 de partie 1,

Quand V1ϵ[1,9], la relation est linéaire. La relation est :f=18.556V-13.935

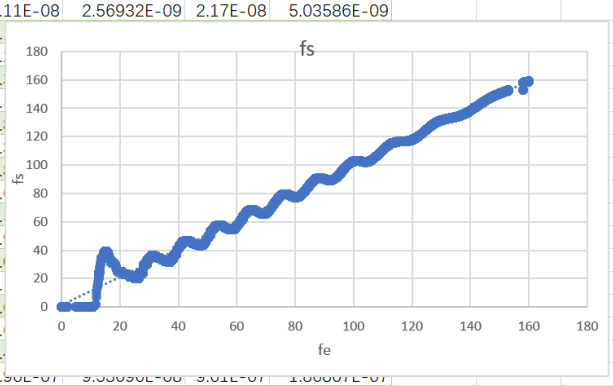
Quand V1ϵ[0,1], la relation est : f=1.96V

Quand V1ϵ[0,1], la relation est : f=2V+140

1) PC2 : C2 = 100nF (croissante)

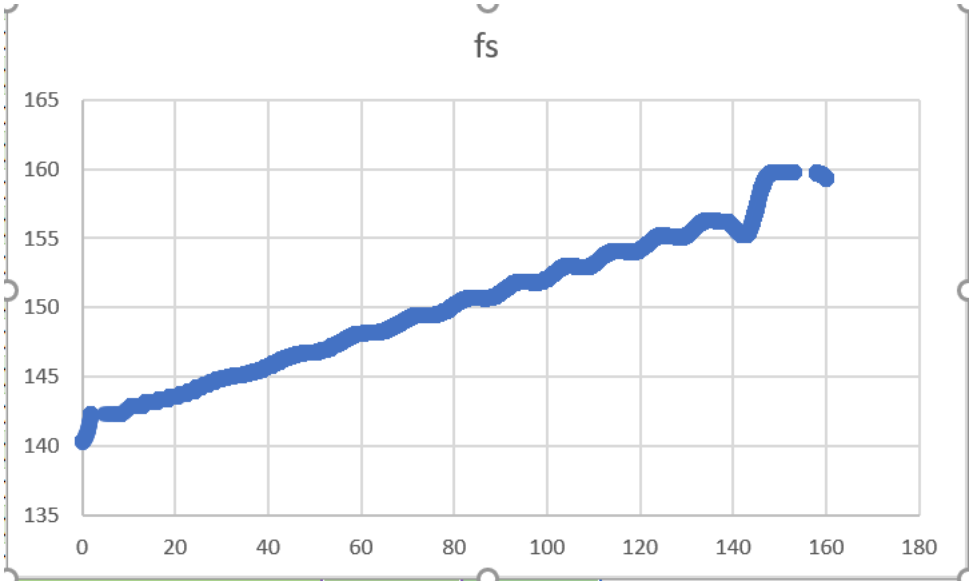
D2 =IF(B2<1,1.96*B2,IF(B2<9,18.556*B2-13.935,2*B2+140))

	A	B	C	D	E
1	time	V(frEqcontrol)	V(vco_in)	fe	fs
2	0.000000000000000e+000	1.02E-08	2.35992E-09	2E-08	4.62545E-09
3	3.051757793953031e-013	1.08E-08	2.50853E-09	2.12E-08	4.91672E-09
4	3.461313109637340e-013	1.09E-08	2.52866E-09	2.14E-08	4.95617E-09
5	4.280423741005958e-013	1.11E-08	2.56932E-09	2.17E-08	5.03586E-09
6	5.918645003743195e-013	1.			
7	9.195087529217660e-013	1.			
8	1.574797258016659e-012	1.			
9	2.724759223892137e-012	1.			
10	4.137219929924688e-012	1.			
11	6.641101205465673e-012	2.			
12	9.322644077363047e-012	2.			
13	1.305894883947259e-011	3.			
14	1.740820269702776e-011	4.			
15	2.459005012110384e-011	5.			
16	3.523005596930106e-011	8.			
17	5.389235748324176e-011	1.			
18	7.842771433615781e-011	1.			
19	1.246480099764204e-010	2.			
20	1.686879116504623e-010	3.			
21	2.400350640664839e-010	4.			
22	3.244333631670618e-010	6.59E-07	1.22228E-07	1.29E-06	2.39566E-07



f1=11.60KHz, f2=160.00KHz

2) PC2 : C2 = 100nF (décroissante)

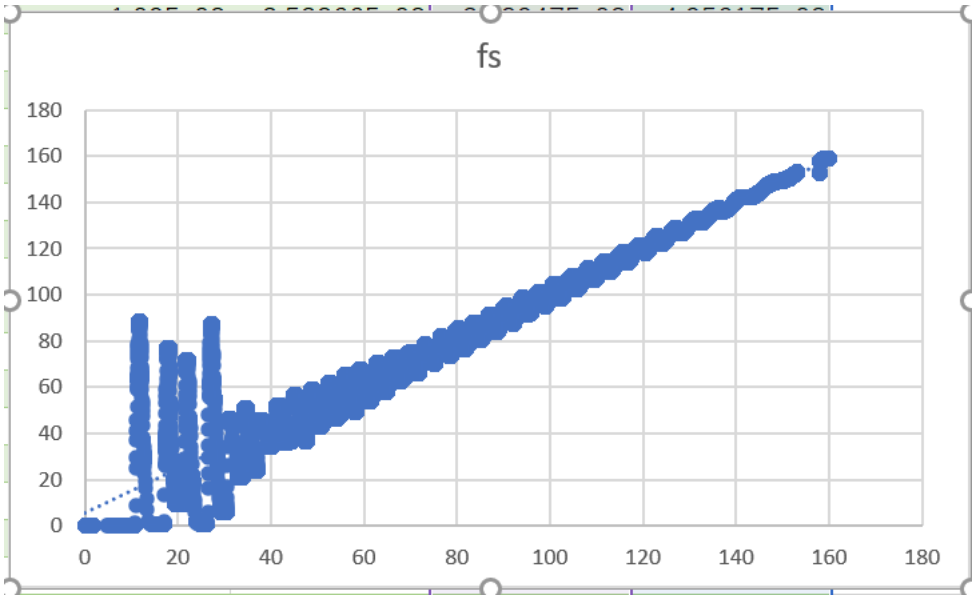


f1=0KHz,f2=146.50KHz

donc, la plage de capture est : 11.60KHz-146.50KHz

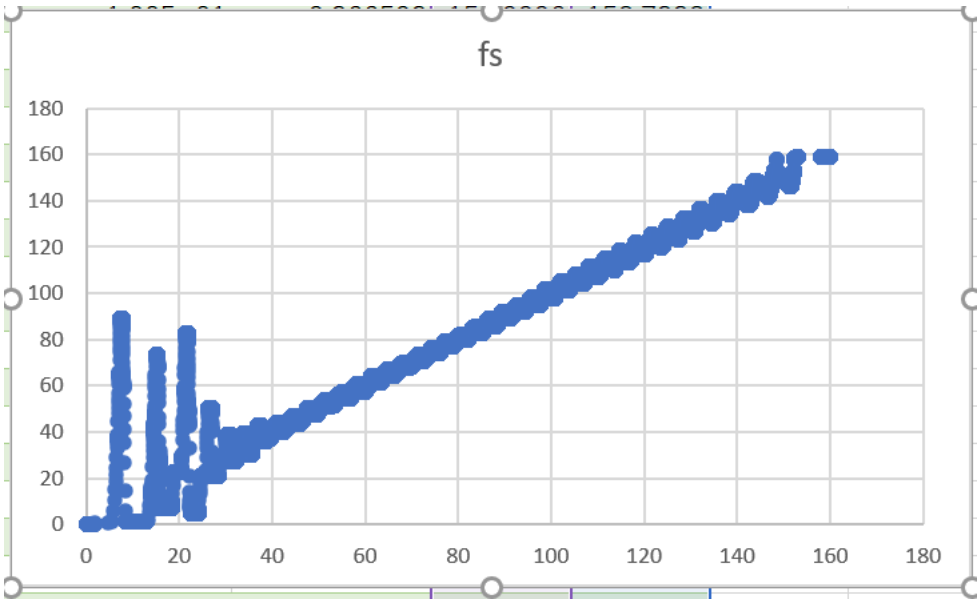
La plage de verrouillage : 0-160.00kHz

3) PC2 : C2 = 10nF (croissante)



f1=13.49KHz, f2=160.00KHz

4) PC2 : C2 = 10nF (décroissante)

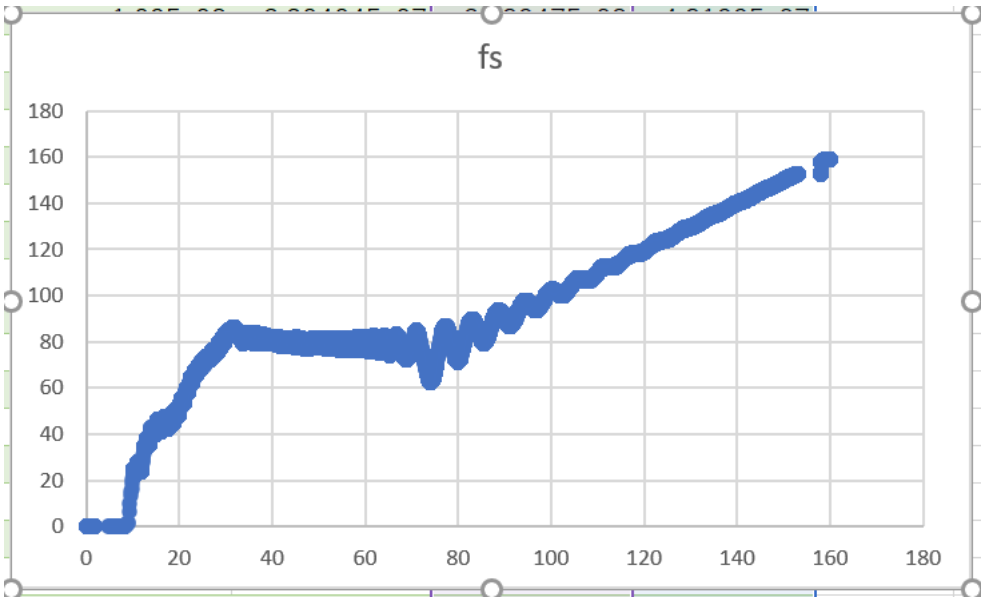


f1=4.80KHz, f2=152.21KHz

donc, la plage de capture est : 13.49KHz-152.21KHz

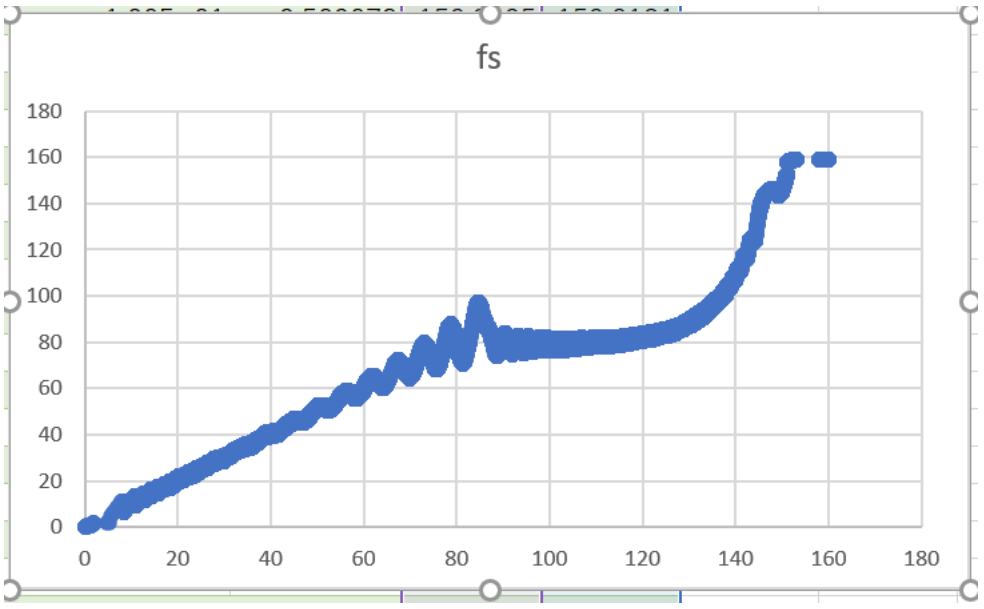
La plage de verrouillage : 4.80-160.00kHz

5) PC1 : C2 = 100nF (croissante)



f1=8.88KHz, f2=160.00KHz

6) PC1 : C2 = 100nF (décroissante)

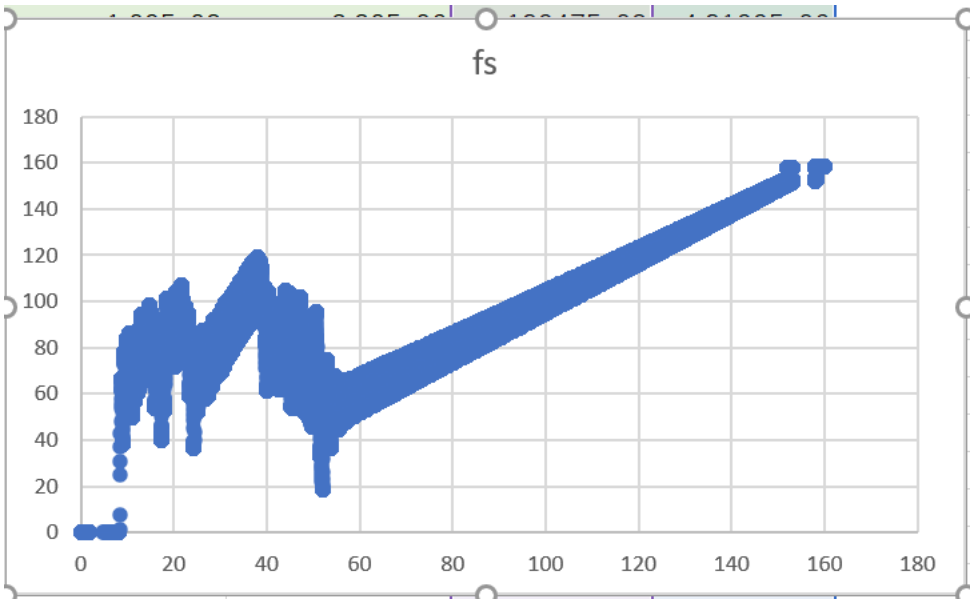


f1=0KHz, f2=151.17KHz

donc, la plage de capture est : 8.88KHz-151.17KHz

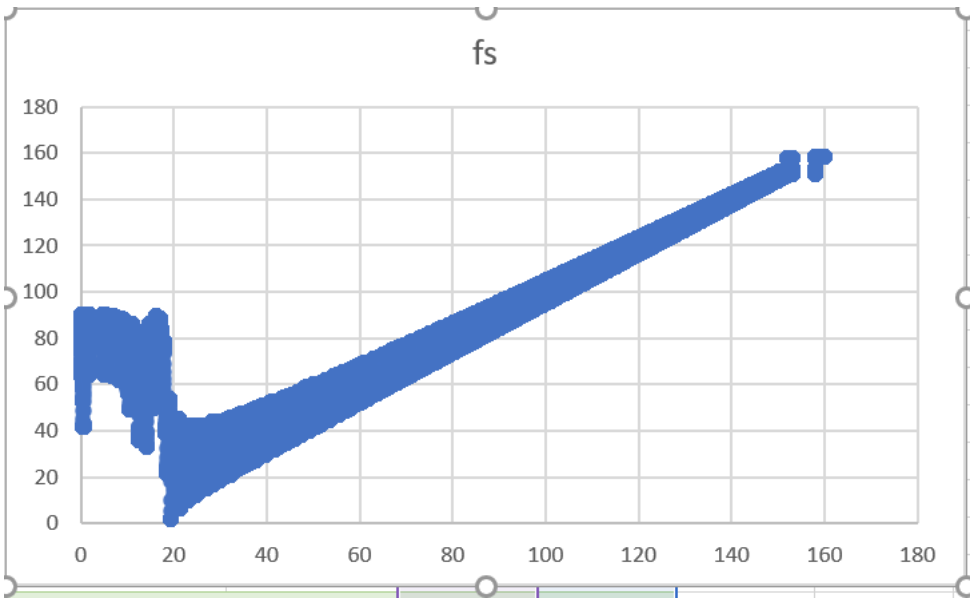
La plage de verrouillage : 0-160.00kHz

7) PC1 : C2 = 10nF (croissante)



f1=8.15KHz, f2=159.98KHz

8) PC1 : C2 = 10nF (décroissante)



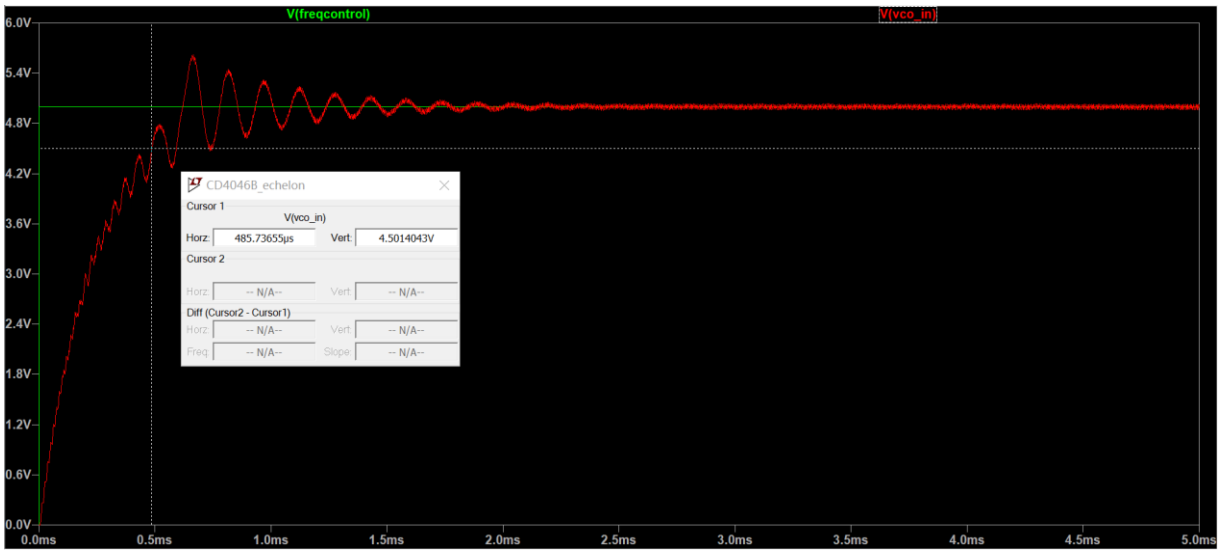
f1=0KHz, f2=151.85KHz

donc, la plage de capture est : 8.15KHz-151.85KHz

La plage de verrouillage : 0-151.85kHz

3 Réponse de la PLL à un échelon

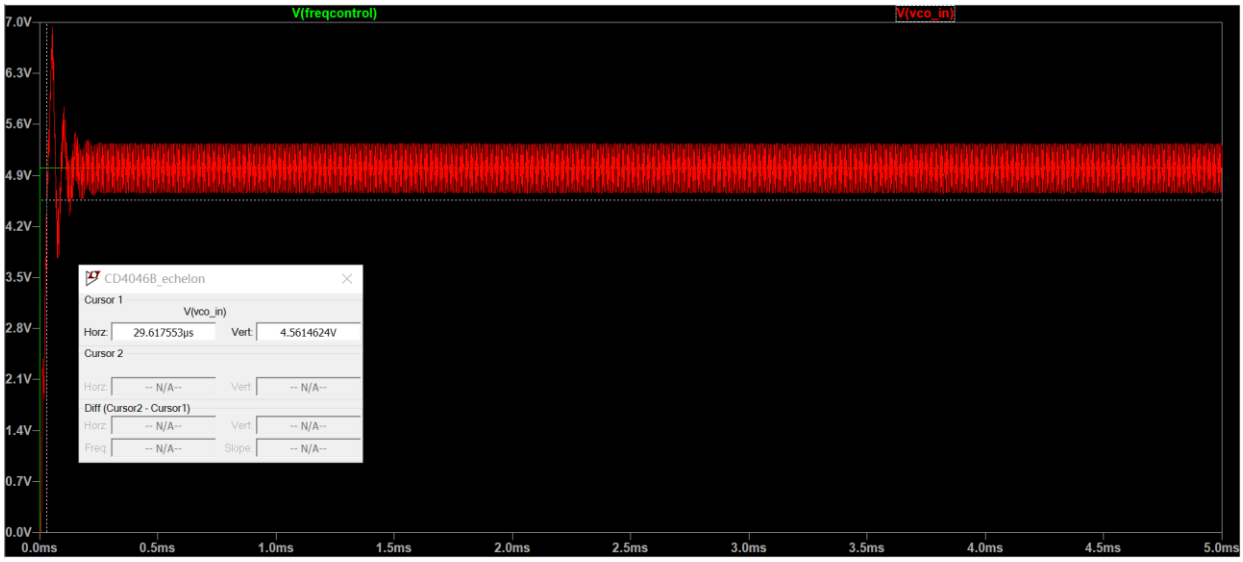
1&2. PC1 : C2=100nF



V(freqcontrol) = 5V, 0.9* V(freqcontrol) = 4.5V

le temps pour atteindre 90% est 485.74µs

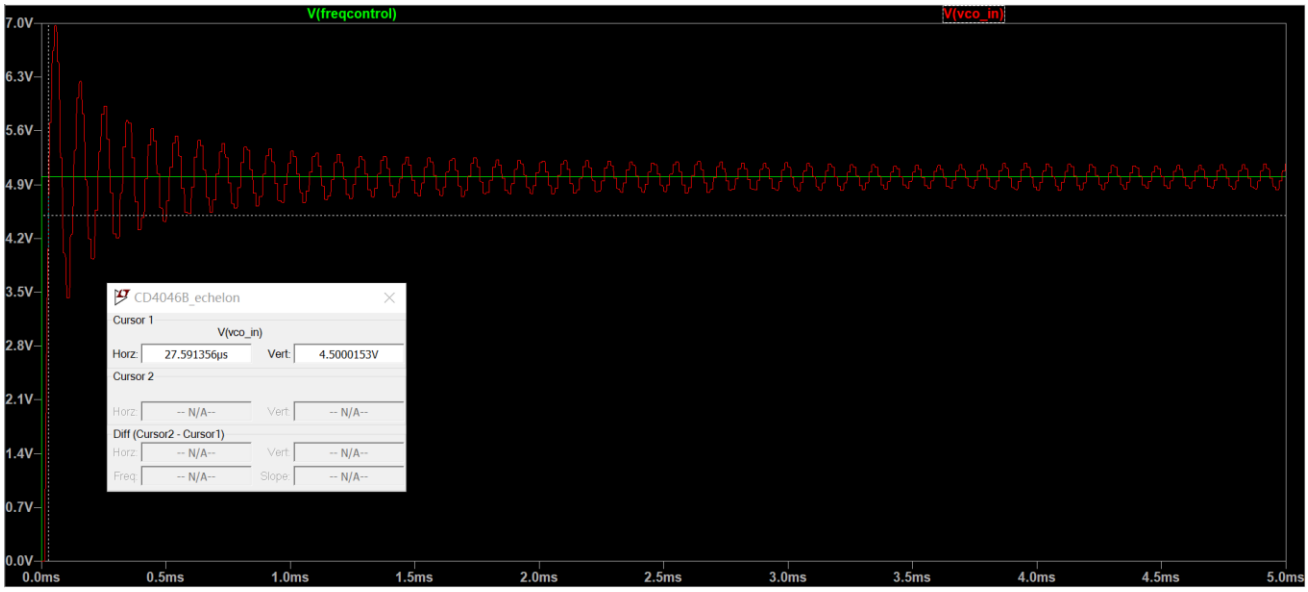
PC1 : C2=10nF



V(freqcontrol) = 5V, 0.9* V(freqcontrol) = 4.5V

le temps pour atteindre 90% est 29.62µs

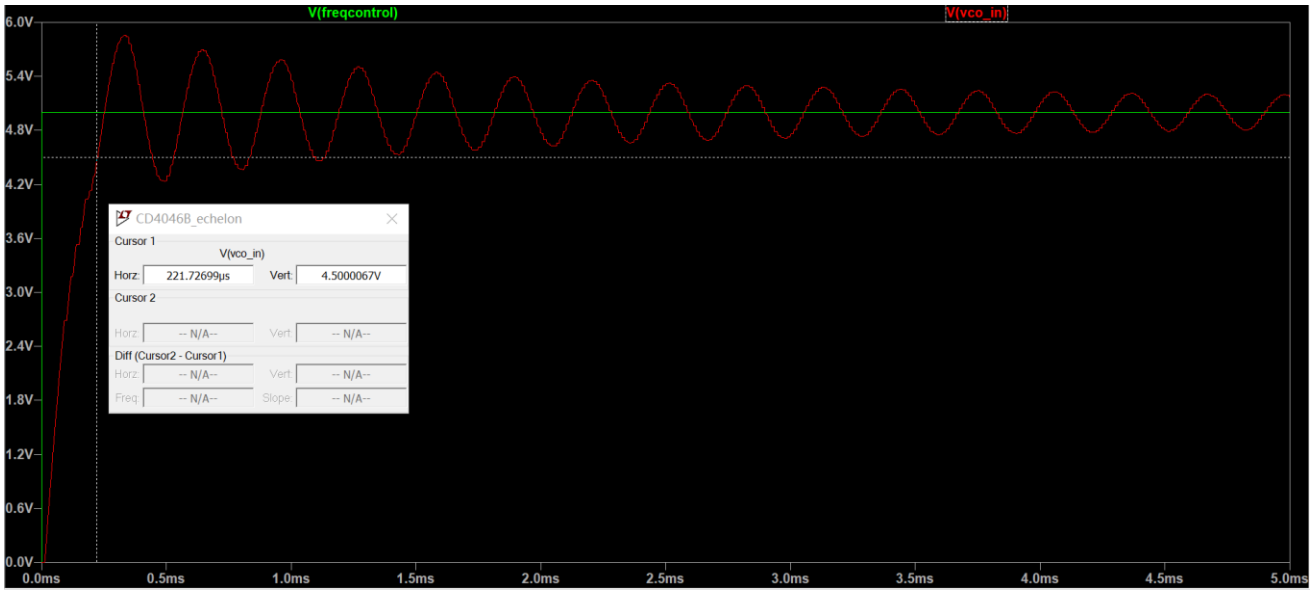
PC2 : C2=10nF



V(freqcontrol) = 5V, 0.9* V(freqcontrol) = 4.5V

le temps pour atteindre 90% est 27.59µs

PC2 : C2=100nF



V(freqcontrol) = 5V, 0.9* V(freqcontrol) = 4.5V

le temps pour atteindre 90% est 221.73µs

3. Temps caractéristiques : $\tau = RC$

Quand C2=10nF, R3=1.8KHz, $\tau = 18\mu s$

D'après la question précétente,

PC1, $\tau = 29.62\mu s$ PC2, $\tau = 27.59\mu s$

Quand C2=100nF, R3=1.8KHz, $\tau = 180\mu s$

D'après la question précétente,

PC1, $\tau = 485.74\mu s$ PC2, $\tau = 227.31\mu s$