Electronique

Etude de la PLL CD4046B

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1. Caractérisation du VCO

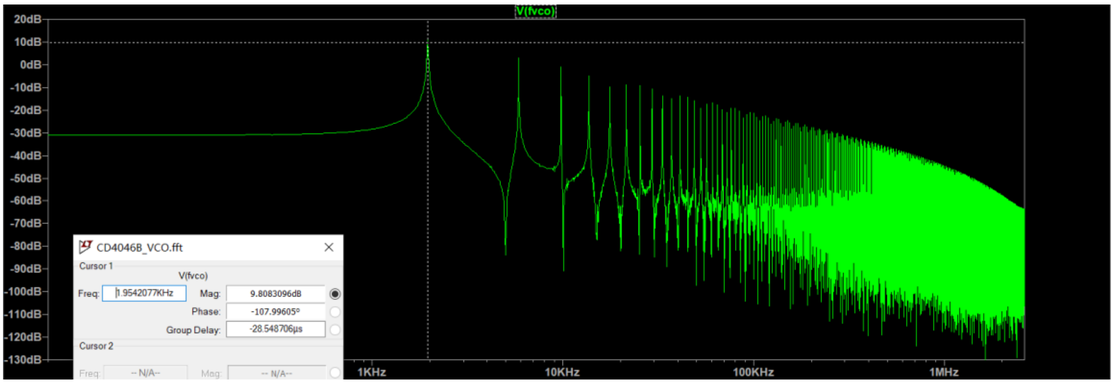
1. D'après la figure 7 dans le document technique, on trouve que

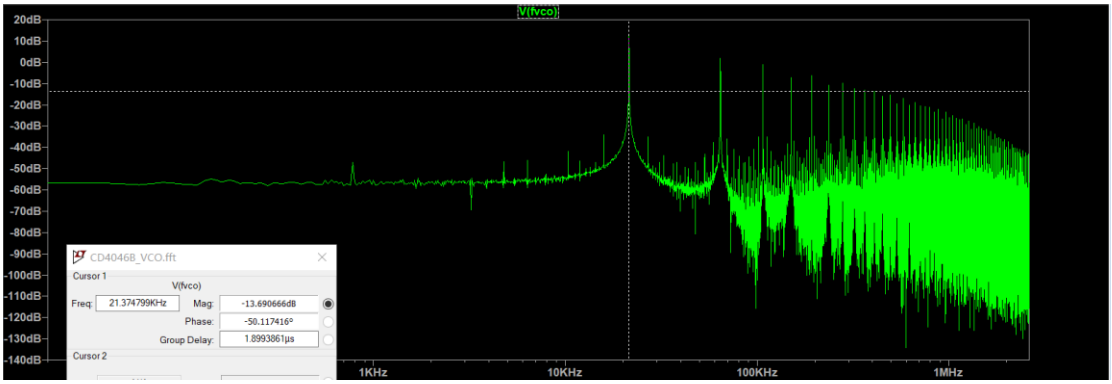
$$f_0 = 80kHz$$

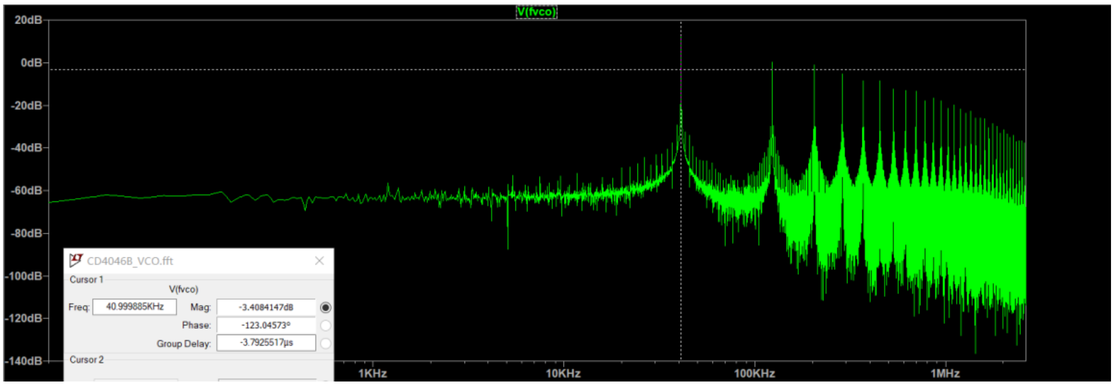
   Alors on a

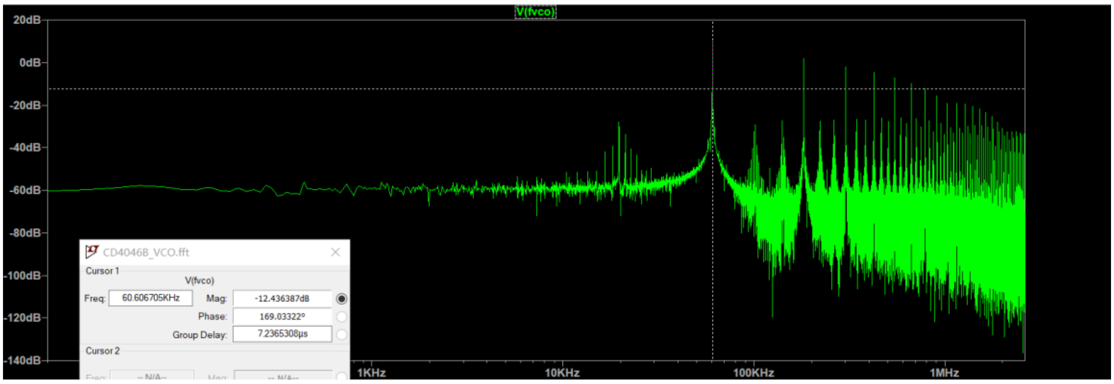
$$f_{max} = 2f_0 = 160kHz$$

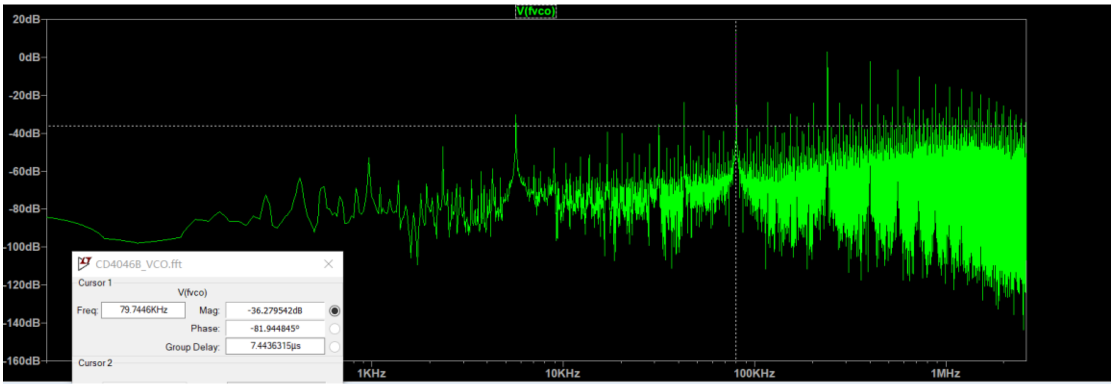
2. On mesurera la fréquence du signal fvco en sortie du VCO :
   On prendra pour la tension d'entrée V1 des valeurs de 0 à 10 V par pas de 1 V.
   [V1=1,2,3…10V]

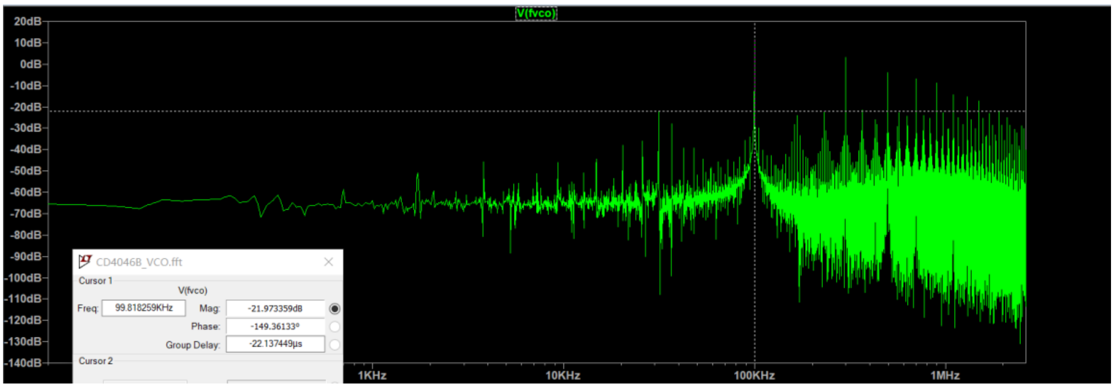


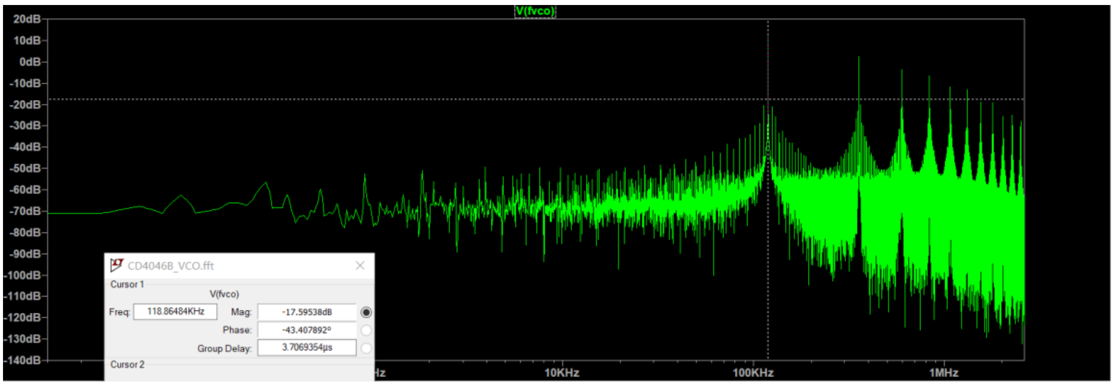


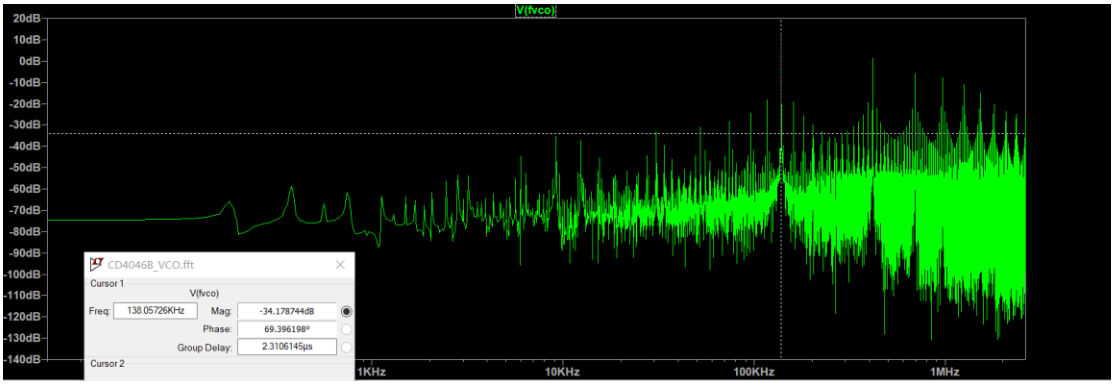


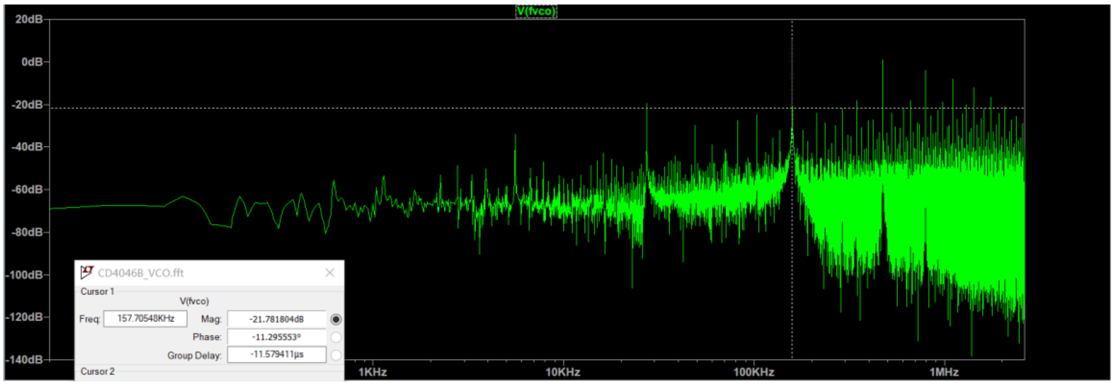

V(fvco)
20dB
0dB
-20dB
-40dB
-60dB
-80dB
-100dB
-120dB
-140dB
1KHz
10KHz
100KHz
1MHz
CD4046B_VCO.fft
Cursor 1
V(fvco)
Freq: 60.606705KHz
Mag: -12.436387dB
Phase: 169.03322°
Group Delay: 7.2365308µs
Cursor 2

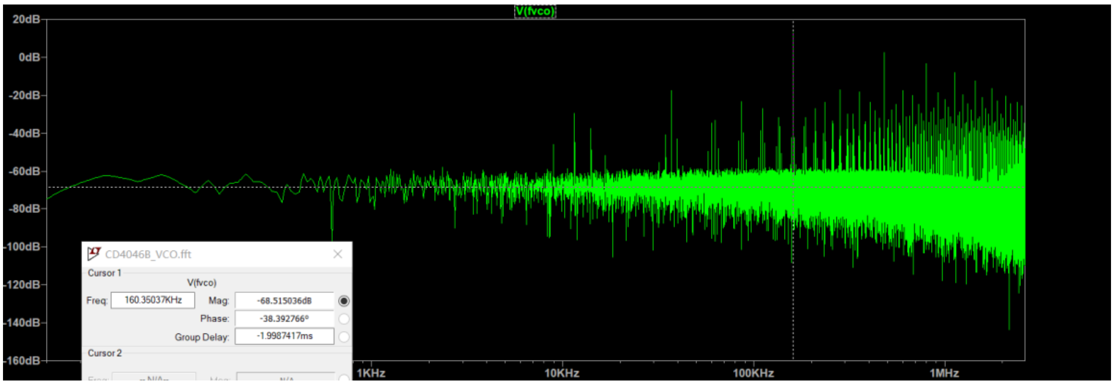

V(fvco)
20dB
0dB
-20dB
-40dB
-60dB
-80dB
-100dB
-120dB
-140dB
-160dB
1KHz
10KHz
100KHz
1MHz
CD4046B_VCO.fft
Cursor 1
V(fvco)
Freq: 79.7446KHz
Mag: -36.279542dB
Phase: -81.944845°
Group Delay: 7.4436315µs
Cursor 2


V(fvco)
20dB
10dB
0dB
-10dB
-20dB
-30dB
-40dB
-50dB
-60dB
-70dB
-80dB
-90dB
-100dB
-110dB
-120dB
-130dB
-140dB
1KHz
10KHz
100KHz
1MHz
CD4046B_VCO.fft
Cursor 1
V(fvco)
Freq: 99.818259KHz
Mag: -21.973359dB
Phase: -149.36133°
Group Delay: -22.137449µs
Cursor 2


V(fvco)
20dB
10dB
0dB
-10dB
-20dB
-30dB
-40dB
-50dB
-60dB
-70dB
-80dB
-90dB
-100dB
-110dB
-120dB
-130dB
-140dB
10KHz
100KHz
1MHz
CD4046B_VCO.fft
Cursor 1
V(fvco)
Freq: 118.86484KHz
Mag: -17.59538dB
Phase: -43.407892°
Group Delay: 3.7069354µs
Cursor 2

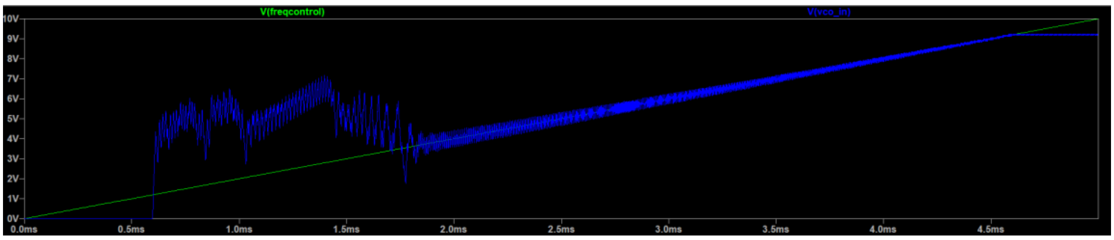




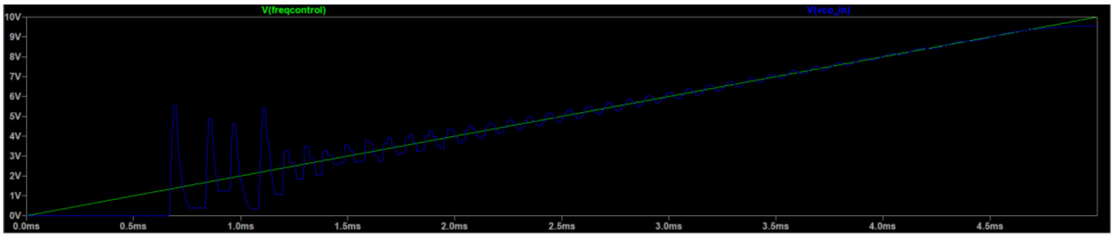


2. Mesure des plages de capture et de verrouillage

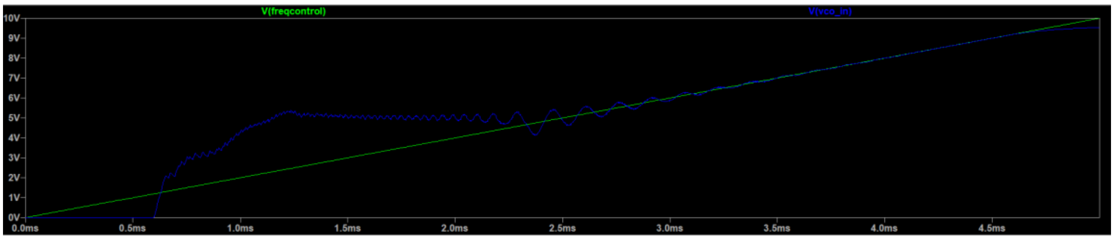
3. PC1, $C_2 = 10nF$



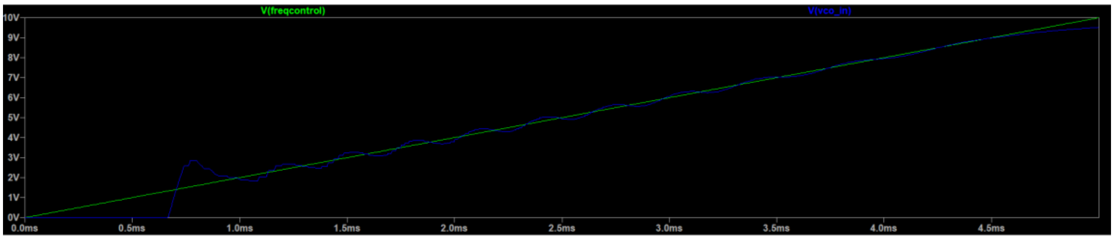
PC2, $C_2 = 10nF$



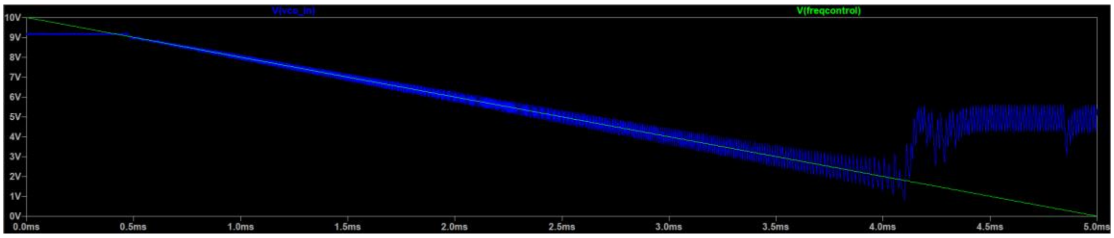
PC1, $C_2 = 100nF$



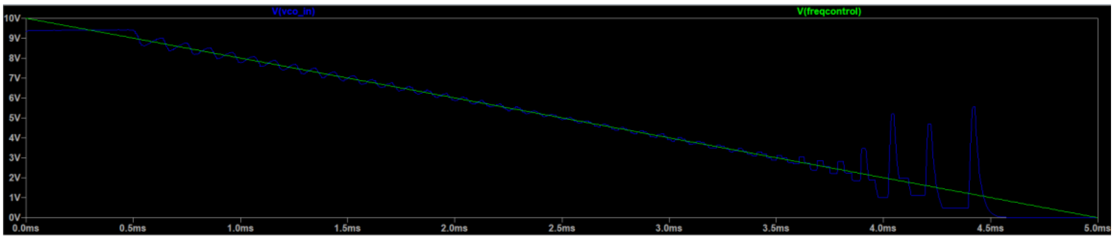
PC2, $C_2 = 100nF$



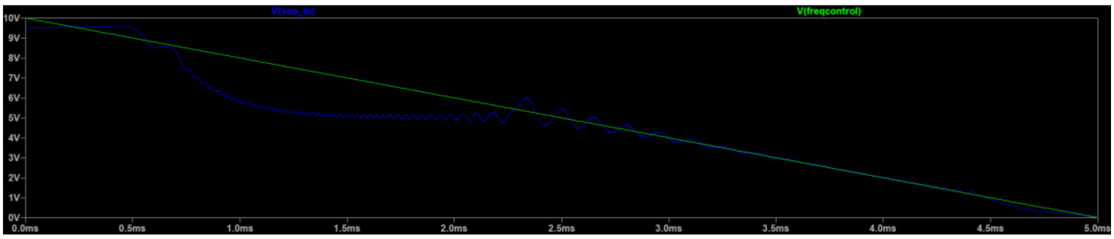
4. PC1, $C_2 = 10nF$



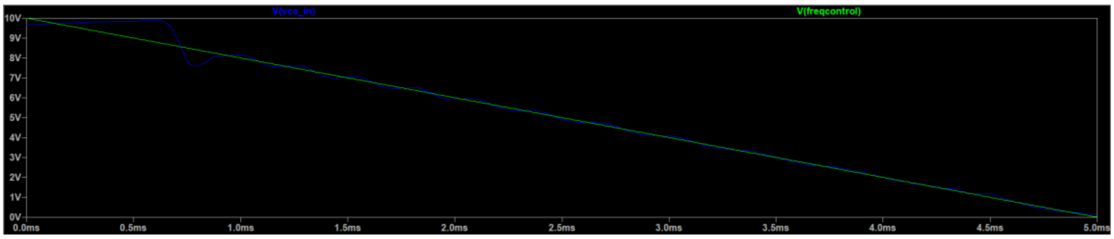
PC2, $C_2 = 10nF$



PC1, $C_2 = 100nF$

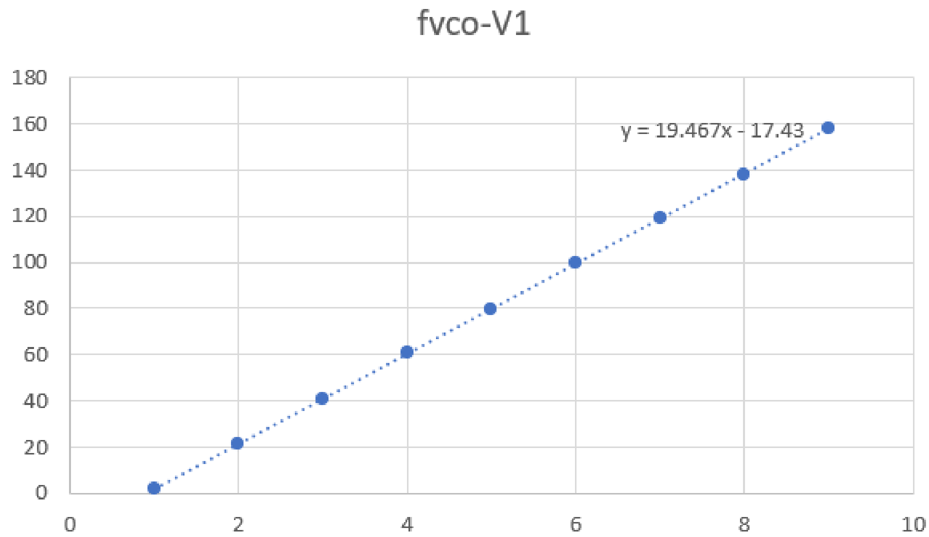


PC2, $C_2 = 100nF$



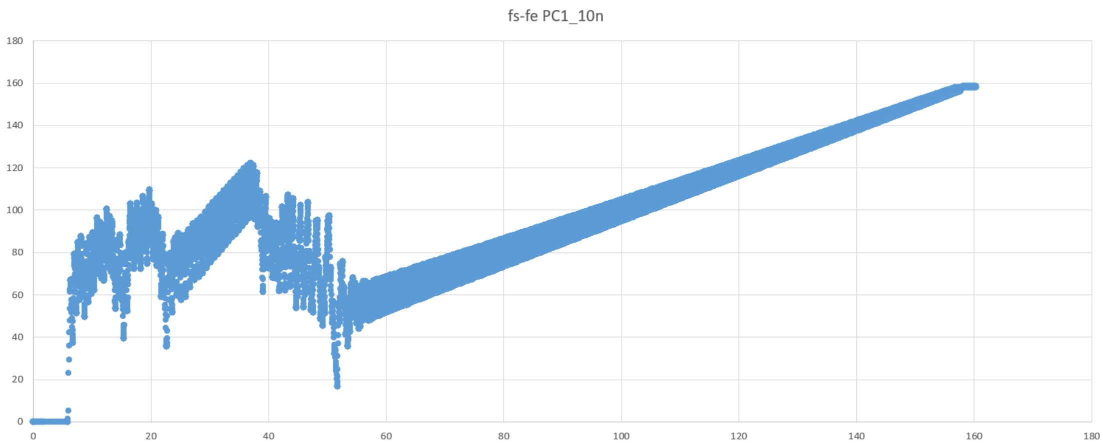
5. D'après partie 1, on peut trouver la relation entre V1 et f_{vco}

$$f_{vco} = \begin{cases} 1.954V1 \ (V1 \leq 1) \\ 19.467V1 - 17.43 \ (1 \leq V1 \leq 9) \\ 2.645V1 + 133.9 \ (9 \leq V1 \leq 10) \end{cases}$$



Alors on peut calculer f_s et f_e, ensuite trouver la relation entre eux :

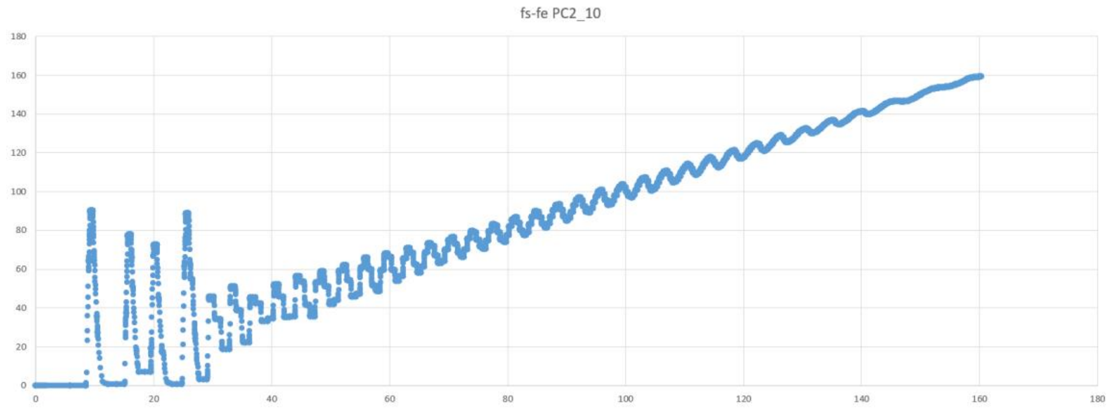
Croissant PC1, $C_2 = 10nF$



$$f_1 = 5.83kHz, f_2 = 159.89kHz$$

plage de capture : [5.83kHz, 159.89kHz]

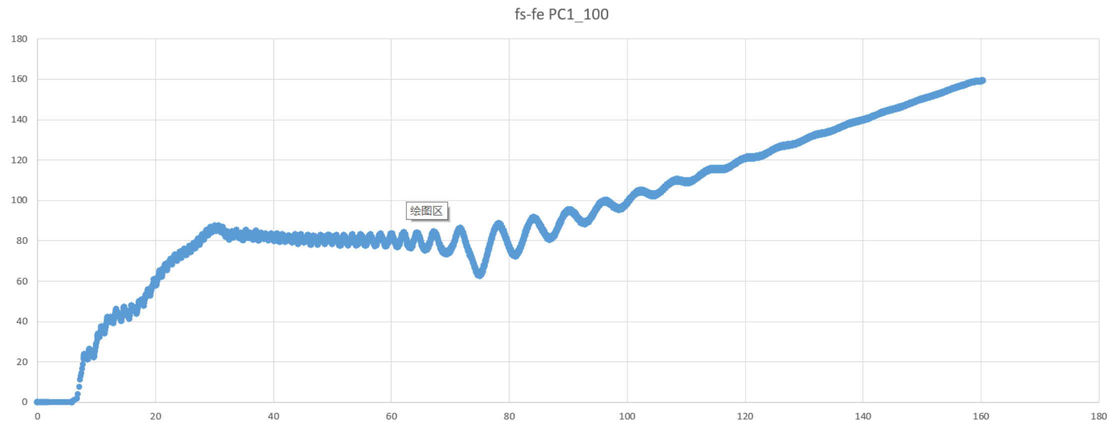
Croissant PC2, $C_2 = 10nF$



$$f_1 = 8.52kHz\,, f_2 = 160.34kHz$$

plage de capture : [8.52kHz, 160.34kHz]

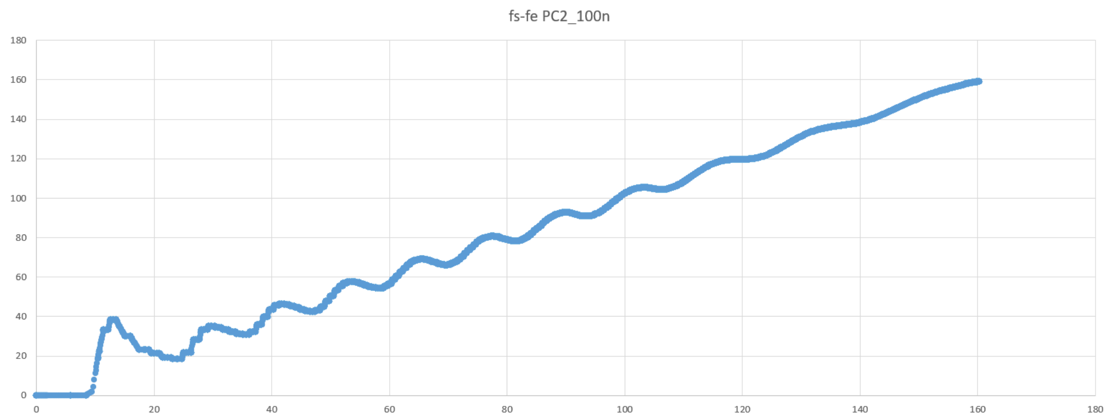
Croissant PC1, $C_2 = 100nF$



$$f_1 = 6.13kHz\,, f_2 = 160.34kHz$$

plage de capture : [6.13kHz, 160.34kHz]

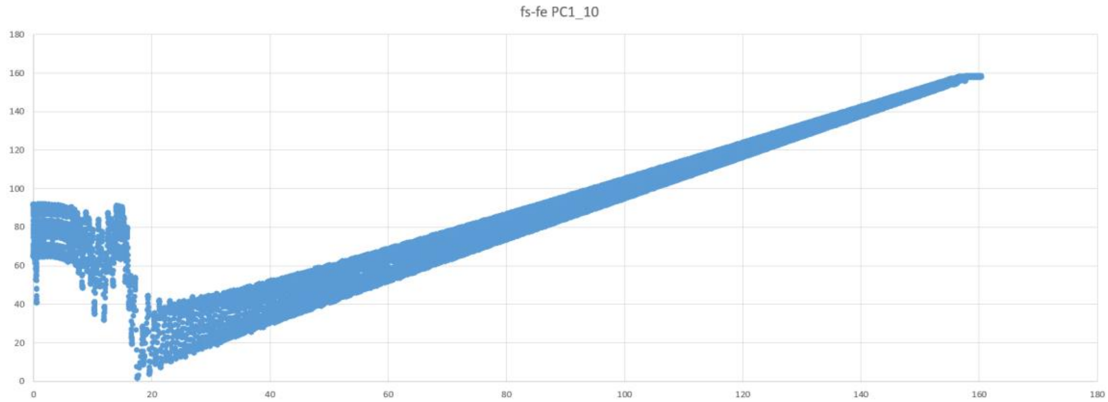
Croissant PC2, $C_2 = 100nF$



$$f_1 = 8.57kHz\,, f_2 = 160.34kHz$$

plage de capture : [8.57kHz, 160.34kHz]

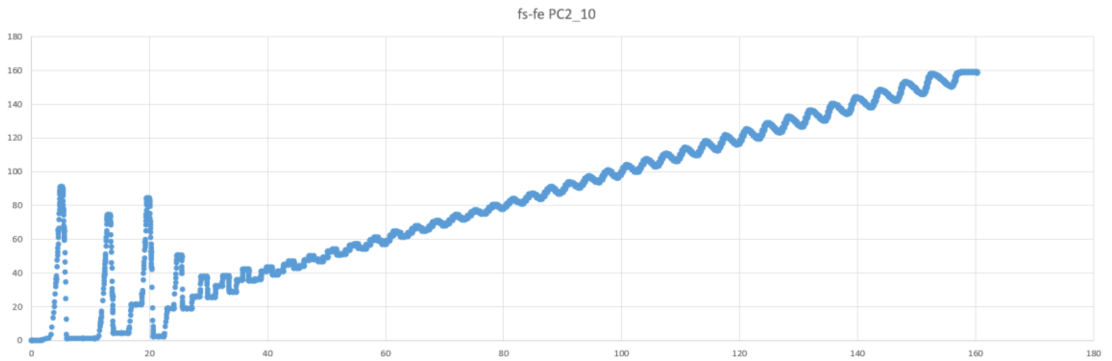
Décroissant PC1, $C_2 = 10nF$



$$f_1 = 0kHz\,, f_2 = 156.90kHz$$

plage de verrouillage : [0kHz, 156.90kHz]

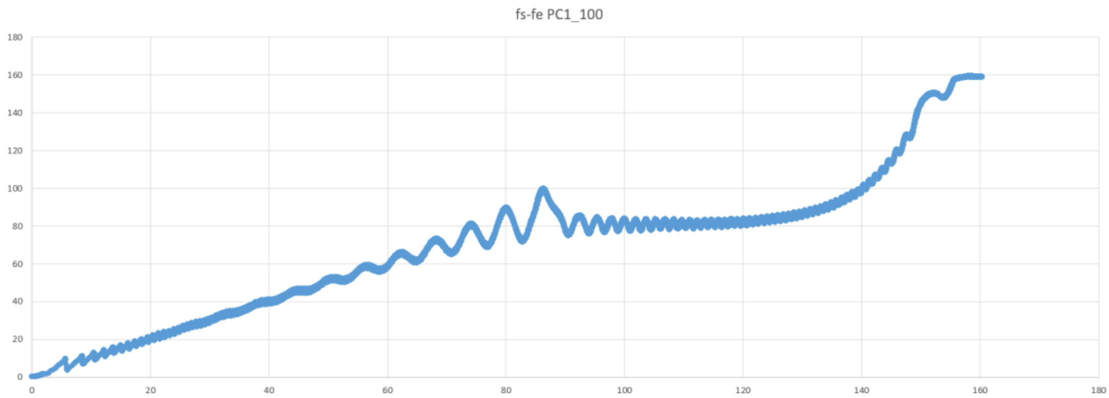
Décroissant PC2, $C_2 = 10nF$



$$f_1 = 0kHz\,, f_2 = 156.87kHz$$

plage de verrouillage : [0kHz, 156.87kHz]

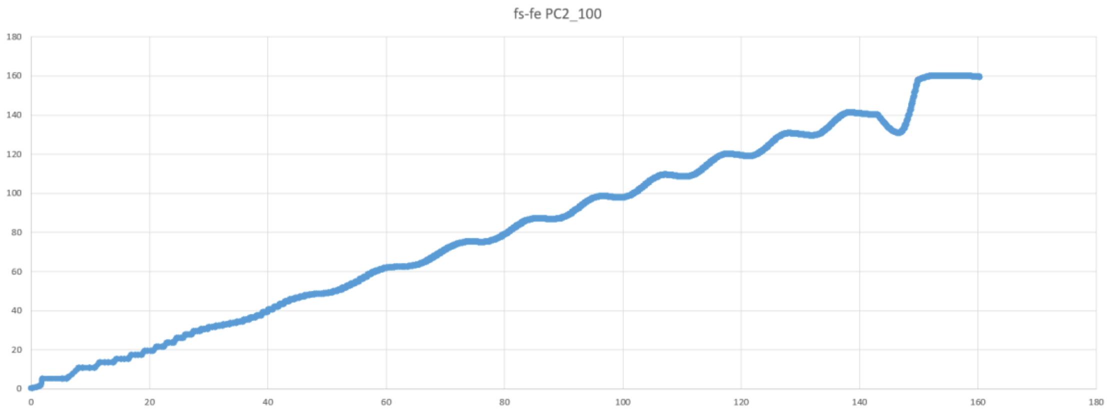
Décroissant PC1, $C_2 = 100nF$



$$f_1 = 0kHz\,, f_2 = 157.12kHz$$

plage de verrouillage : [0kHz, 157.12kHz]

Décroissant PC2, $C_2 = 100nF$

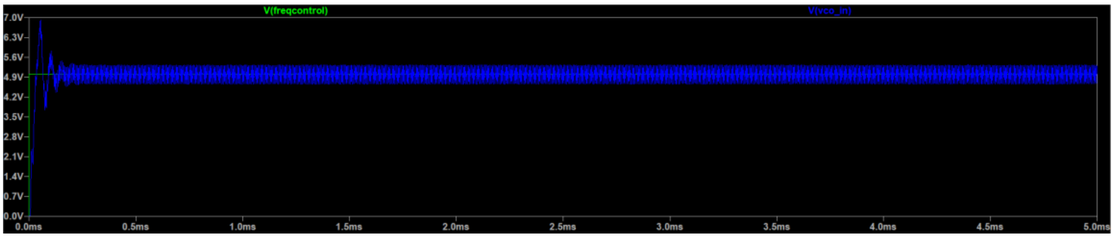


$$f_1 = 0kHz\ , f_2 = 151.05kHz$$

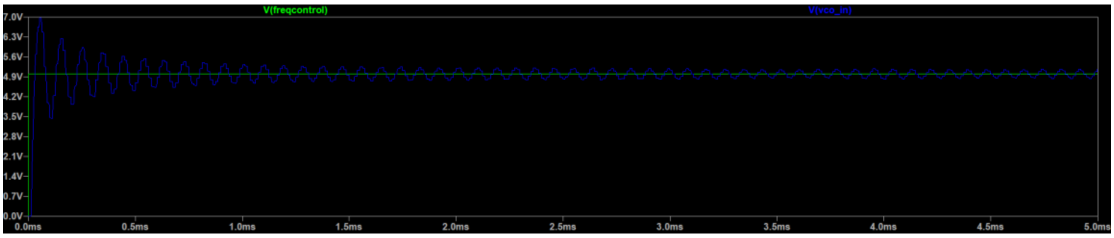
plage de verrouillage : [0kHz, 151.05kHz]

3. Réponse de la PLL à un échelon

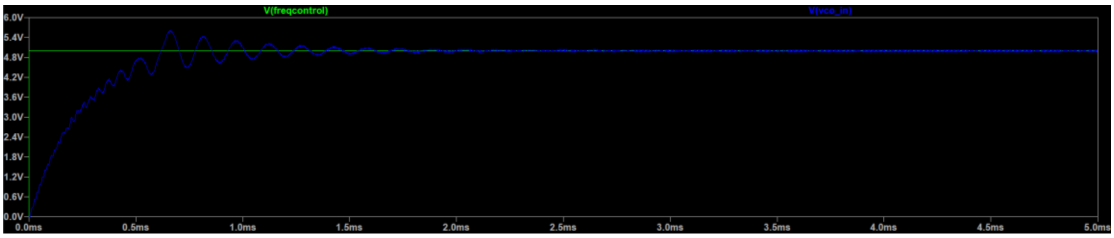
1. PC1, $C_2 = 10nF$



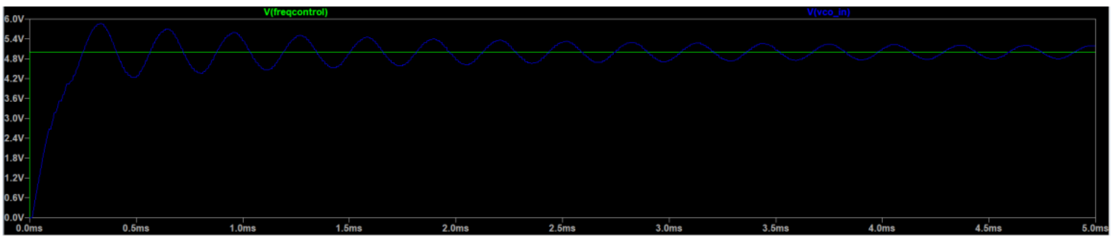
PC2, $C_2 = 10nF$



PC1, $C_2 = 100nF$



PC2, $C_2 = 100nF$



2. Le temps nécessaire pour atteindre 90% de la valeur de V(freqcontrol)
PC1, $C_2 = 10nF$
$$t_{90\%} = 131.768\mu s$$
PC2, $C_2 = 10nF$
$$t_{90\%} = 548.93\mu s$$
PC1, $C_2 = 100nF$
$$t_{90\%} = 0.75ms$$
PC2, $C_2 = 100nF$
$$t_{90\%} = 1.139ms$$
3. Temps caractéristiques des filtres utilisés.
PC1, $C_2 = 10nF$
$$t_{carac} = RC = 100\mu s$$
PC2, $C_2 = 10nF$
$$t_{carac} = RC = 100\mu s$$
PC1, $C_2 = 100nF$
$$t_{carac} = RC = 1ms$$
PC2, $C_2 = 100nF$
$$t_{carac} = RC = 1ms$$