

Devoir4 Étude de la PLL CD4046B

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1 Caractérisation du VCO

1.

The CD4046 PLL
Helmut Sennewald, V0.8
Please refer to TI, Fairchild, Onsemi and Philips datasheets.
<http://focus.ti.com/lit/ds/symlink/cd4046b.pdf>
<http://www.fairchildsemi.com/ds/CD/CD4046BC.pdf>
<http://www.onsemi.com/pub/Collateral/MC14046B-D.PDF>
http://www.semiconductors.philips.com/acrobat_download/datasheets/HEF4046B_CNV_3.pdf
Check carefully the datasheets, because there may be differences.

This is a hierarchical design. You can RightMouseClicked on the instance(symbol) and probe down the hierarchy. To probe signals down the hierarchy requires Control Panel -> Save Defaults
...Save Subcircuit Voltages
...Save Subcircuit Currents

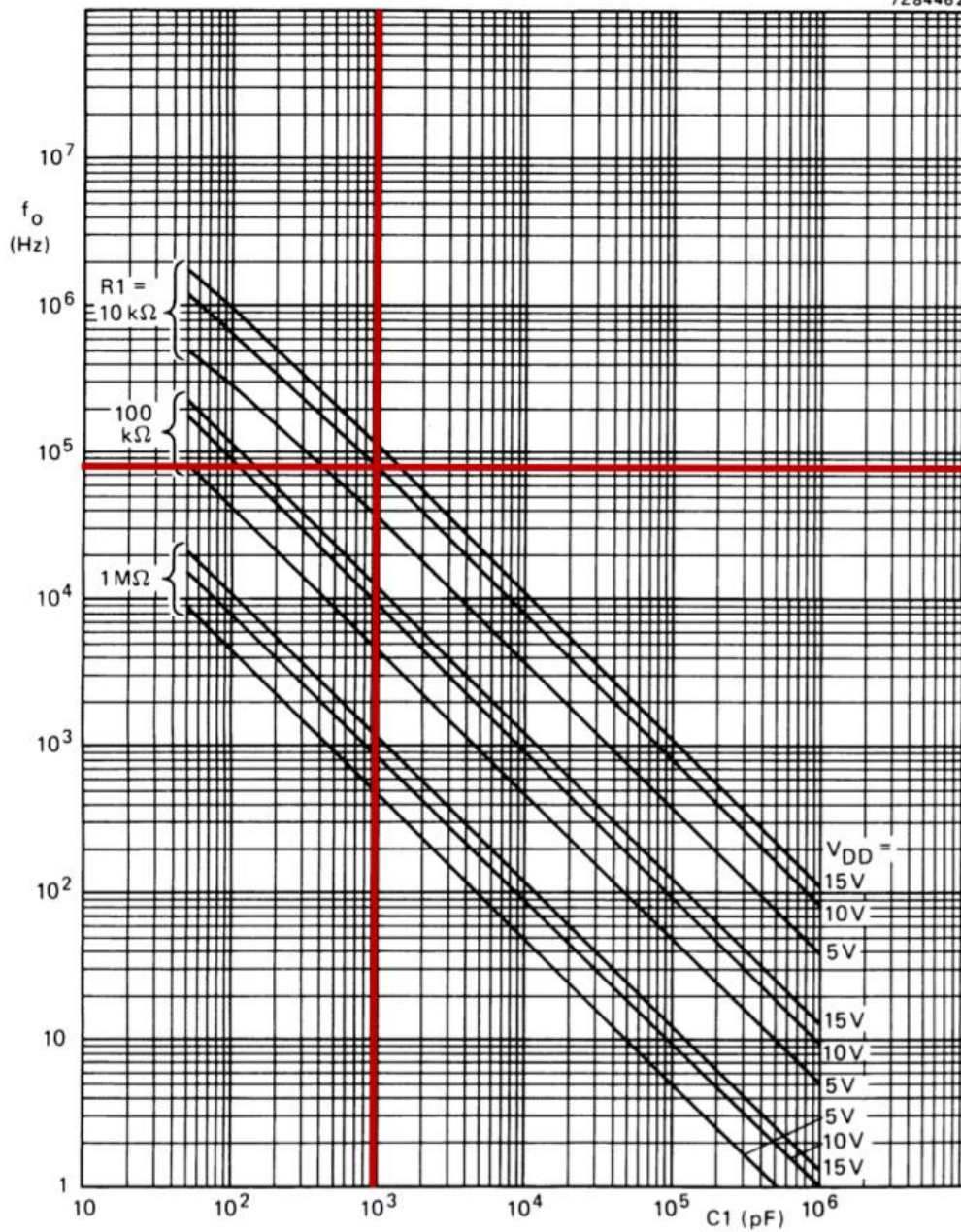
`.tran 0 50m 0 500n`
`.options plotwinsize=0`

`.options cshunt=1e-15`

`VCC1=10 FMIN=0.000001e6 FMAX=0.160e6 SPEED=1.0 TDEL1=20n TRIPDT1=8n`

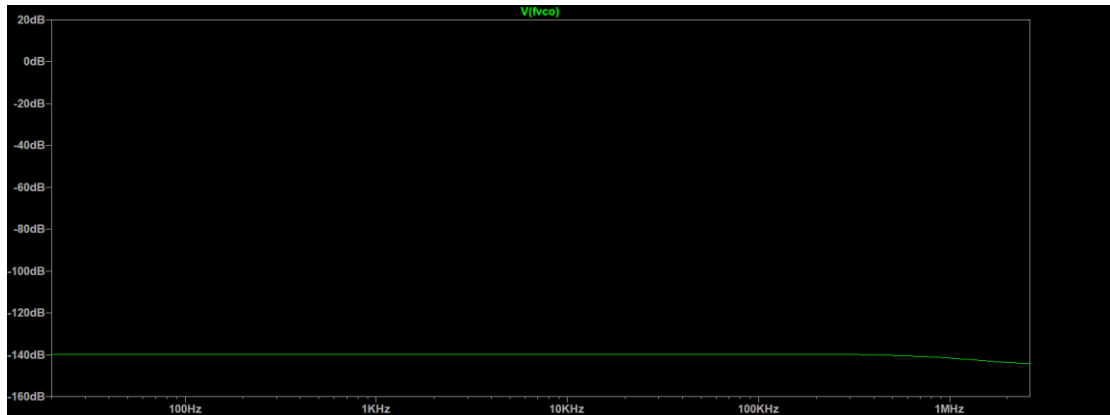
The visible parameters are from the CD4046 model.
They can be made invisible in the symbol's dialog.
Therefore RightMouseClicked on the symbol and uncheck it.

FMAX = max. VCO frequency
FMIN = min. VCO frequency
TDEL1=20n internal gate delay; don't change it
TRIPDT1=8n change it to 8n for $F_{vco} \geq 2.5e5$, $8n * 2.5e5 / F_{vco_max}$
Example: $F_{vco_max} = 1\text{kHz} \rightarrow \text{TRIPDT} = 2\mu$

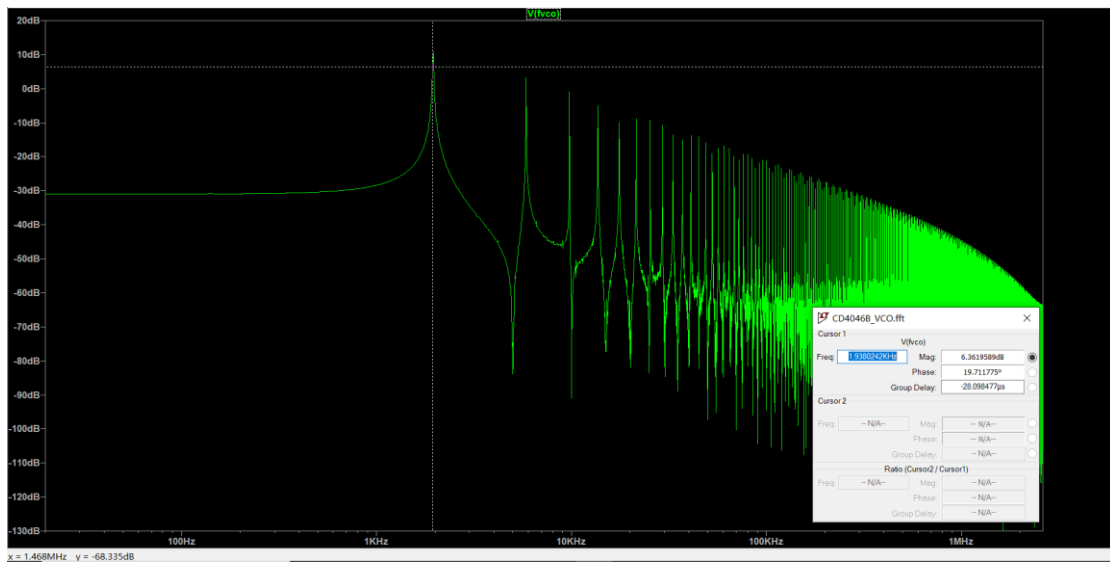


Par lecture de l'abaque, on sait que la plage de fonctionnement du VCO est de largeur $2f_L = 160\text{kHz}$ centrée autour $f_0 = 80\text{kHz}$.

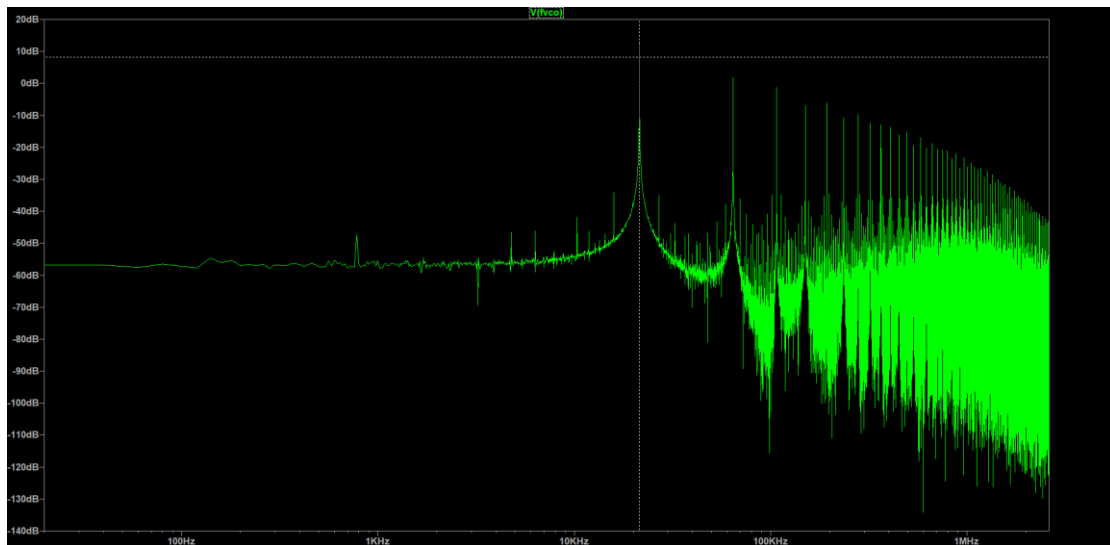
2. $f_{min} = 0\text{Hz}$, $f_{max} = 160\text{kHz}$
 $V1=0\text{V}$



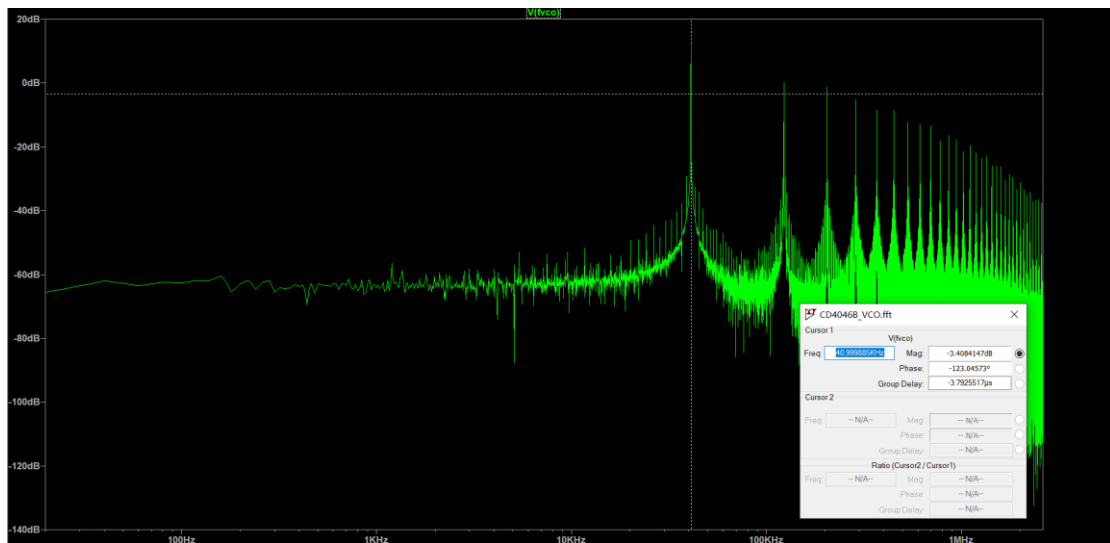
$V1=1\text{V}$, $f_{vco}=1.9380242\text{KHz}$



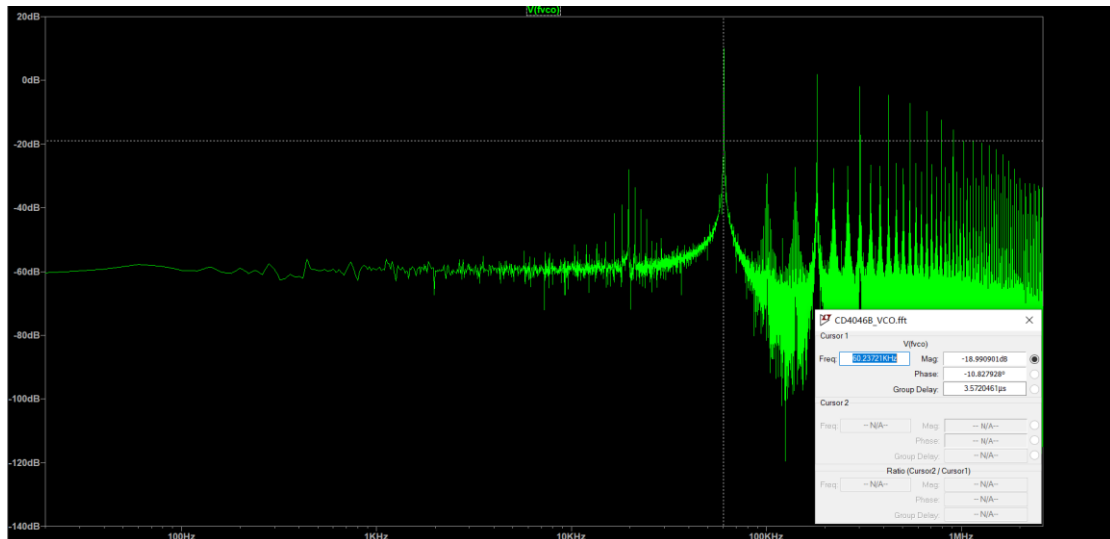
$V1=2\text{V}$, $f_{vco}= 21.450631\text{KHz}$



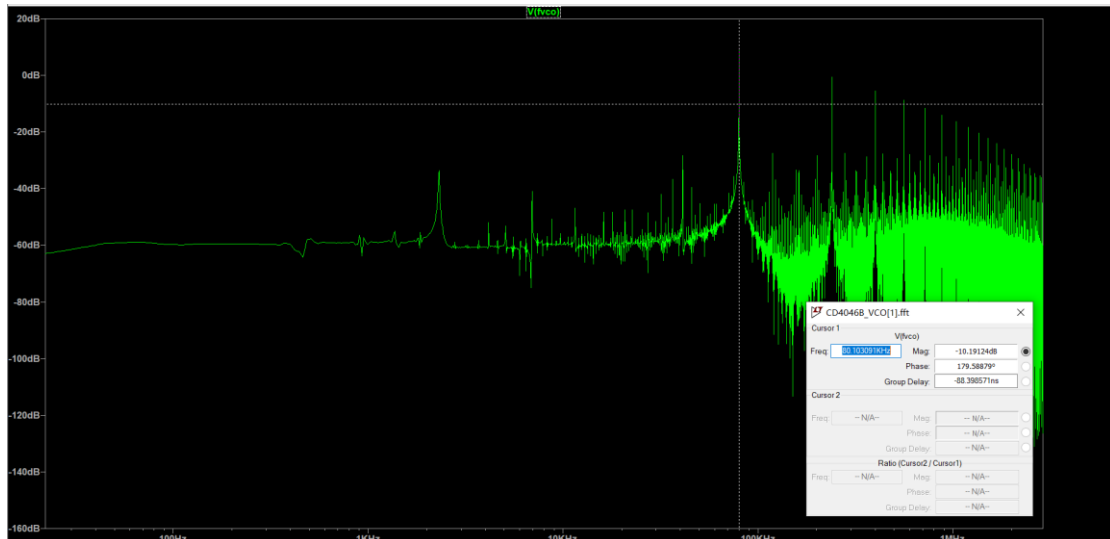
V1=3V, fvco=40.999885KHz



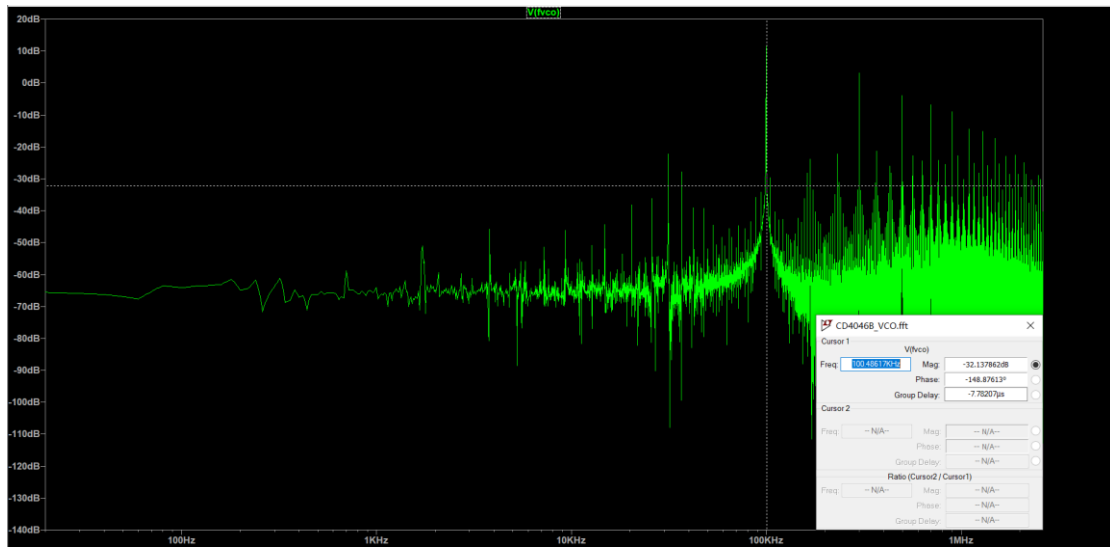
V1=4V, fvco=60.23721KHz



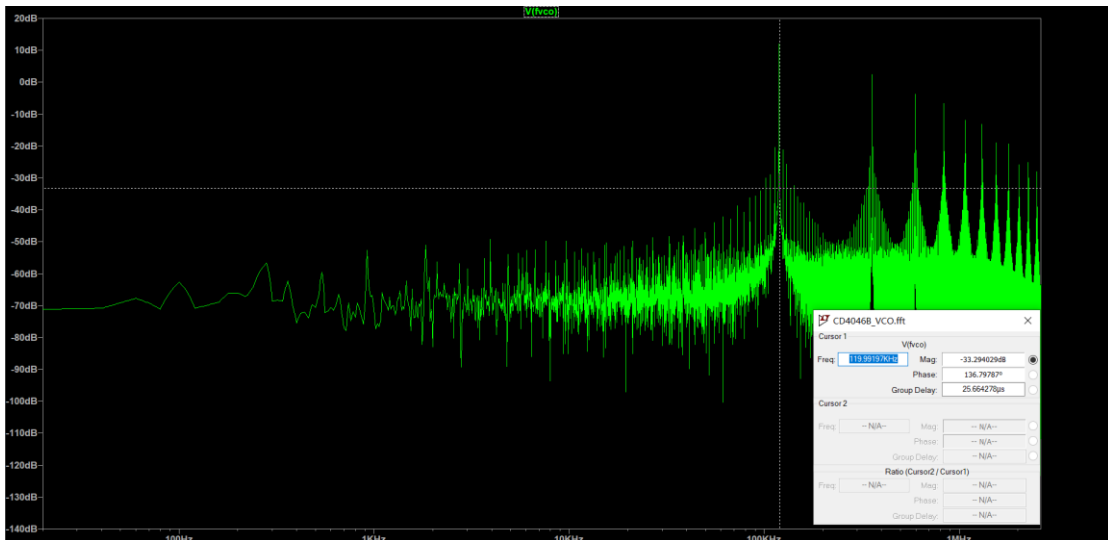
V1=5V, fvco=80.103091KHz



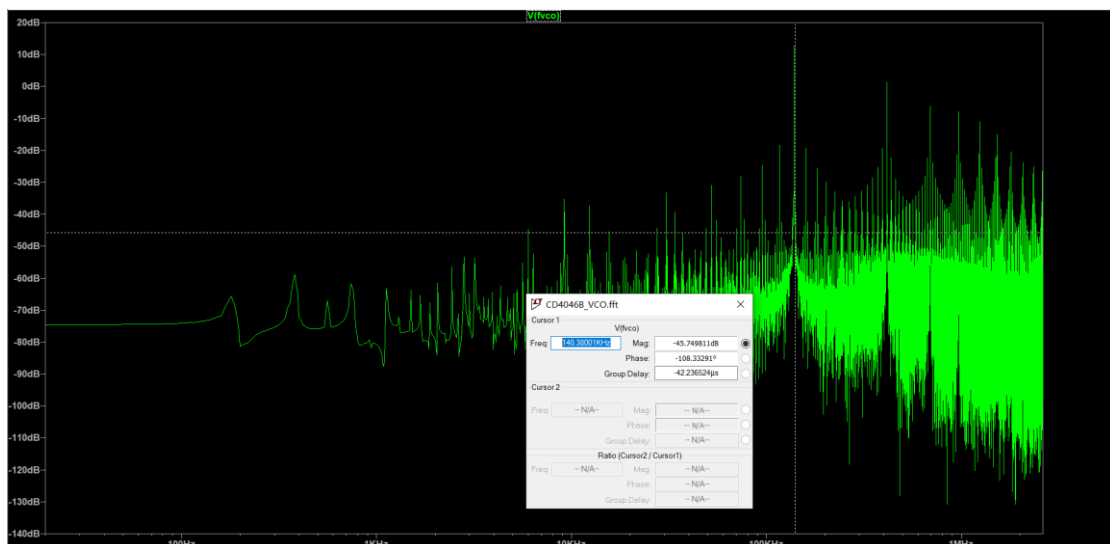
V1=6V, fvco=100.48617KHz



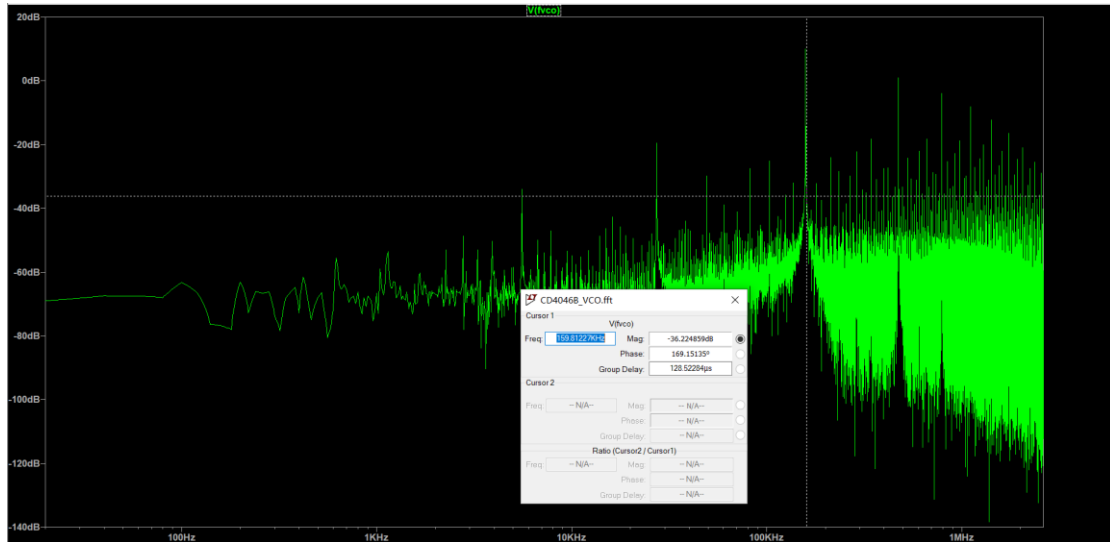
V1=7V, fvco=119.99197KHz



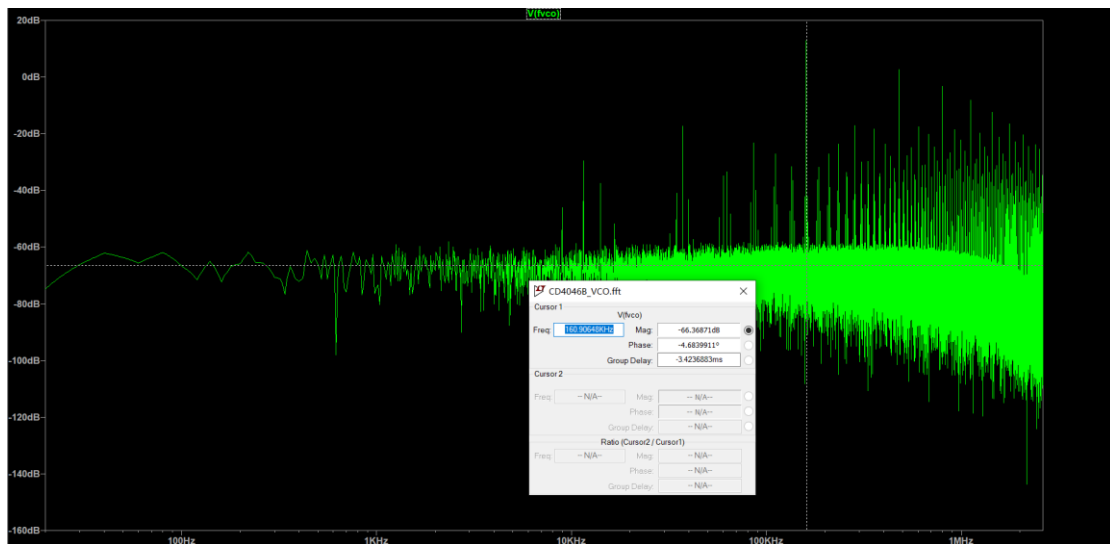
V1=8V, fvco=140.38001KHz



V1=9V, $f_{vco}=159.81227\text{KHz}$



V1=10V, $f_{vco}=160.90648\text{KHz}$

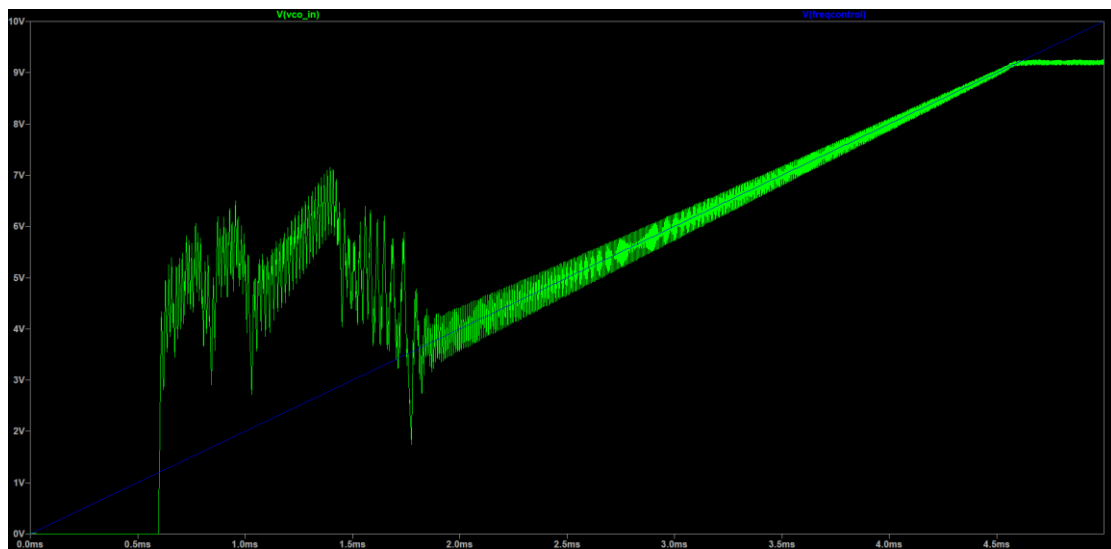


On peut voir que la fréquence du signal $f_{min}=0\text{Hz}$, $f_{max}=160\text{kHz}$. On vérifie bien la plage de fonctionnement de PLL HEF 4046B.

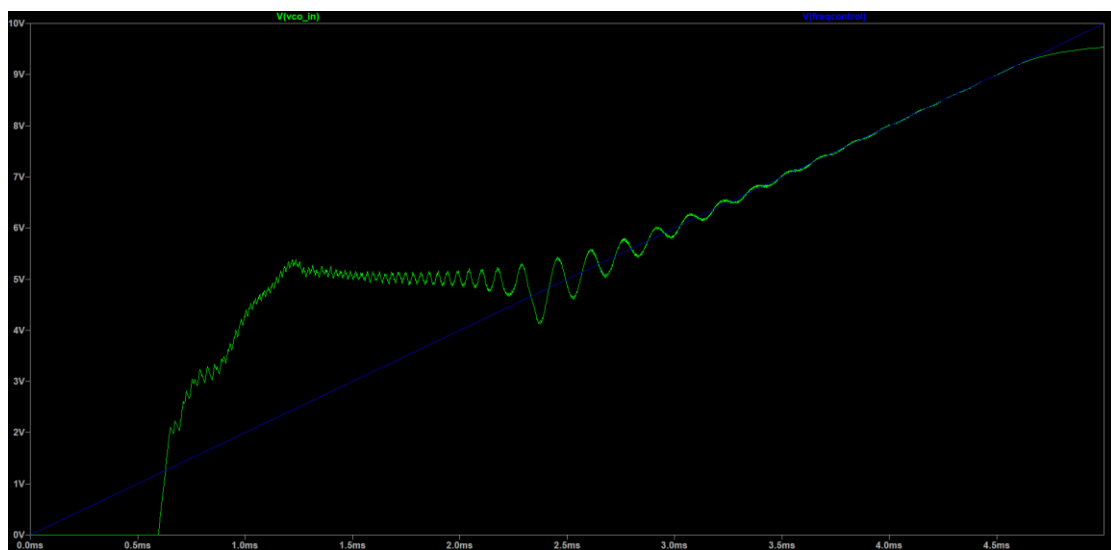
2 Mesure des plages de capture et de verrouillage

3. Pour le comparateur pc1

$$C_2 = 10nF$$

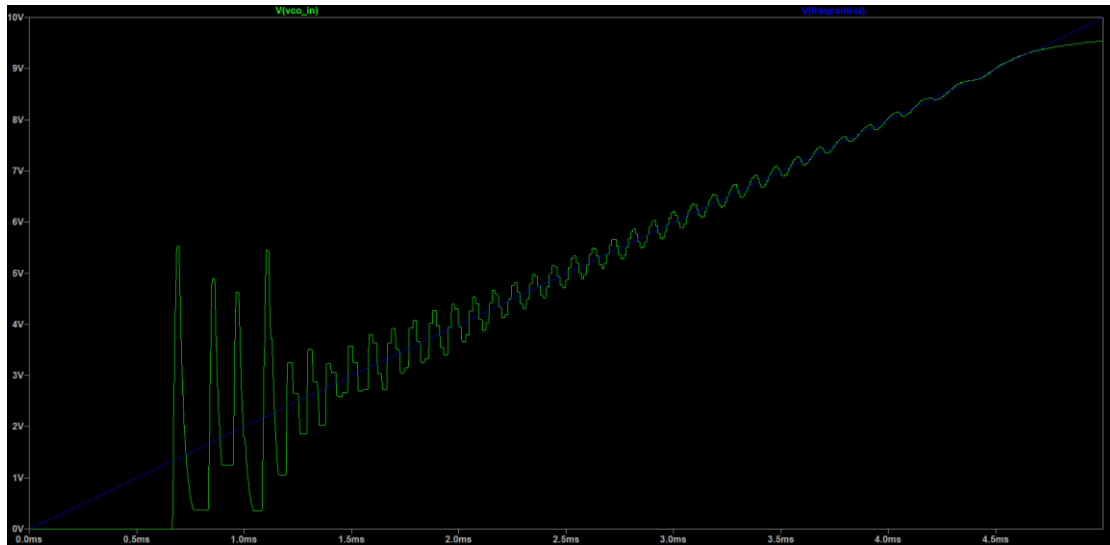


$$C_2 = 100nF$$

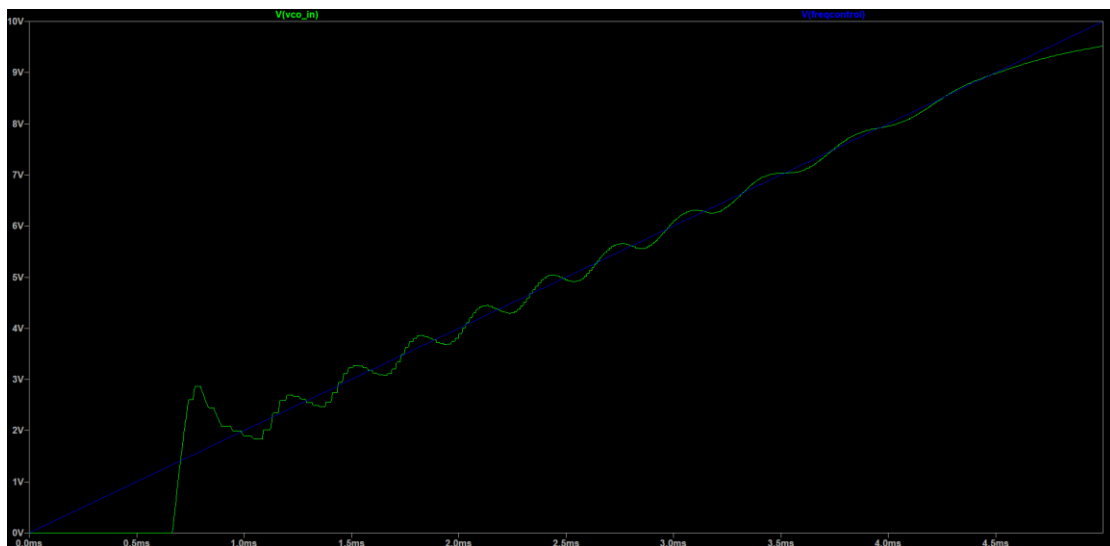


Pour le comparateur pc2

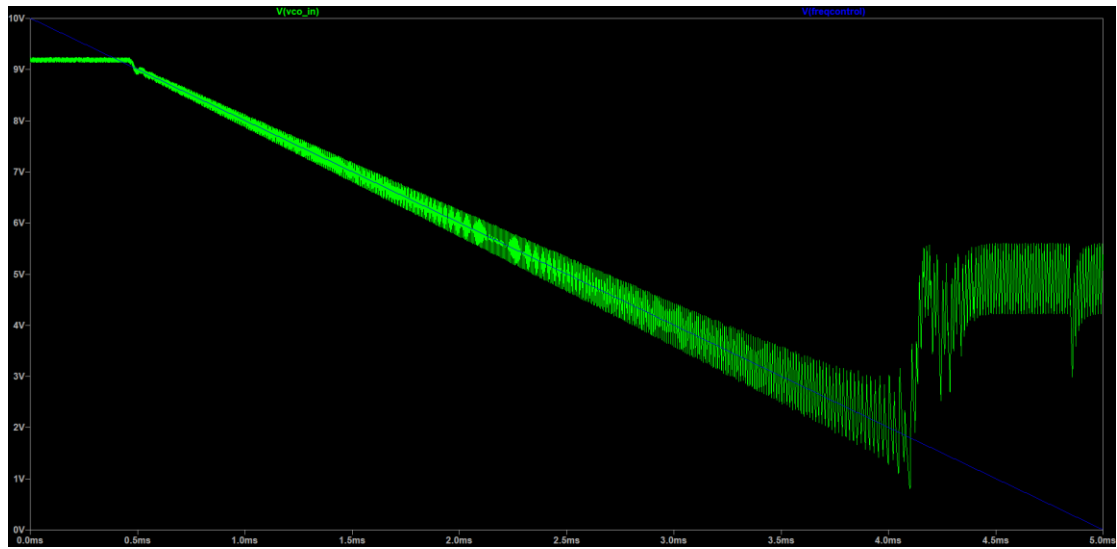
$$C_2 = 10nF$$



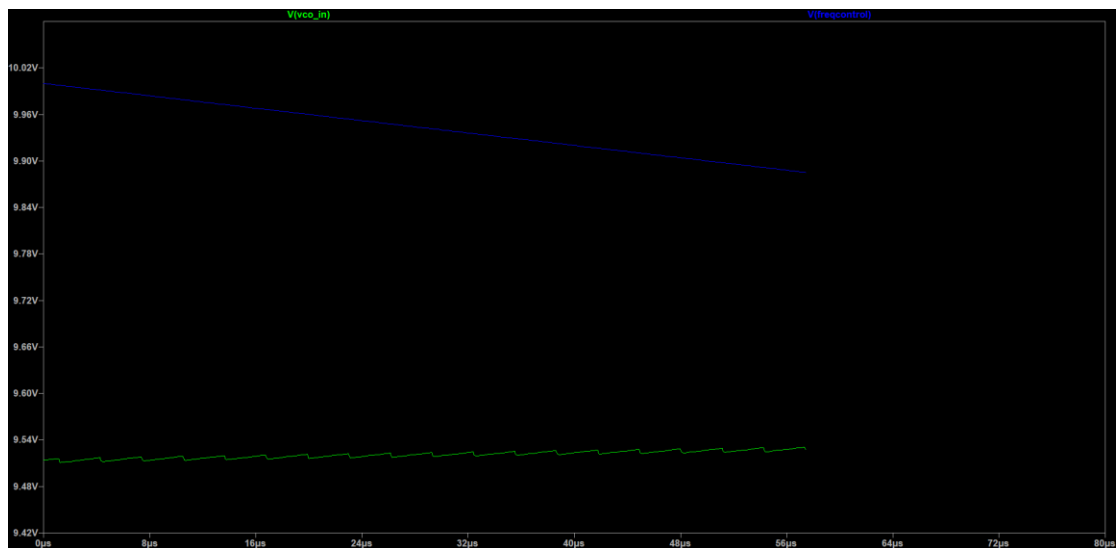
$$C_2 = 100nF$$



4. Pour le comparateur pc1
 $C_2 = 10nF$

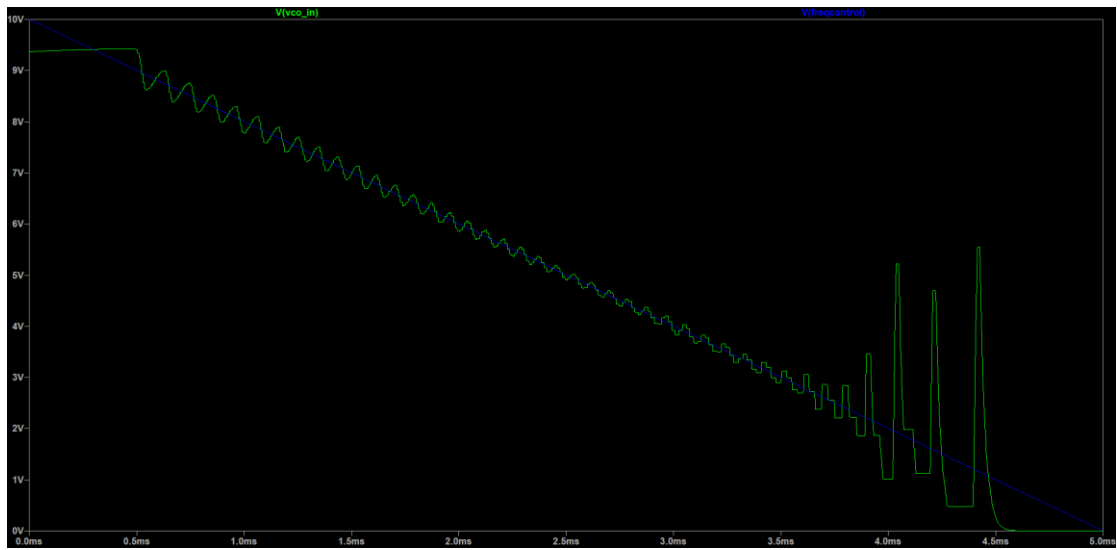


$C_2 = 100nF$

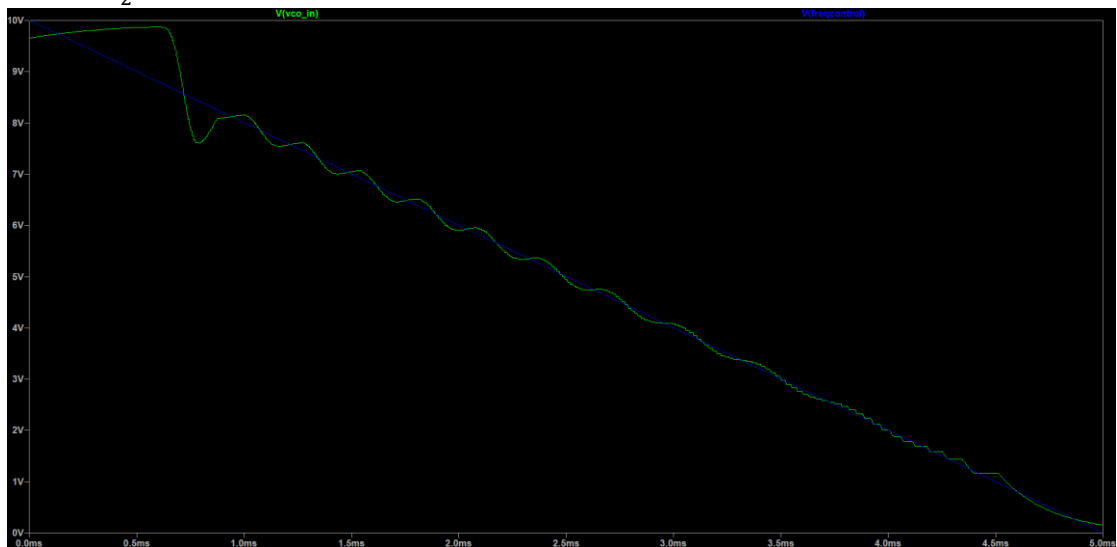


Pour le comparateur pc2

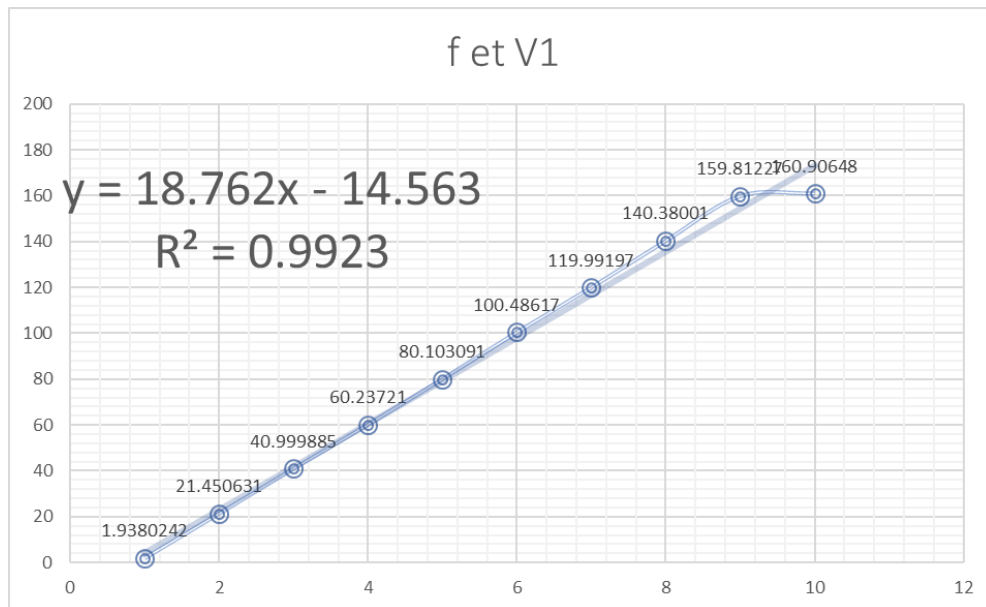
$$C_2 = 10nF$$



$$C_2 = 100nF$$



5. D'après la question 2,
On sait la relation entre f et V

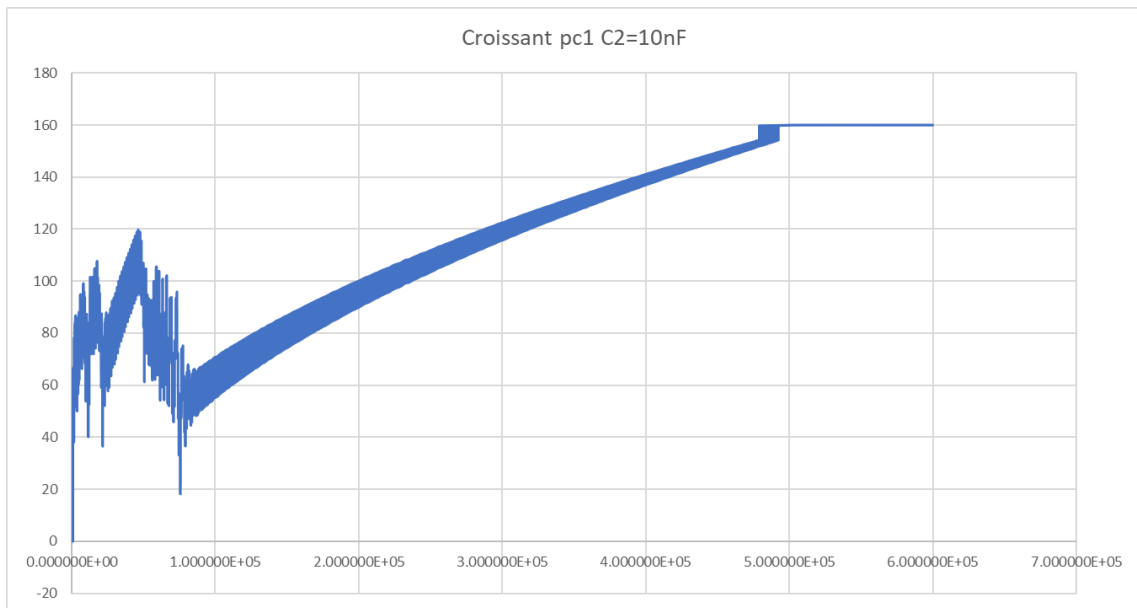


Si V est dans l'intervalle $[0,1]$, $f = 1.938V$

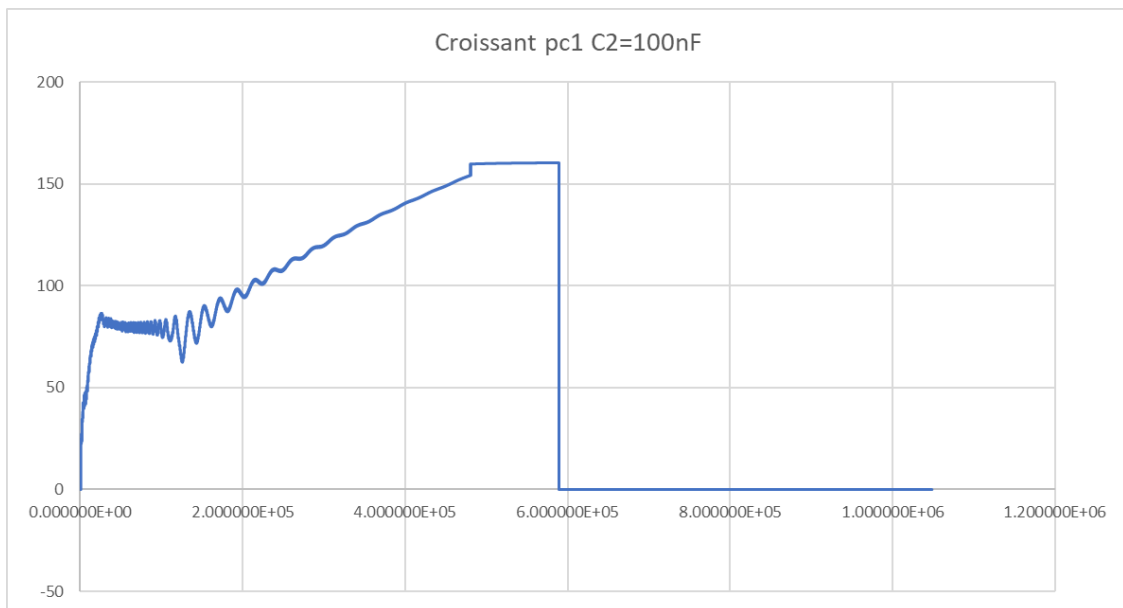
Si V est dans l'intervalle $[1,9]$, $f = 18.762V - 14.563$

Si V est dans l'intervalle $[9,10]$, $f = 1.0942V + 149.96$

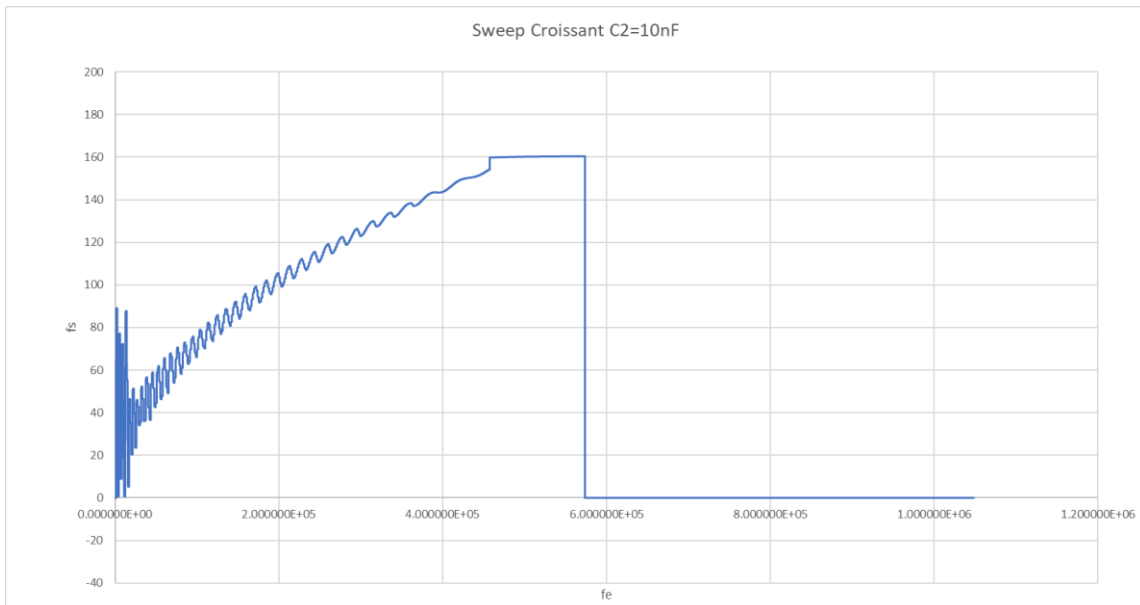
Sweep Croissant
Pour le comparateur pc1
C2=10nF



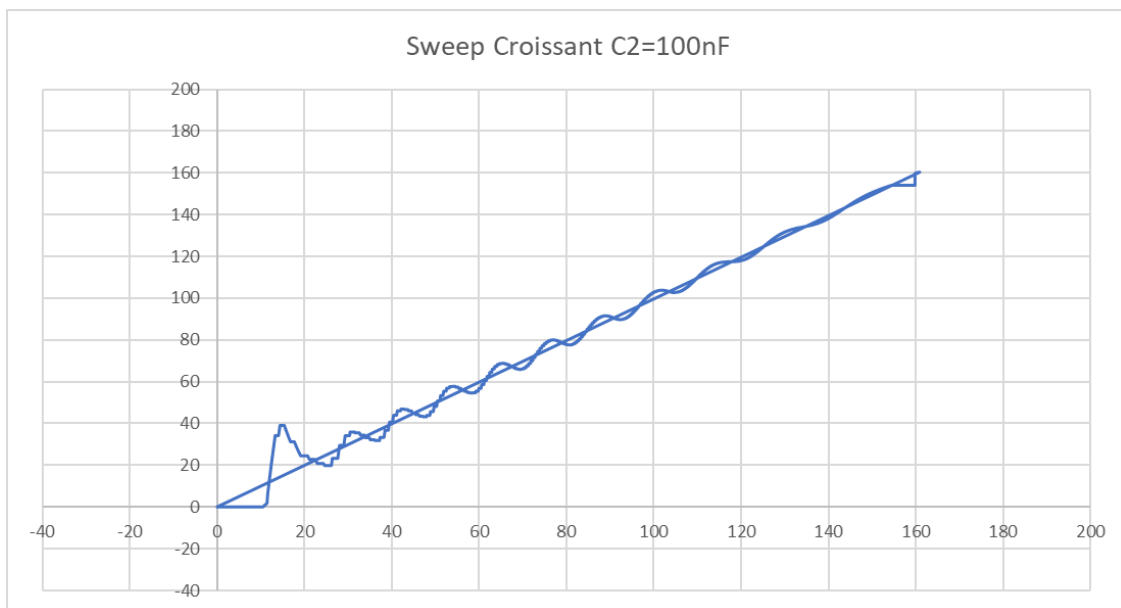
C2=100nF



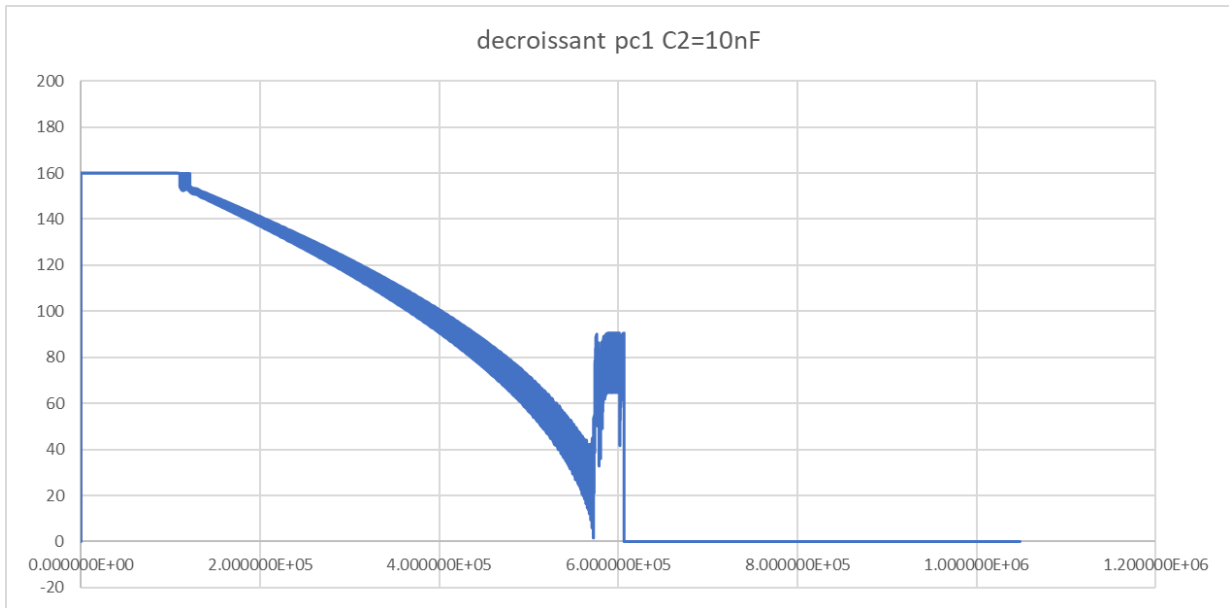
Pour le comparateur pc2
C2=10nF



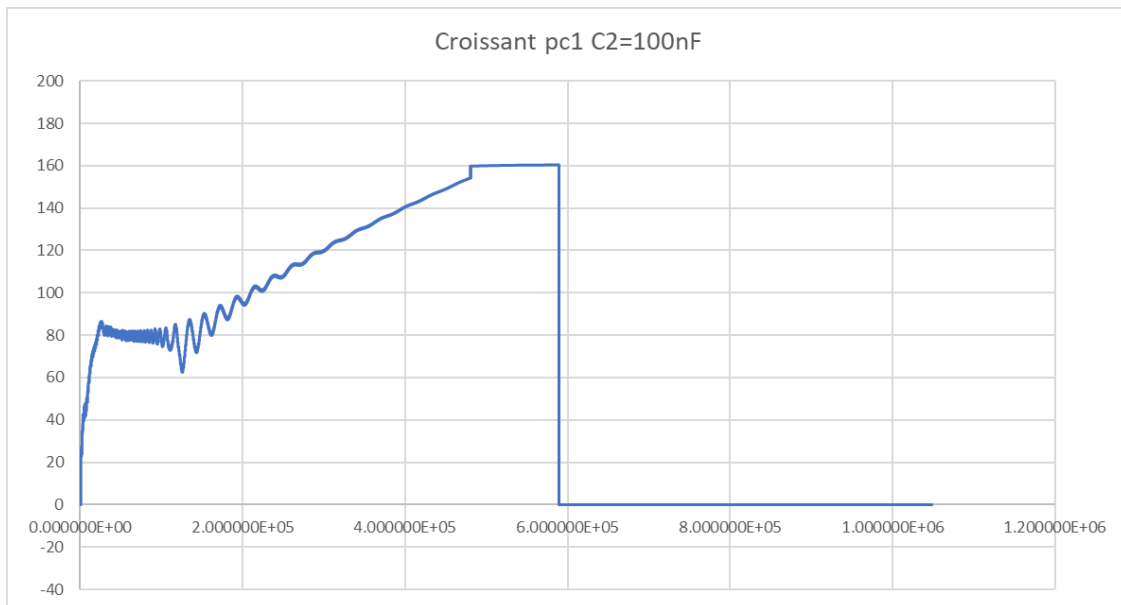
C2=100nF



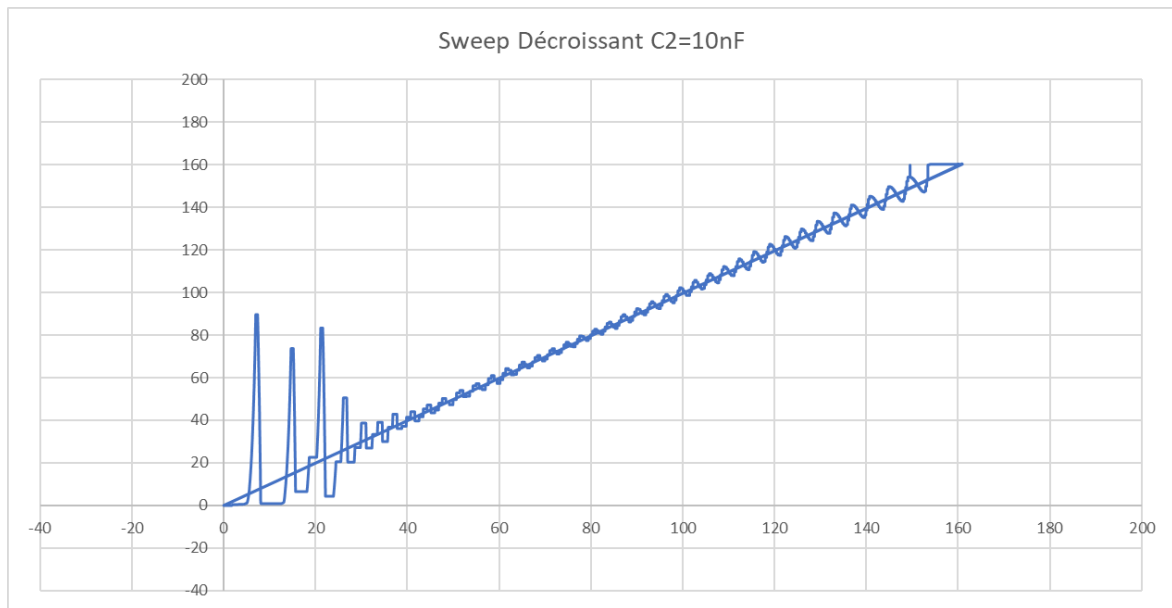
Sweep Décroissant
Pour le comparateur pc1
C2=10nF



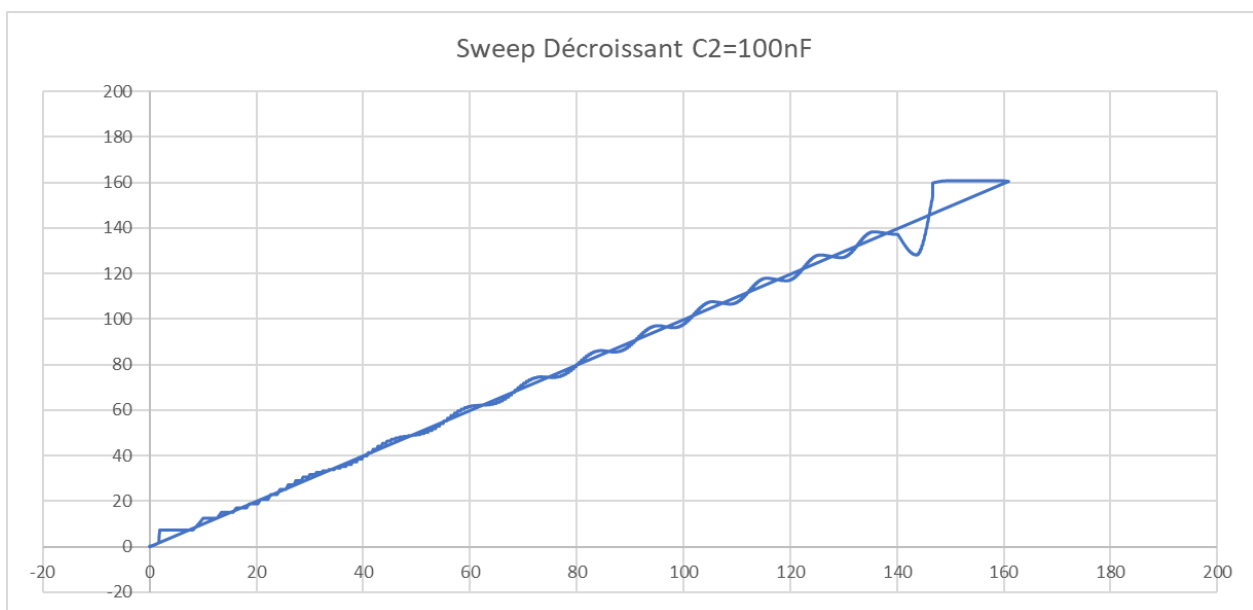
C2=100nF



Pour le comparateur pc2
C2=10nF

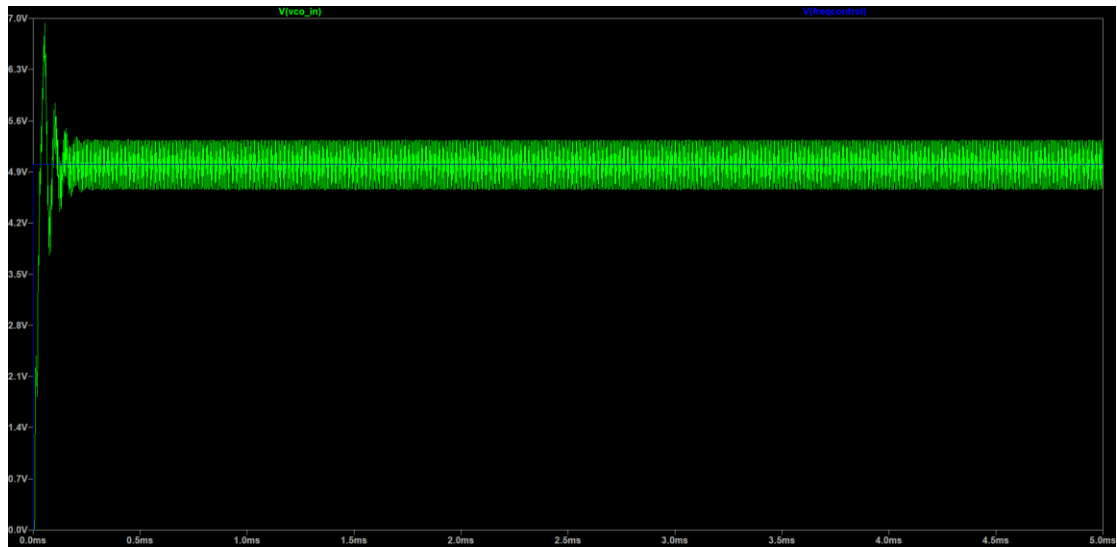


C2=100nF

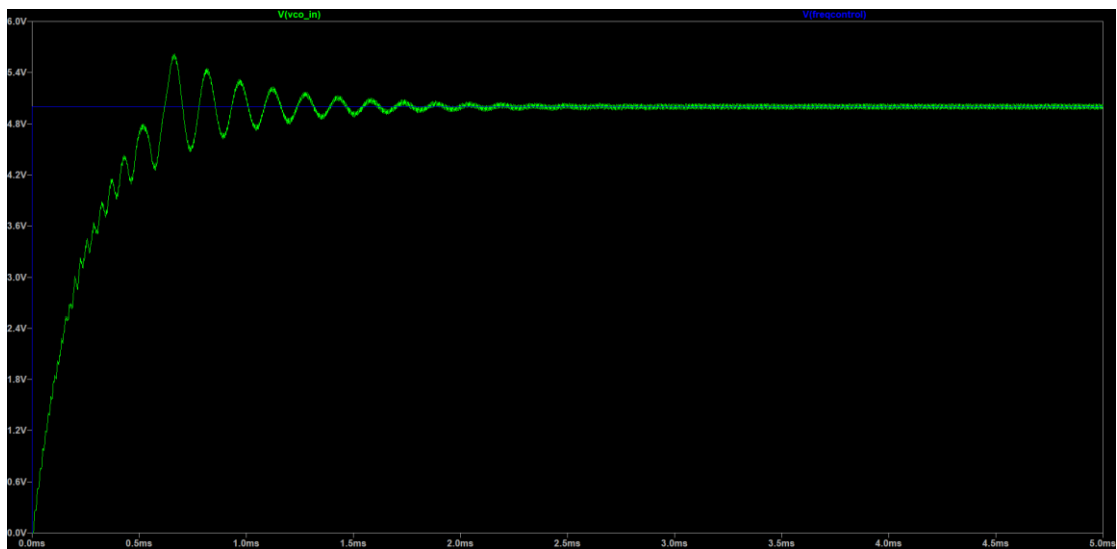


3 Réponse de la PLL à un échelon

1. Pour le comparateur pc1
C2=10nF

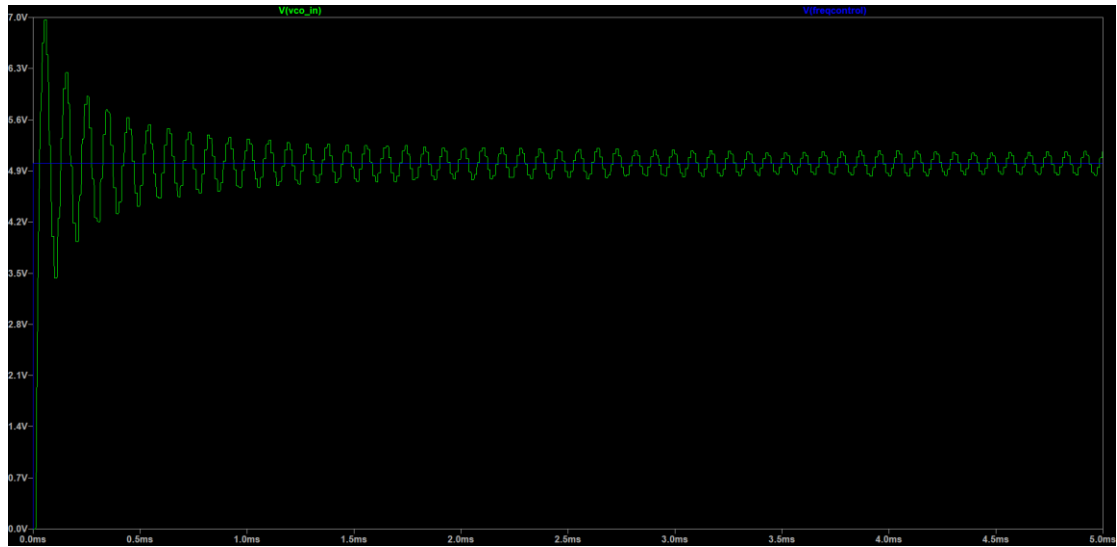


C2=100nF

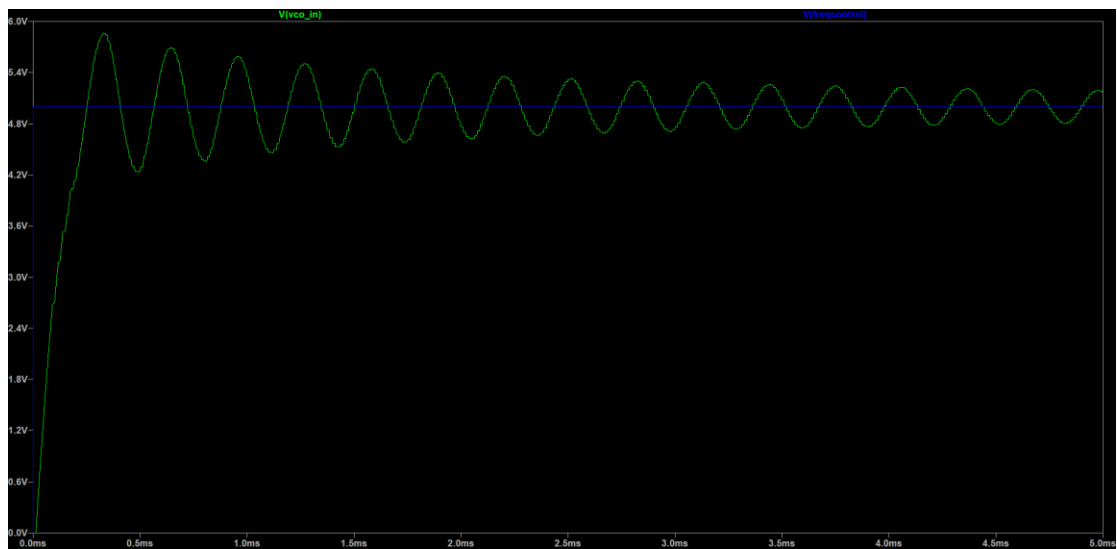


Pour le comparateur pc2

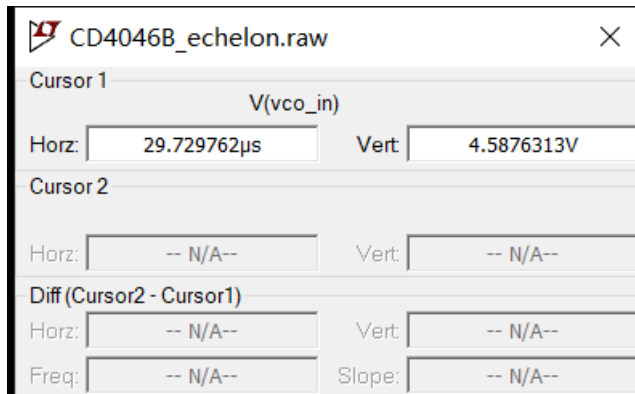
C2=10nF



C2=100nF

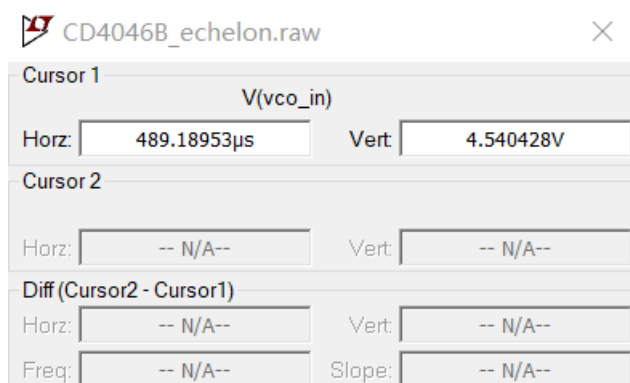


2. $V(\text{freqcontrol})=5\text{V}$, $90\%V(\text{freqcontrol})=4.5\text{V}$
Pour le comparateur pc1
 $C2=10\text{nF}$,



On mesure que le temps nécessaire pour atteindre 90% de la valeur de $V(\text{freqcontrol})$ est **29.729762µs**.

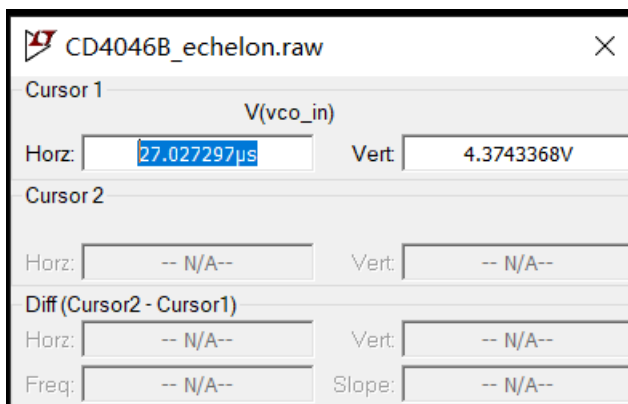
$C2=100\text{nF}$,



On mesure que le temps nécessaire pour atteindre 90% de la valeur de $V(\text{freqcontrol})$ est **489.18953µs**

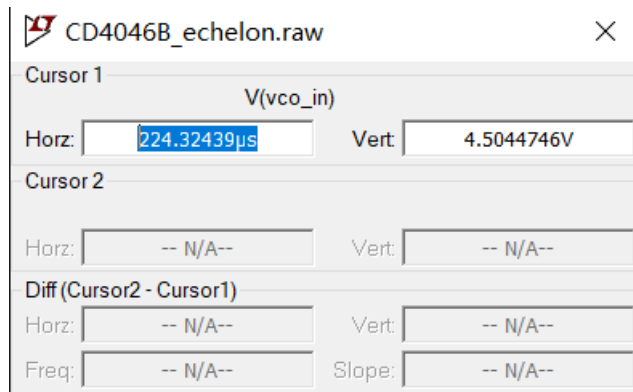
Pour le comparateur pc2

$C2=10\text{nF}$



On mesure que le temps nécessaire pour atteindre 90% de la valeur de $V(\text{freqcontrol})$ est **27.027297µs**

C2=100nF



On mesure que le temps nécessaire pour atteindre 90% de la valeur de V(freqcontrol) est **224.32439µs**

3. Pour C2=10nF, le temps caractéristique de filtre est 18µs.
Pour C2=100nF, le temps caractéristique de filtre est 180µs.
Les temps nécessaires pour atteindre 90% de la valeur de V(freqcontrol) sont tous supérieur aux temps caractéristiques des filtres utilisés.