gm-C Filter Design Sheet

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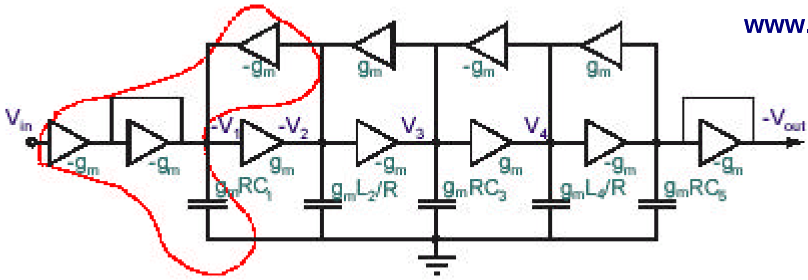


This sheet is used to design the gm-C filter shown above, called a leapfrog realisation. This filter is a 5th order filter. The method I have used is to design from the filter g-coefficients, whice can be obtained from a variety of methods including a program freely available from my web page. I have included some simulation results at the end.

The design equations are from the IEE book "design of high frequency analog filters" Y. Sun plus some lecture notes from Saska Lindfors at Aalborg university

Yellow is user input, Green is output

Main user input area:

First get the g values, these are for a filter with 0.2dB ripple, Chebychev, N = 5. This design only works for odd values of N.

$g := (1\ \ 1.339\ \ 1.337\ \ 2.166\ \ 1.337\ \ 1.339\ \ 1)$ $\quad F_c := 20 \cdot \text{MHz}$ $\quad g_m := 0.1 \dfrac{\text{mA}}{\text{V}}$

Calculate Values

The maths for this filter turns out to be remarkably easy.
For smaller capacitors you need to use a lower gm,
but this means the load impedance needs to be higher

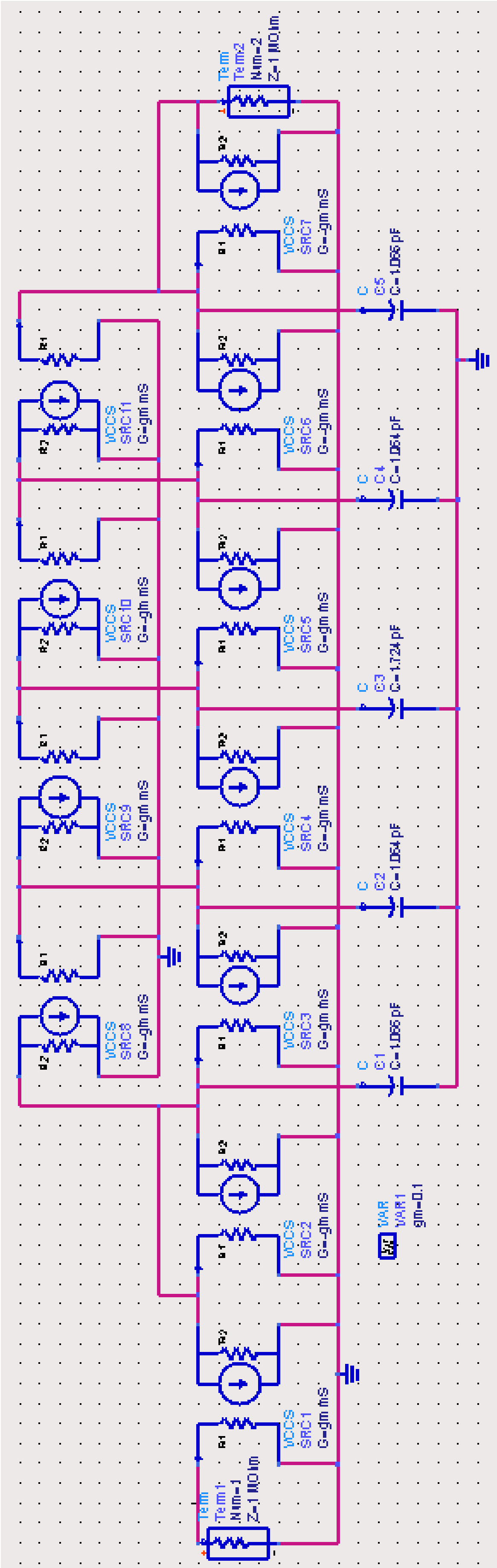
$N := \text{cols}(g) \qquad n := 1, 2 .. N - 2$

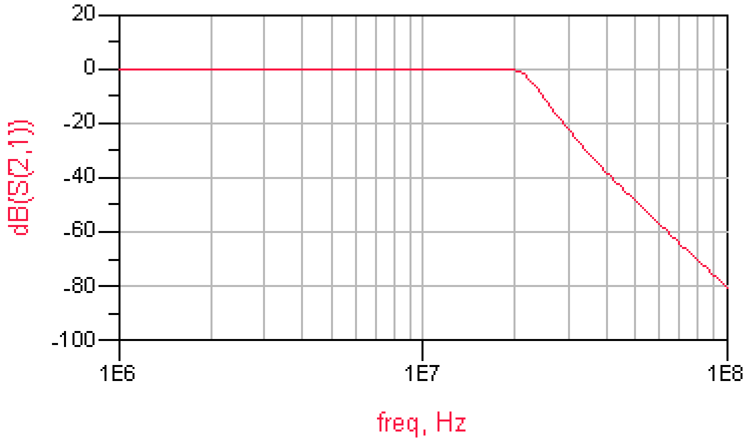
$$C_n := \begin{cases} g_m \cdot \dfrac{g_{0,n}}{2 \cdot \mathbf{p} \cdot F_c} & \text{if } \left(n - 2 \cdot \text{trunc}\left(\dfrac{n}{2}\right)\right) > 0.5 \quad \text{Odd.} \\ g_m \cdot \dfrac{g_{0,n}}{2 \cdot \mathbf{p} \cdot F_c} & \text{if } \left(n - 2 \cdot \text{trunc}\left(\dfrac{n}{2}\right)\right) < 0.5 \quad \text{Even.} \end{cases}$$

$C_n =$

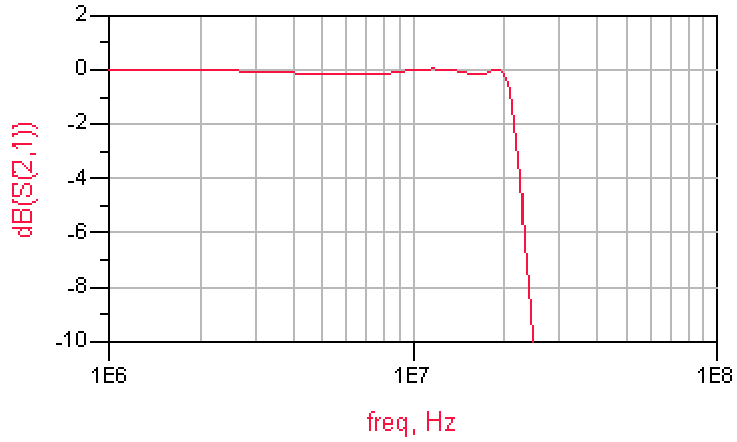
C_n (pF)
1.066
1.064
1.724
1.064
1.066

Simulation Schematic

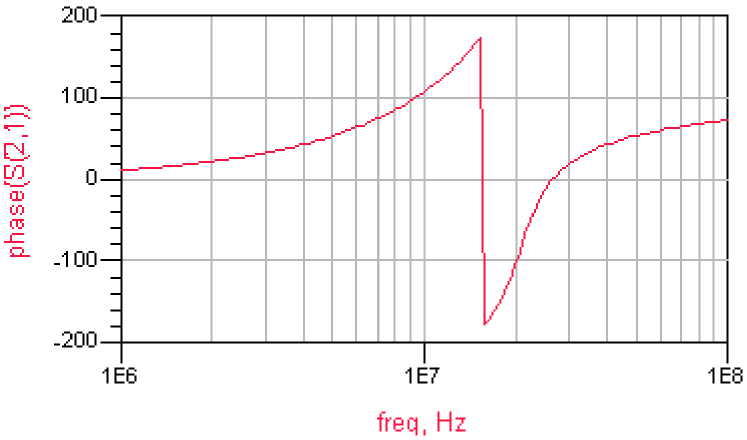




20
0
-20
-40
-60
-80
-100
dB(S(2,1))
1E6
1E7
1E8
freq, Hz



2
0
-2
-4
-6
-8
-10
dB(S(2,1))
1E6
1E7
1E8
freq, Hz



200
100
0
-100
-200
phase(S(2,1))
1E6
1E7
1E8
freq, Hz