TP2
-
Synthèse de filtre en technologie microruban

- Cahier des charges
- Filtres
- Filtre LC
- Filtre à stubs
- Filtre à sauts d’impédance

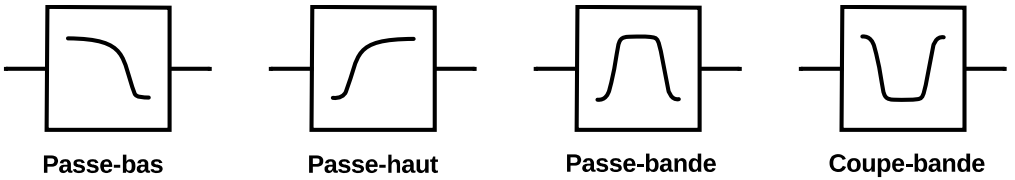
Cahier des charges

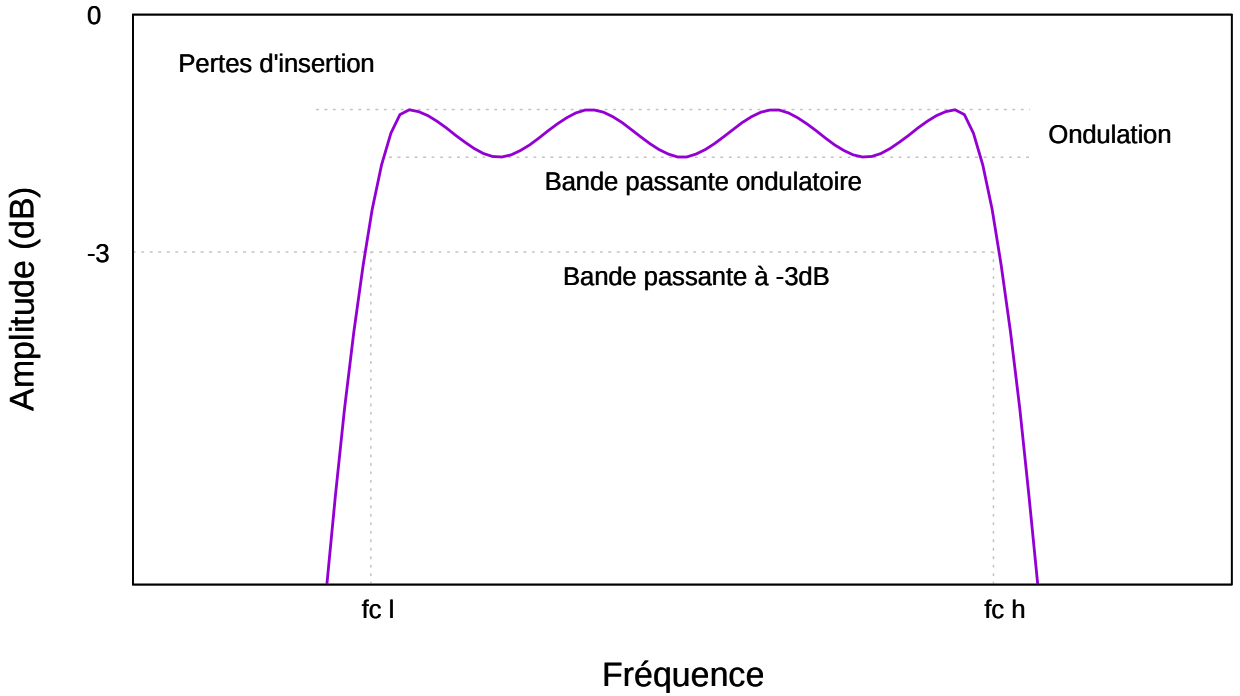
- Passe bas
- Ordre 5
- Tchebychev
- Ondulation : 0,5dB
- fc=1840MHz
- Adaptation : 50Ω

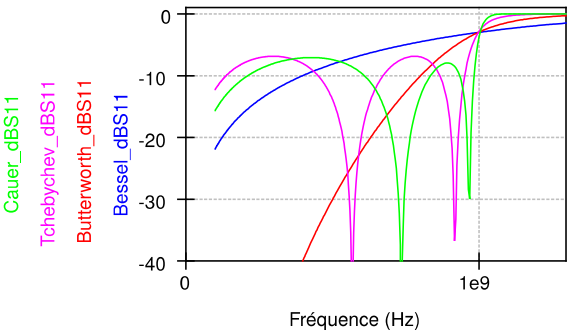
Substrat :

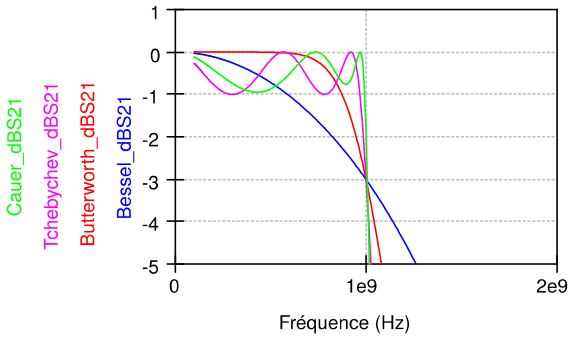
- FR4
- εr=4,7
- H=1,55mm
- t=35µm
- Tanδ=0,014

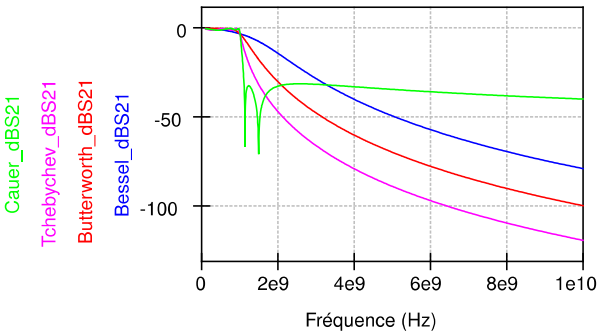
Filtres

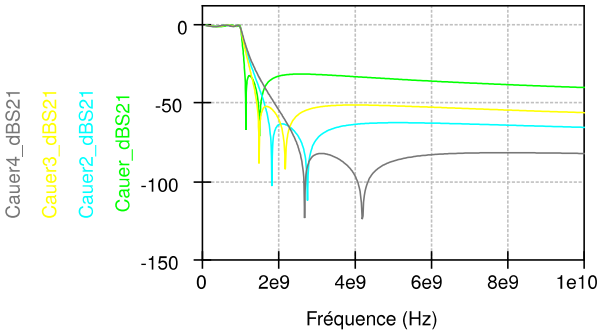

Passe-bas
Passe-haut
Passe-bande
Coupe-bande


0
-3
Amplitude (dB)
Pertes d'insertion
Ondulation
Bande passante ondulatoire
Bande passante à -3dB
fc l
fc h
Fréquence

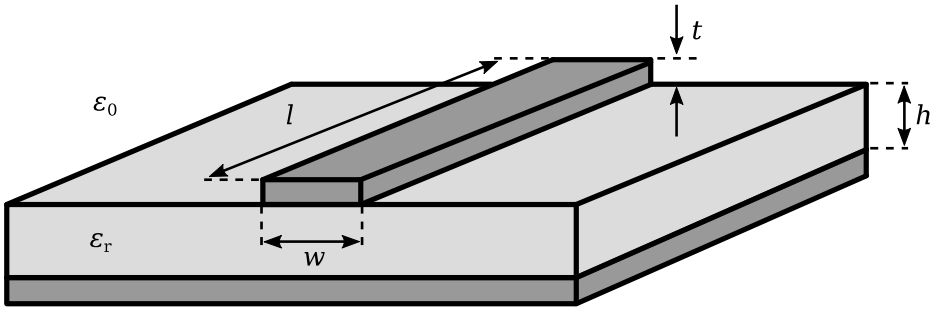

Cauer_dBS11
Tchebychev_dBS11
Butterworth_dBS11
Bessel_dBS11
0
-10
-20
-30
-40
0
1e9
Fréquence (Hz)

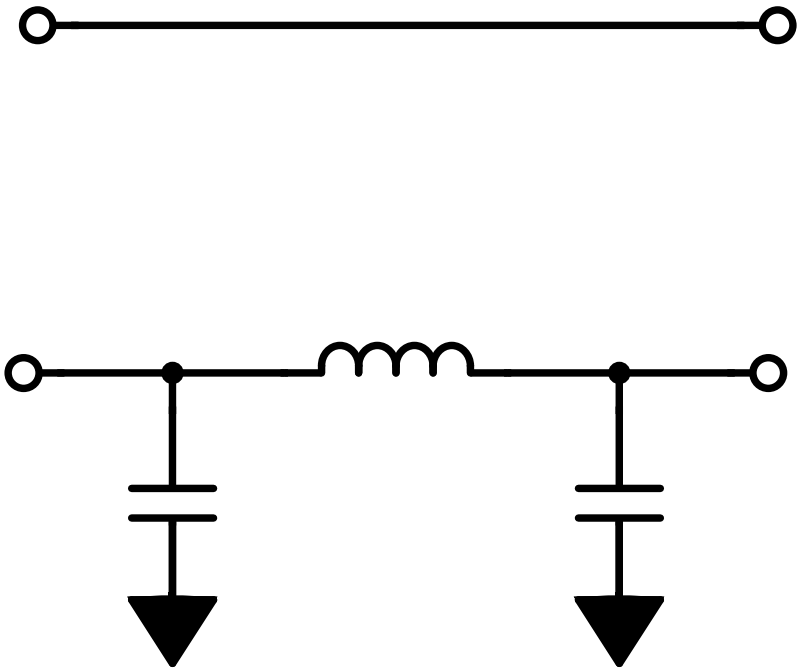

Cauer_dBS21
Tchebychev_dBS21
Butterworth_dBS21
Bessel_dBS21
1
0
-1
-2
-3
-4
-5
0
1e9
2e9
Fréquence (Hz)


Cauer_dBS21
Tchebychev_dBS21
Butterworth_dBS21
Bessel_dBS21
0
-50
-100
0
2e9
4e9
6e9
8e9
1e10
Fréquence (Hz)

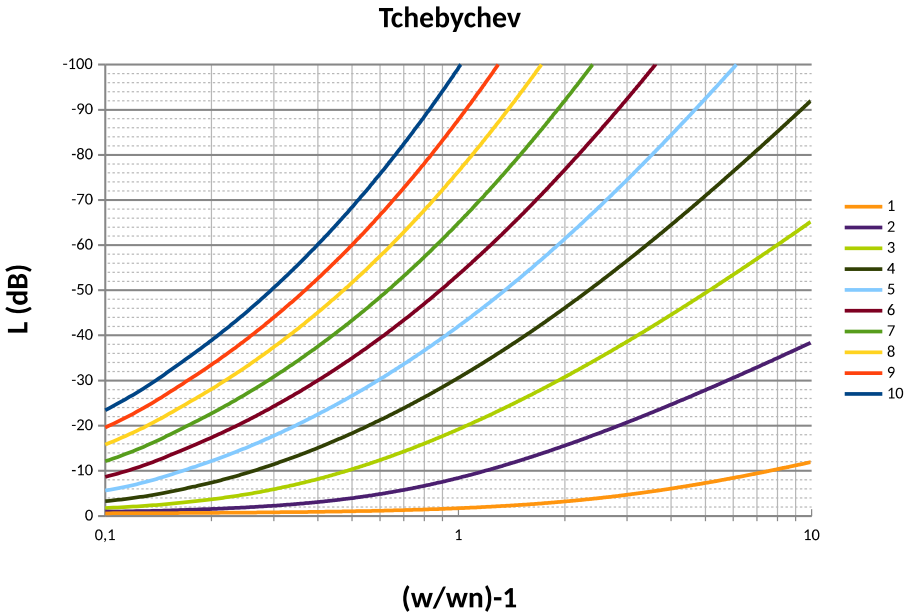

Cauer4_dBS21
Cauer3_dBS21
Cauer2_dBS21
Cauer_dBS21
0
-50
-100
-150
0
2e9
4e9
6e9
8e9
1e10
Fréquence (Hz)

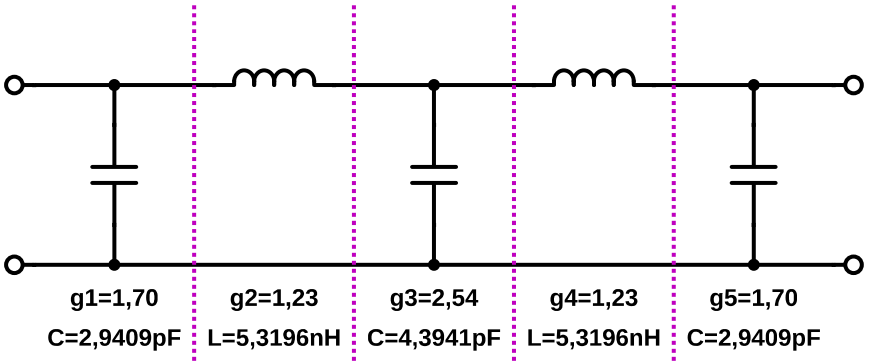
Technologie microruban





Filtre LC



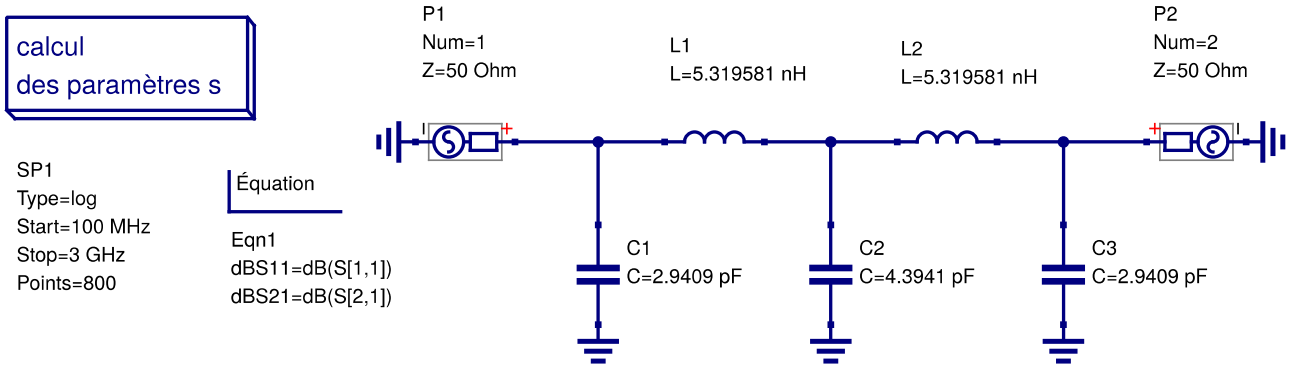


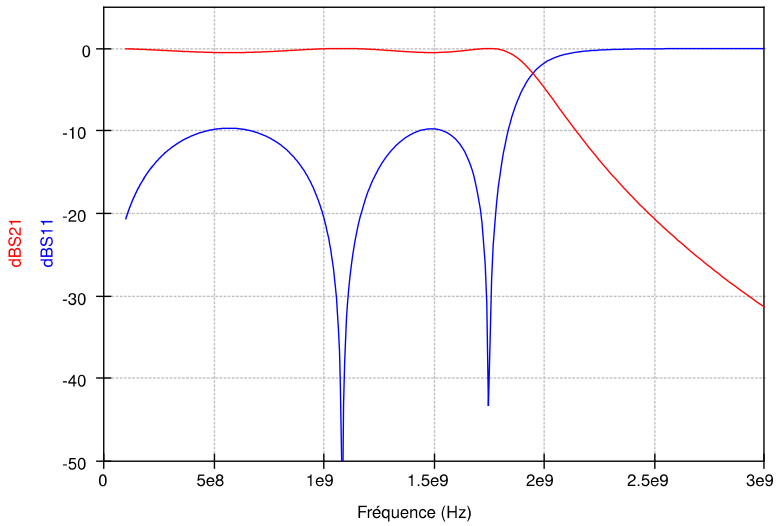
	Ordre n									
Indice k	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	0,699	1,403	1,596	1,670	1,706	1,725	1,737	1,745	1,750	1,754
2		0,707	1,097	1,193	1,230	1,248	1,258	1,265	1,269	1,272
3			1,596	2,366	2,541	2,606	2,638	2,656	2,668	2,675
4				0,842	1,230	1,314	1,344	1,359	1,367	1,372
5					1,706	2,476	2,638	2,696	2,724	2,739
6						0,870	1,258	1,339	1,367	1,381
7							1,737	2,509	2,668	2,723
8								0,880	1,269	1,348
9									1,750	2,524
10										0,884

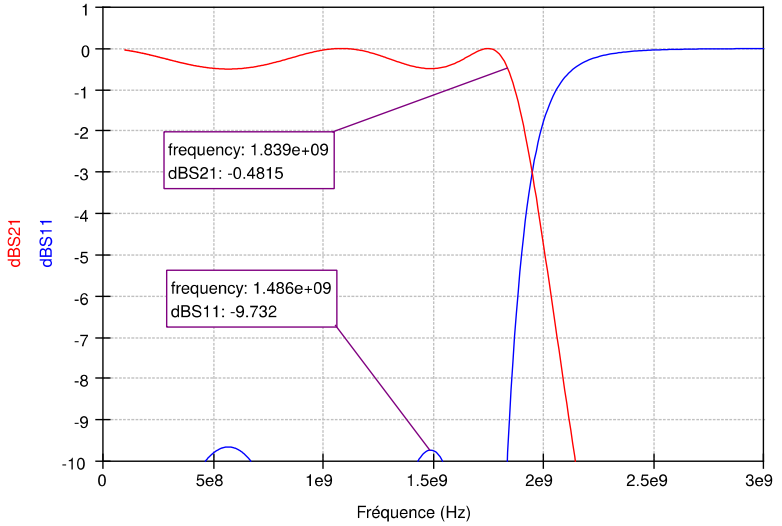
$$L_k = \frac{Z_0}{\omega_c} g_k$$

$$C_k = \frac{1}{Z_0 \omega_c} g_k$$

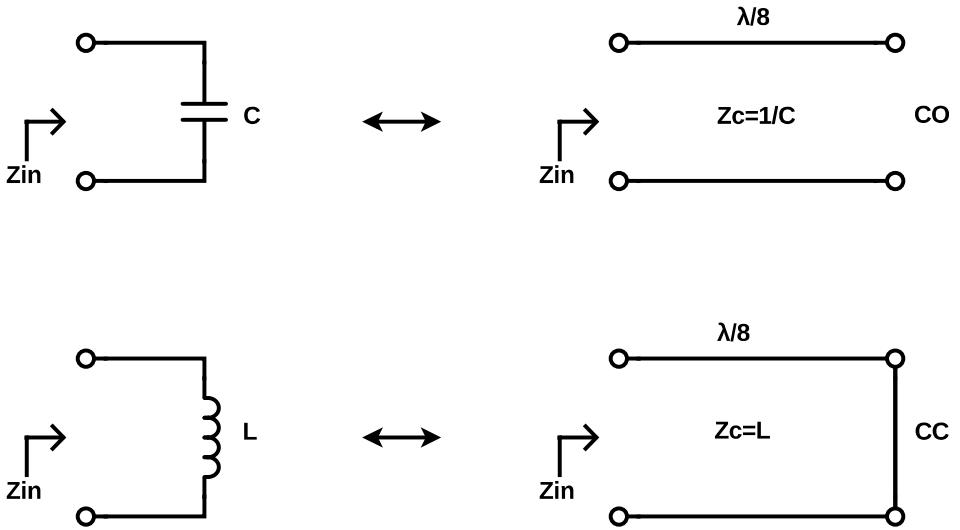
Filtre LC

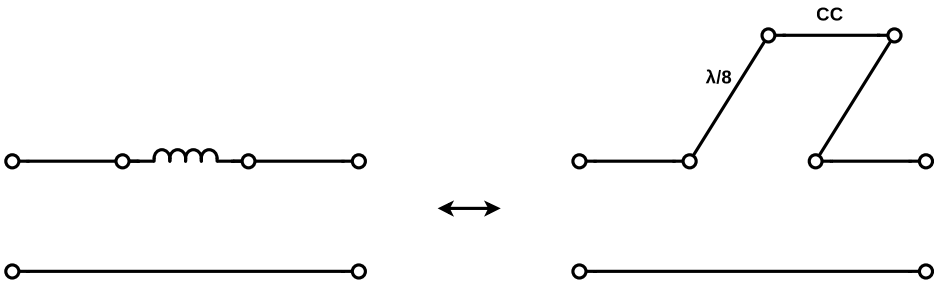

calcul
des paramètres s
SP1
Type=log
Start=100 MHz
Stop=3 GHz
Points=800
Équation
Eqn1
dBS11=dB(S[1,1])
dBS21=dB(S[2,1])
P1
Num=1
Z=50 Ohm
L1
L=5.319581 nH
L2
L=5.319581 nH
P2
Num=2
Z=50 Ohm
C1
C=2.9409 pF
C2
C=4.3941 pF
C3
C=2.9409 pF

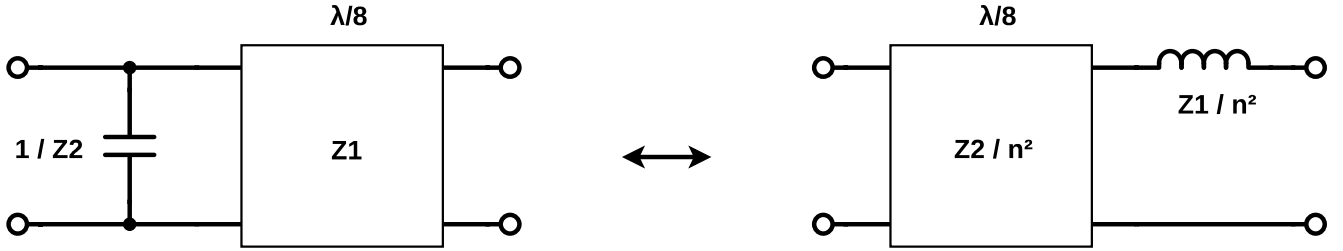

dBS21
dBS11
0
-10
-20
-30
-40
-50
0
5e8
1e9
1.5e9
2e9
2.5e9
3e9
Fréquence (Hz)

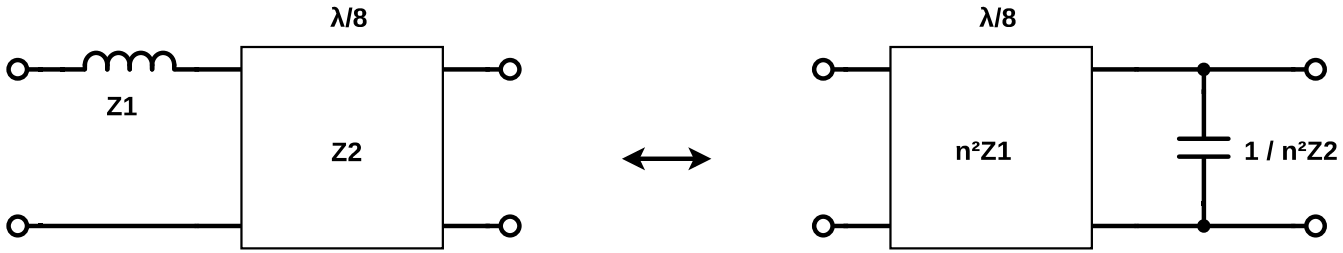

dBS21
dBS11
frequency: 1.839e+09
dBS21: -0.4815
frequency: 1.486e+09
dBS11: -9.732
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
0
5e8
1e9
1.5e9
2e9
2.5e9
3e9
Fréquence (Hz)

Filtre à stubs

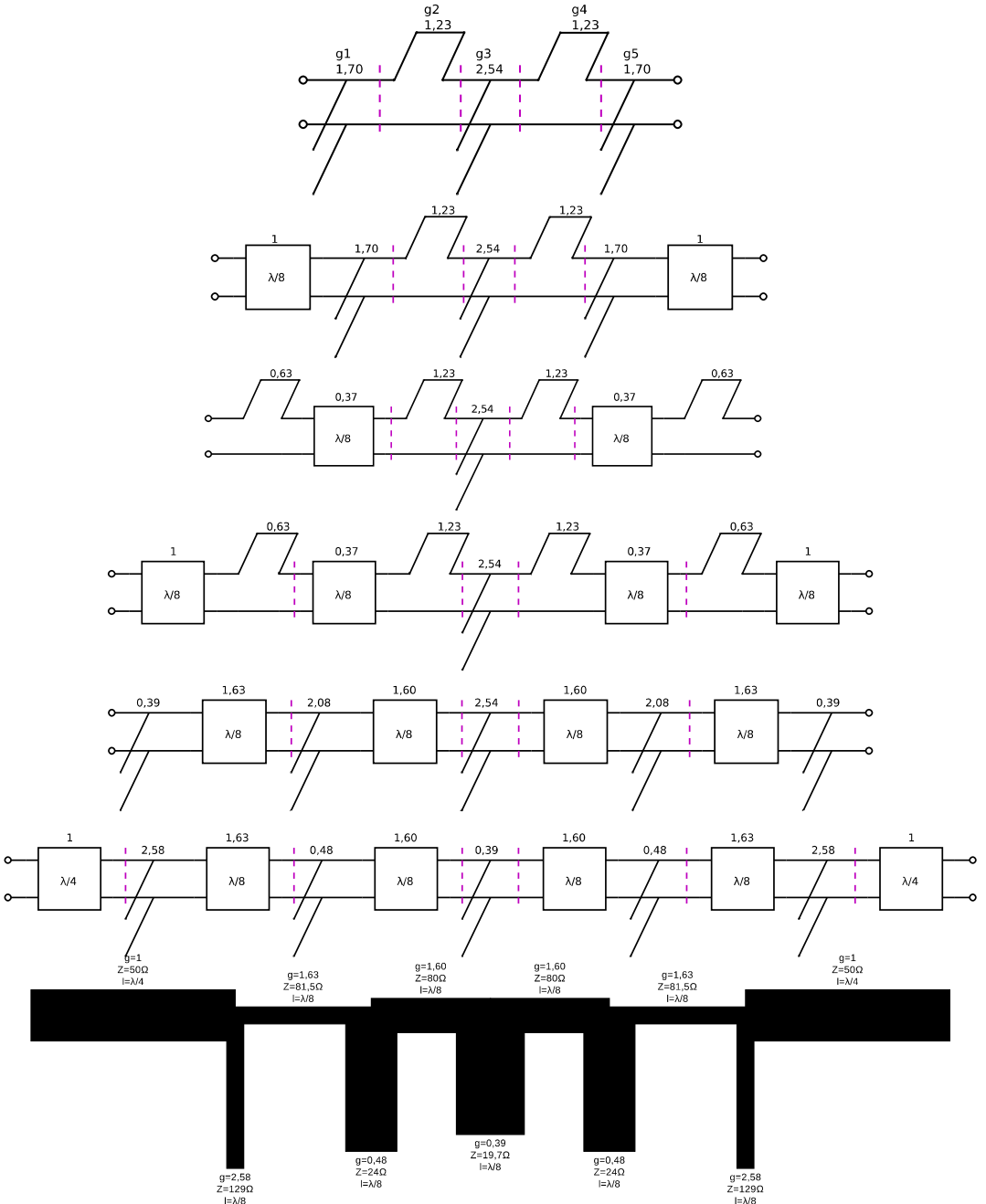




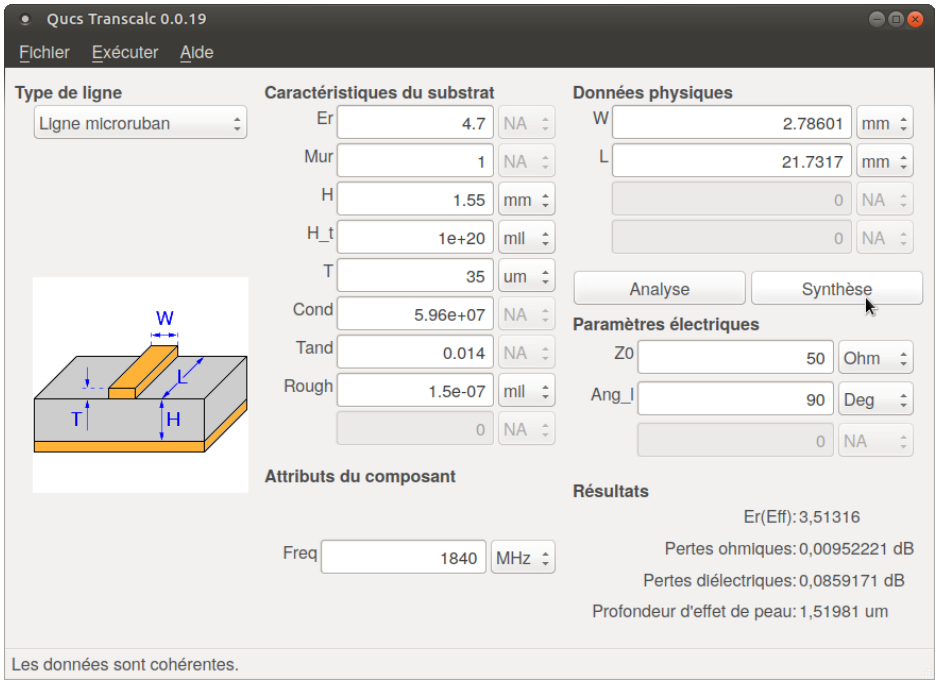


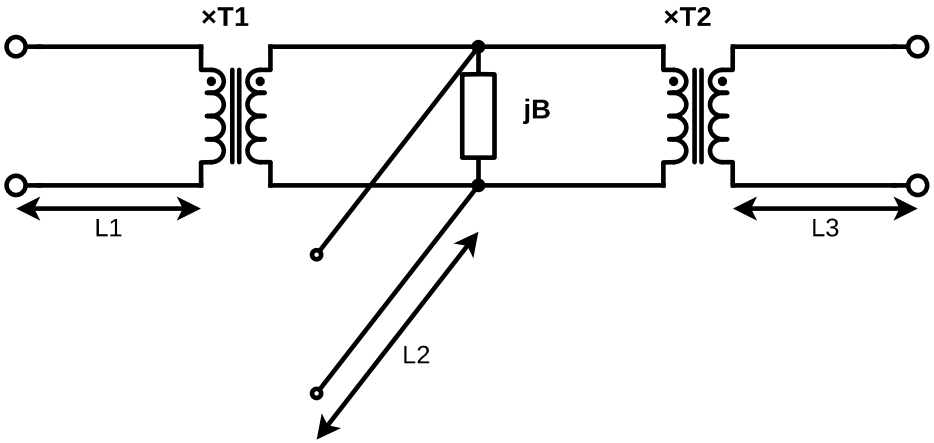


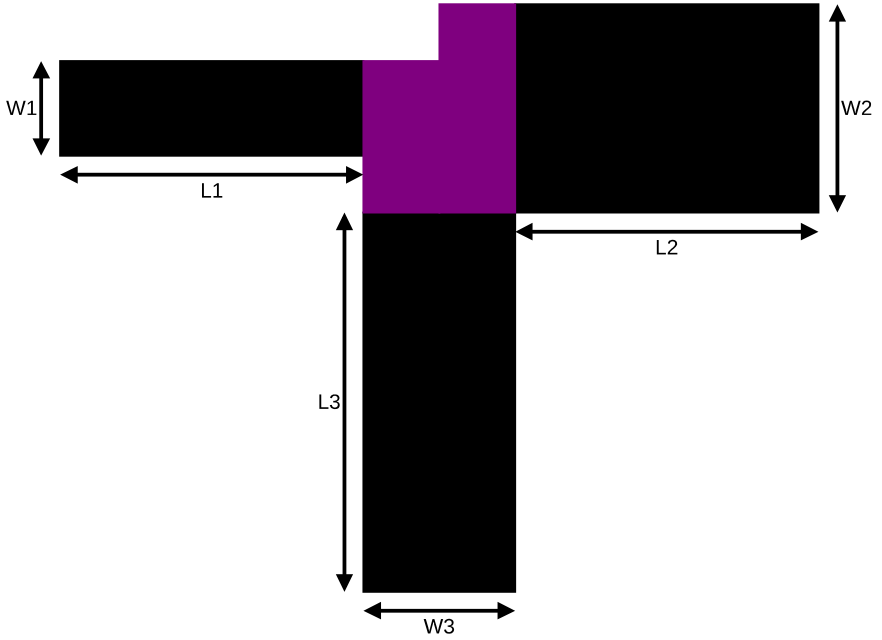
Filtre à stubs



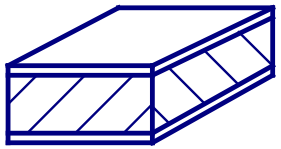
Filtres à stubs







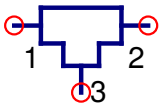
Filtre à stubs



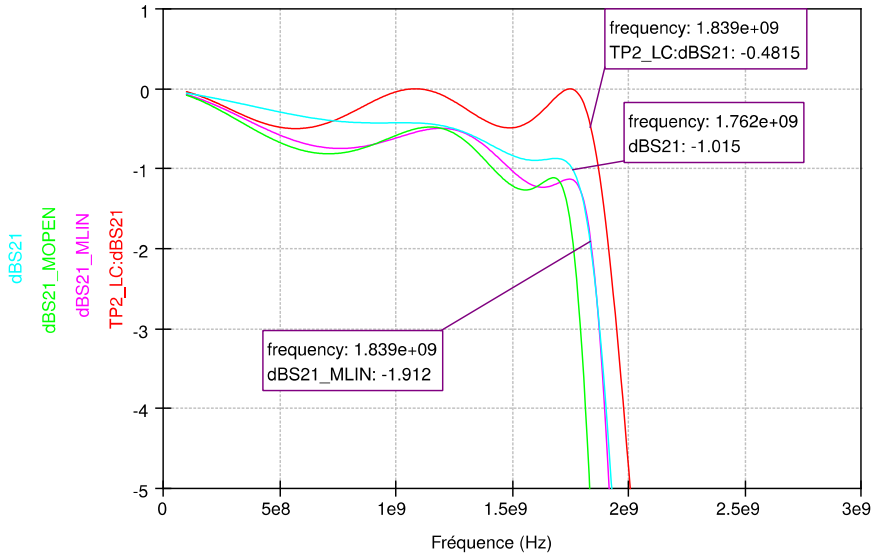
Subst1
er=4.7
h=1.55 mm
t=35 um
tand=0.014
rho=16.78e-9
D=0.15e-6

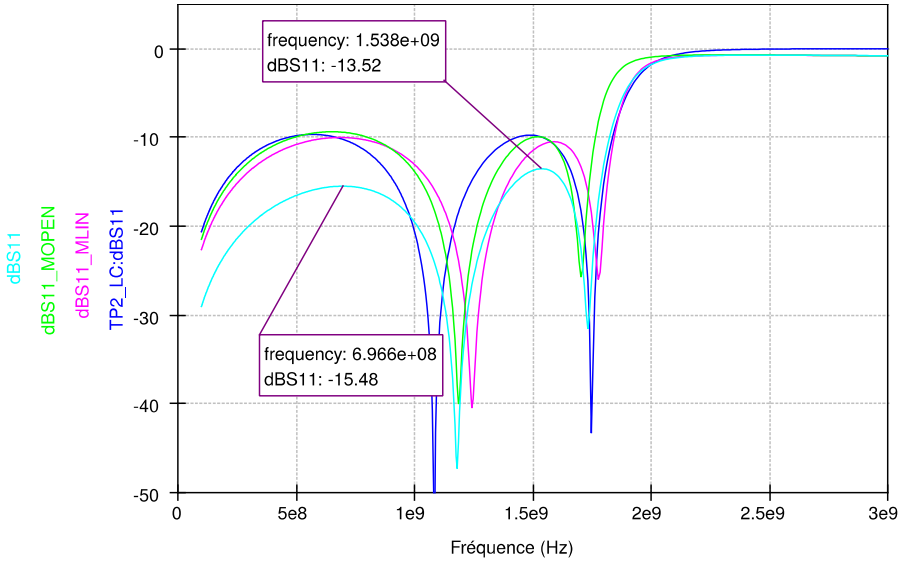
MS1
Subst=Subst1
W=x mm
L=y mm

MS1
Subst=Subst1
W=1 mm

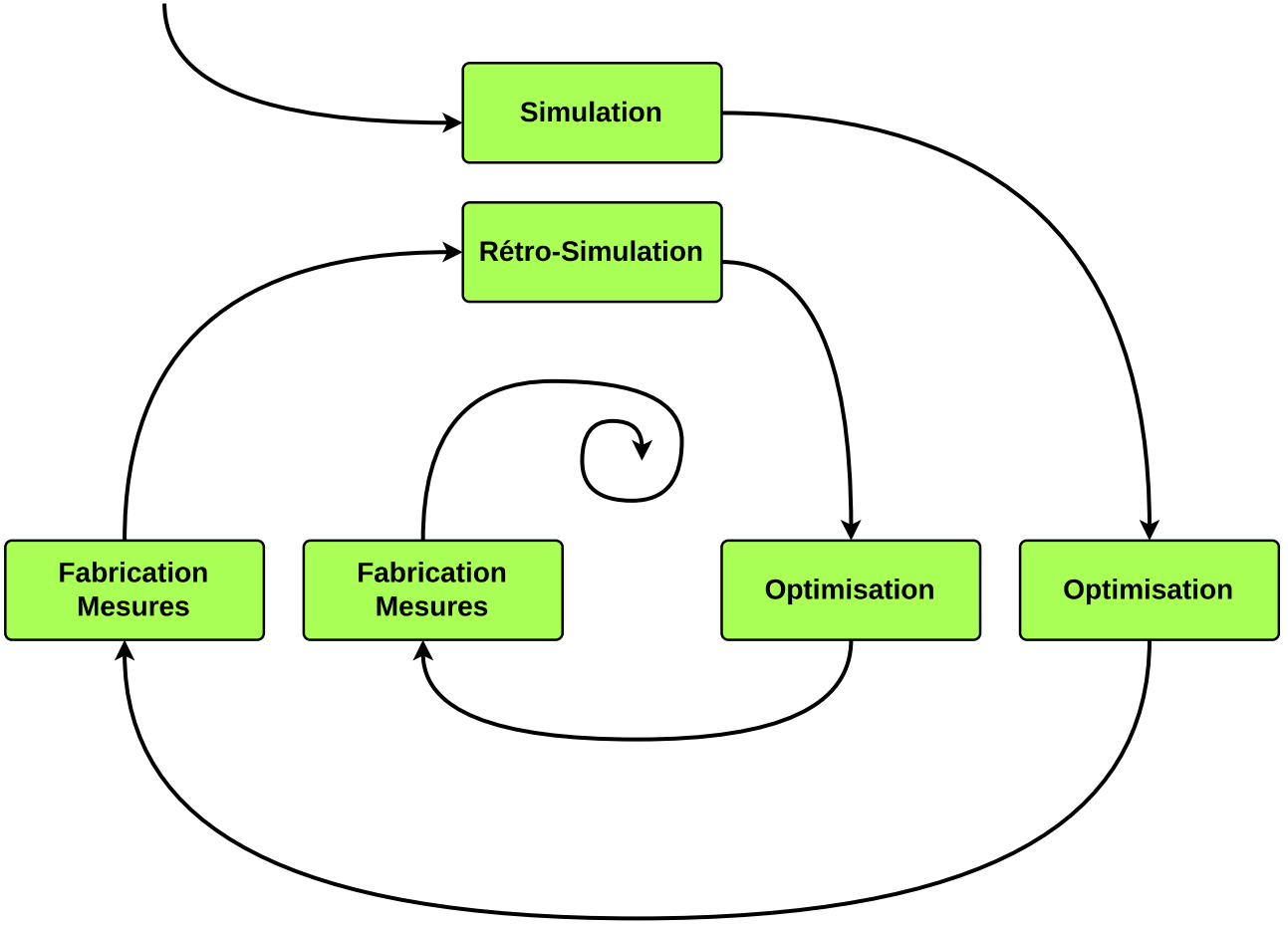


MS1
Subst=Subst1
W1=x mm
W2=y mm
W3=z mm

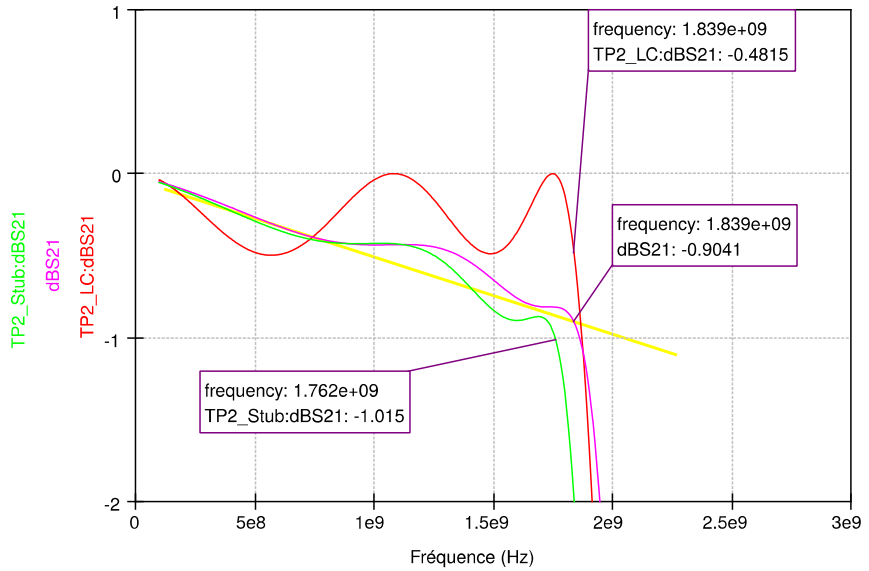


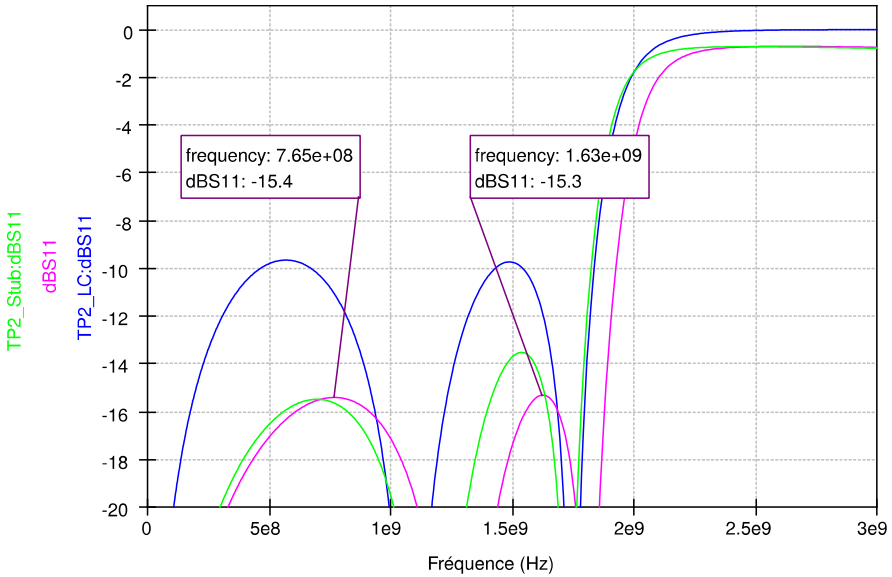


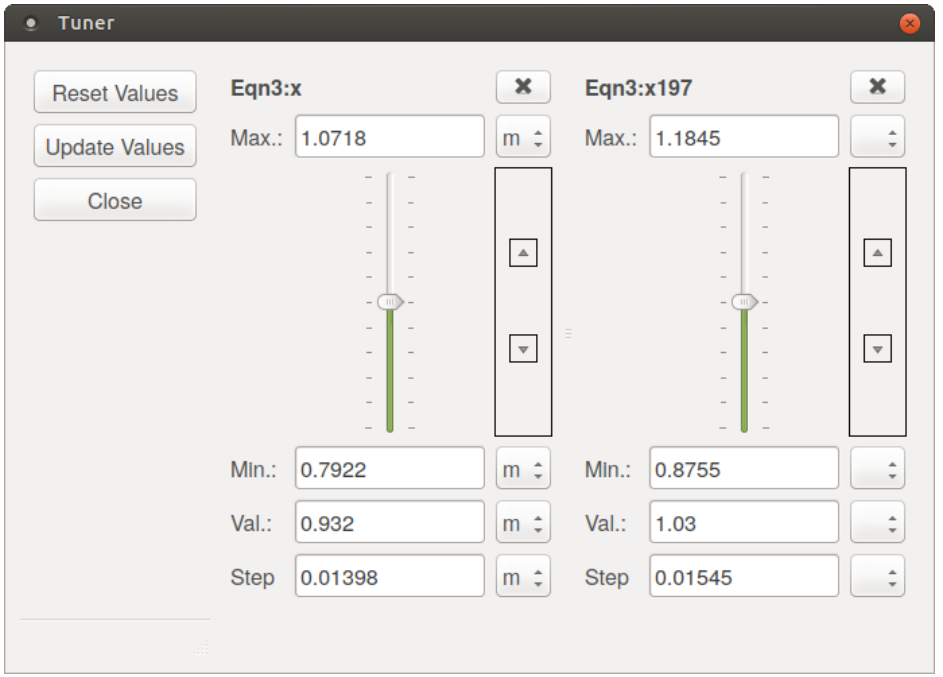
Optimisation / Rétro-simulation



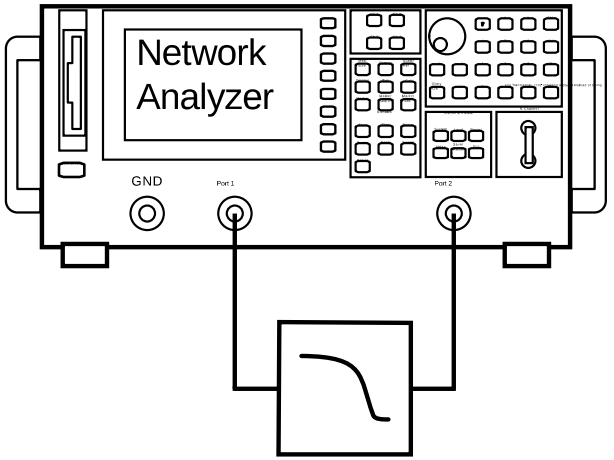
Filtre à stubs

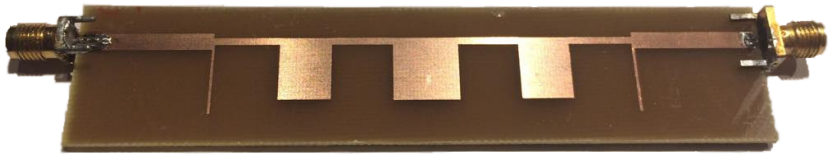


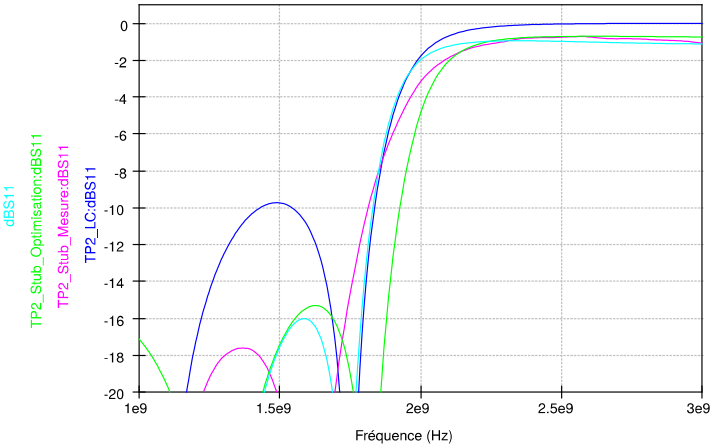


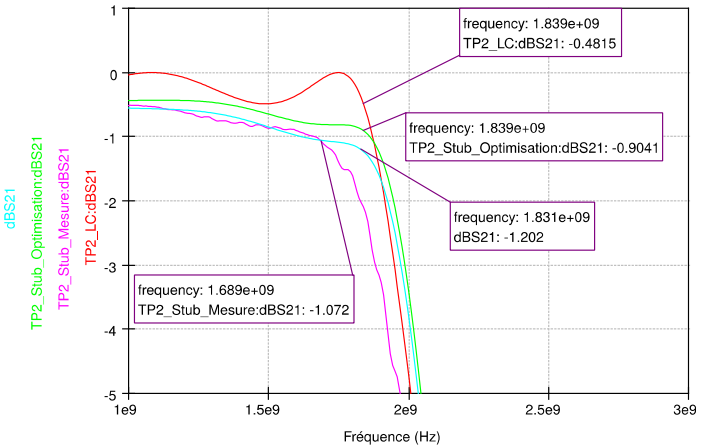


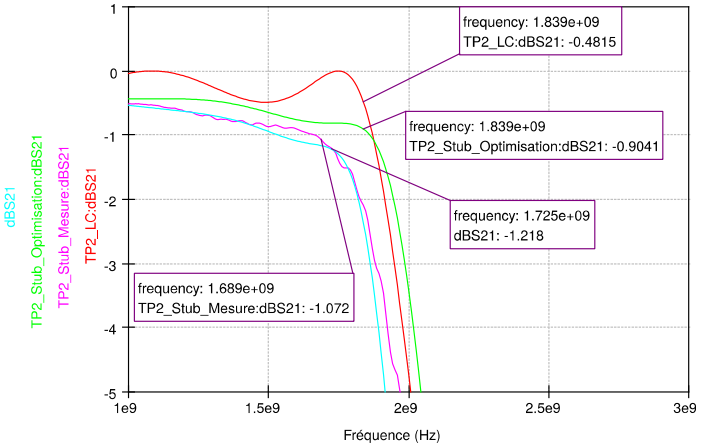
Filtre à stubs





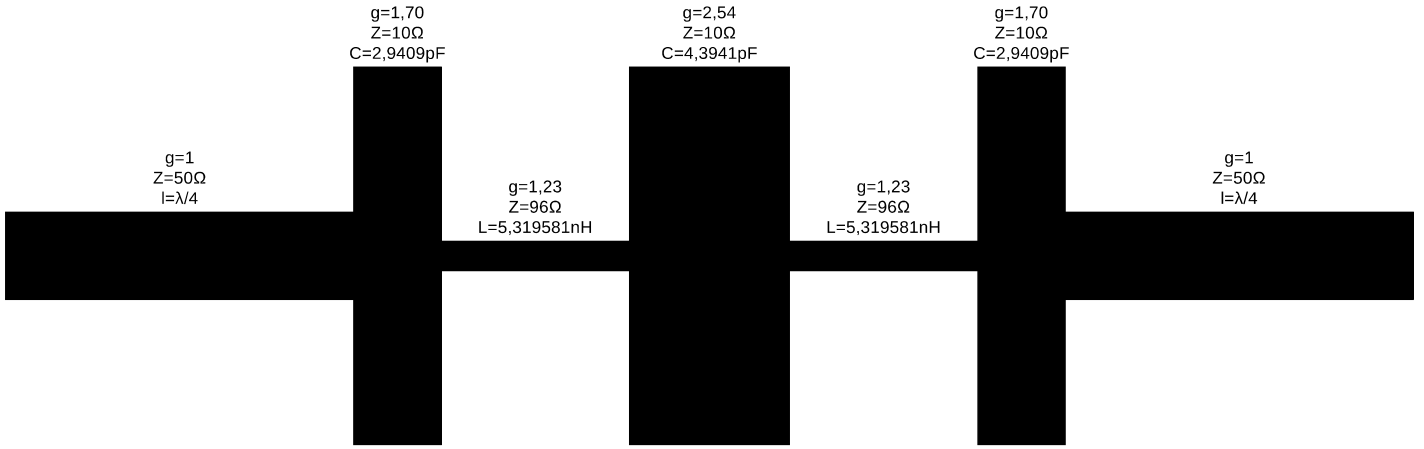






Filtre à sauts d’impédance

- Z1 => L
- Z2 => C

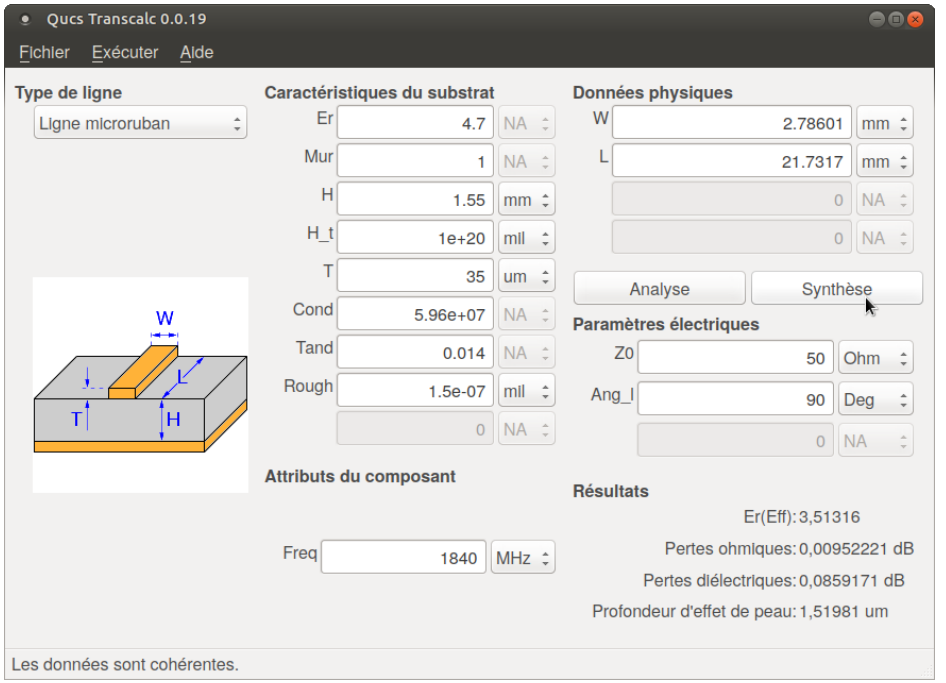


Filtre à sauts d’impédance

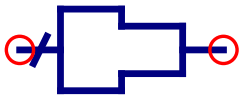
- Zc=10Ω
- ZL=96Ω

$$l_L = \frac{L_C}{Z_C \sqrt{\epsilon_{eff}}}$$

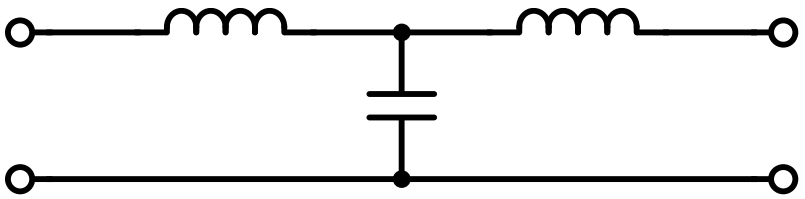
$$l_C = \frac{Z_C C_C}{\sqrt{\epsilon_{eff}}}$$

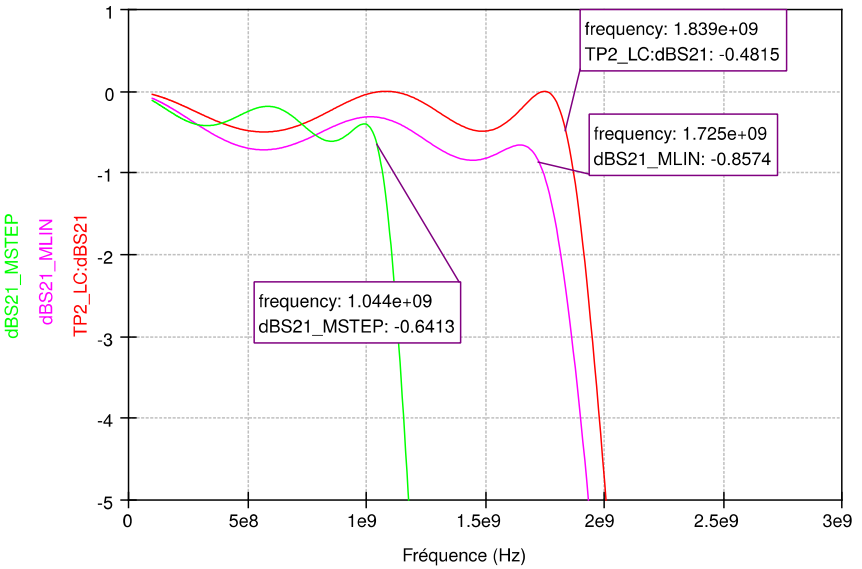


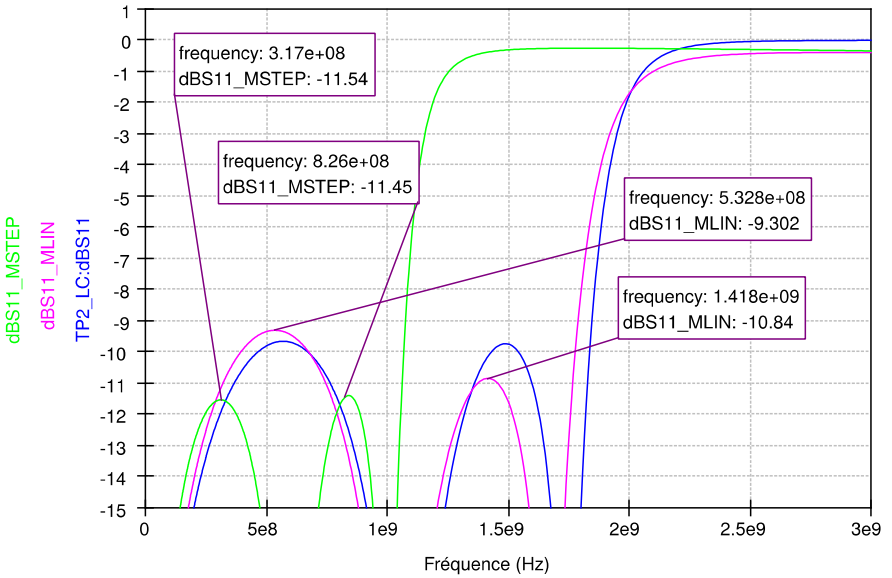
Filtre à sauts d’impédance



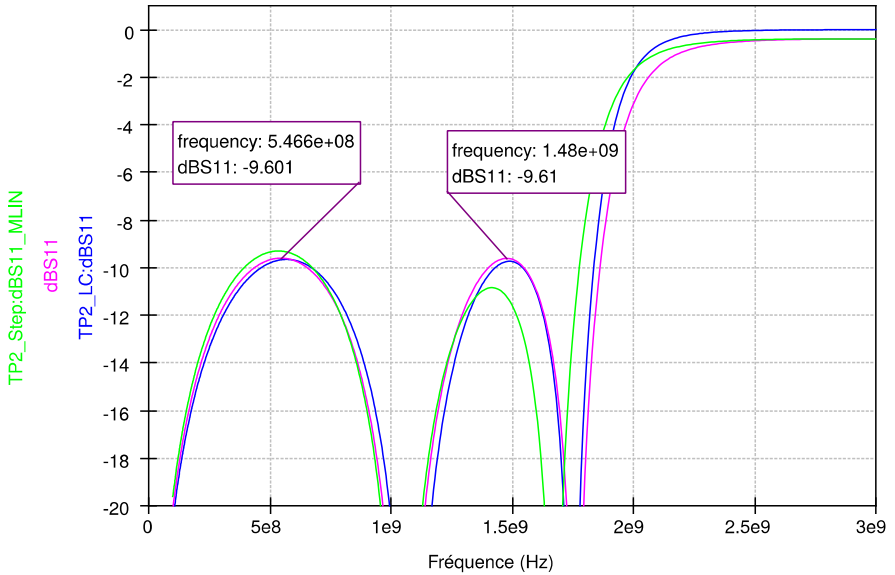
MS1
Subst=Subst1
W1=2 mm
W2=1 mm

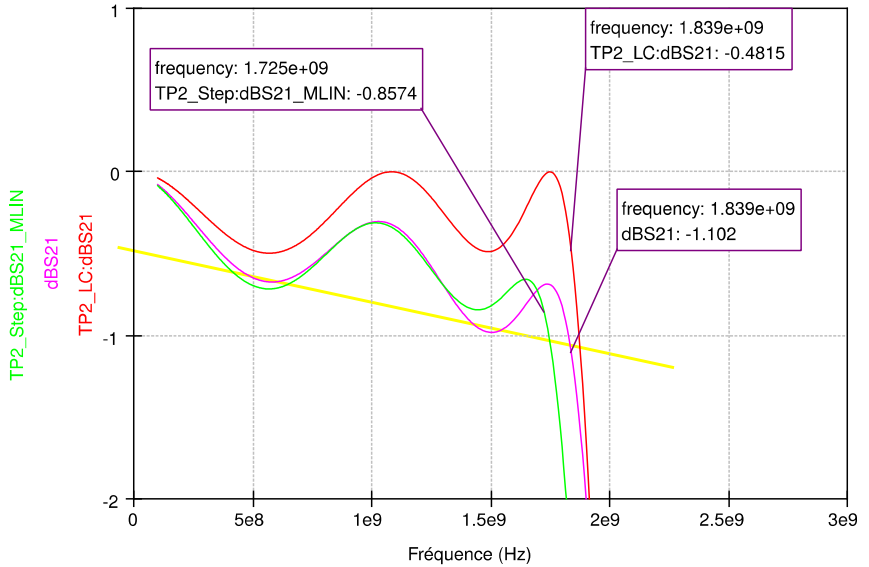


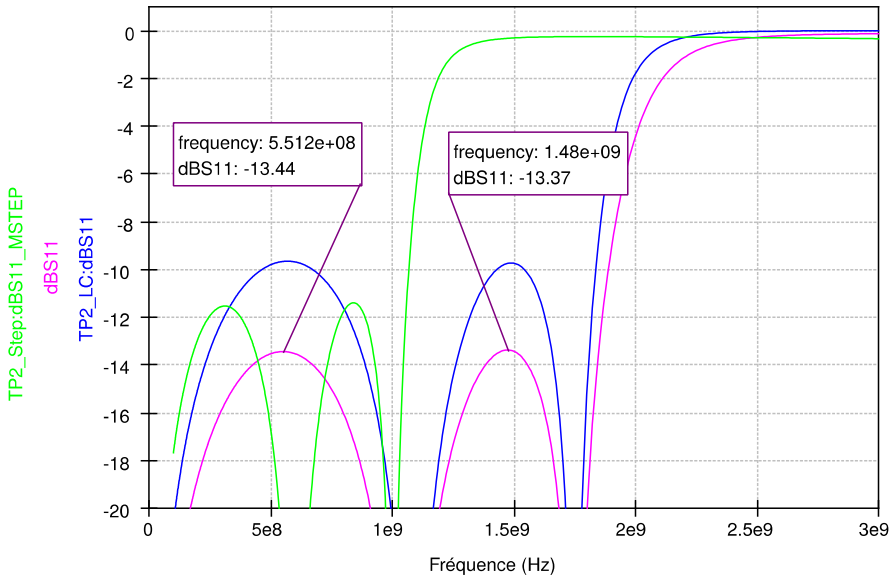


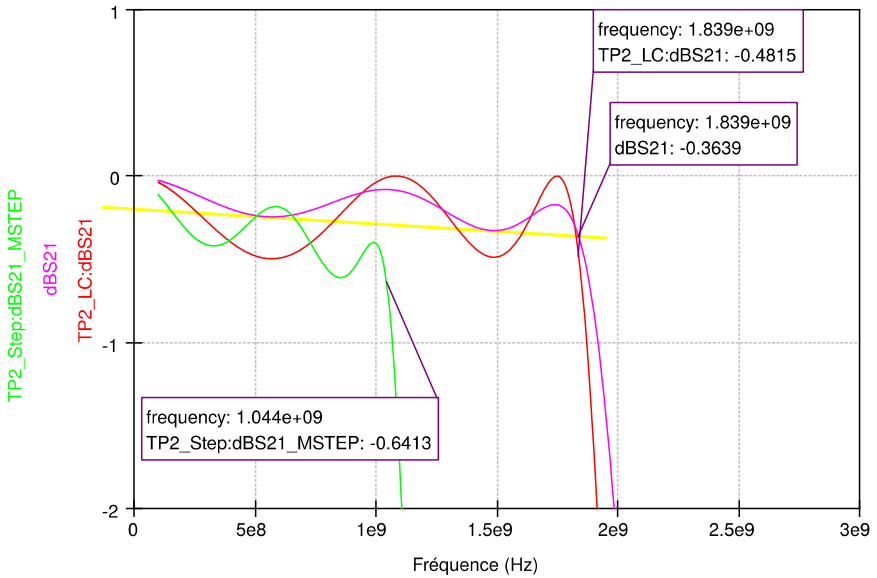


Filtre à sauts d’impédance

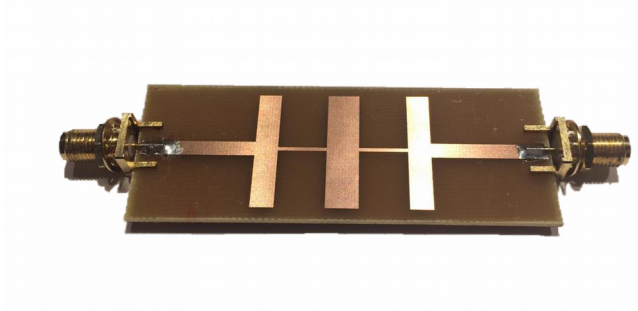


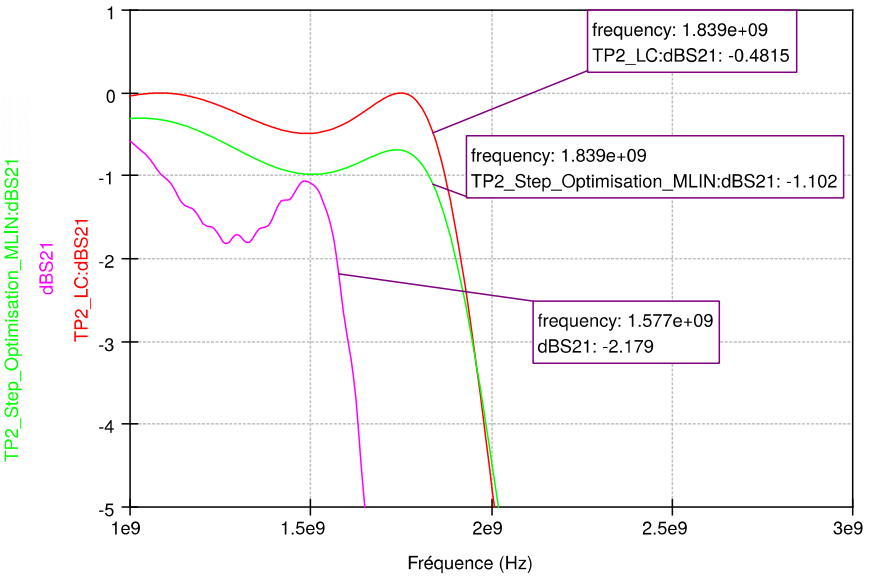




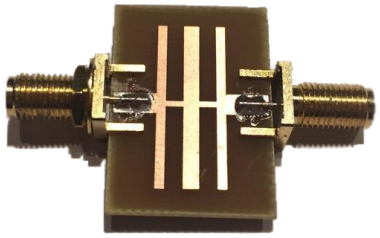


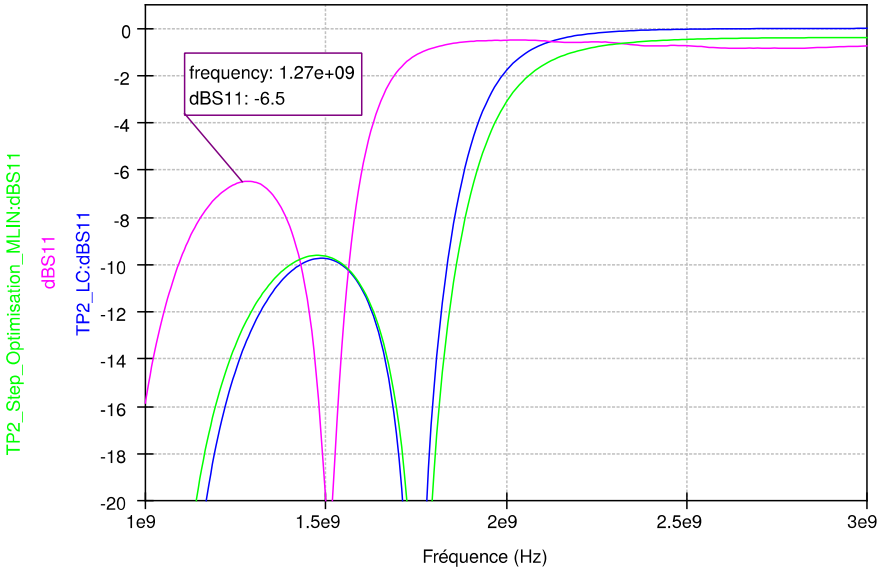
Filtre à sauts d'impédance



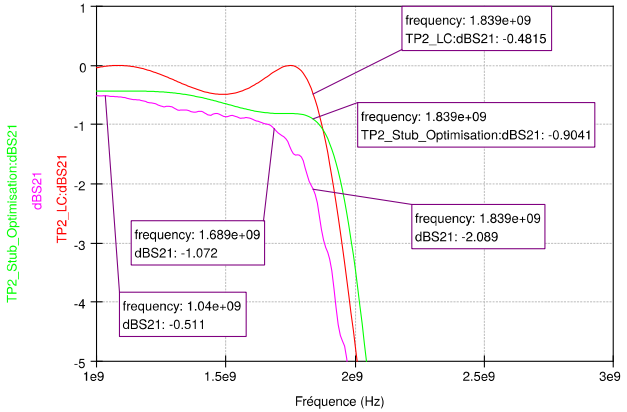


- fc>3GHz





Conclusion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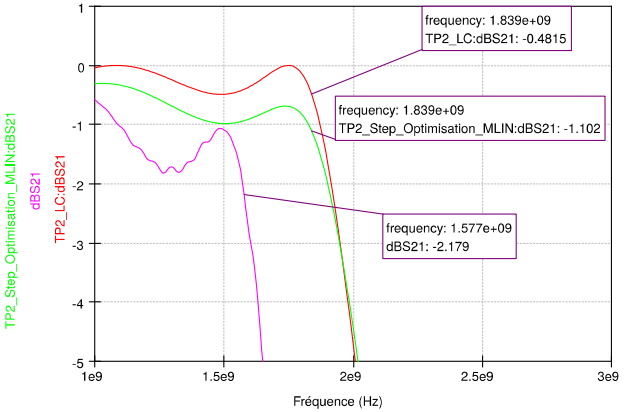
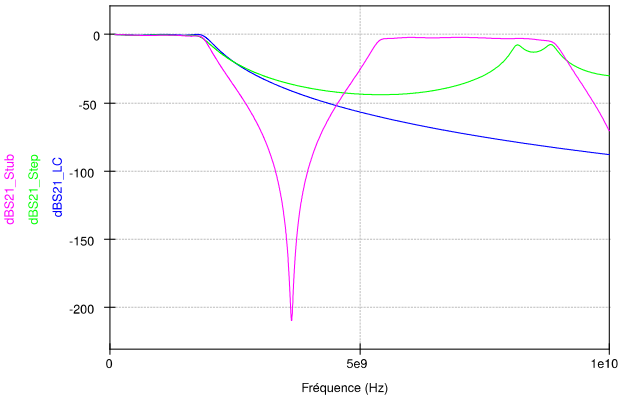
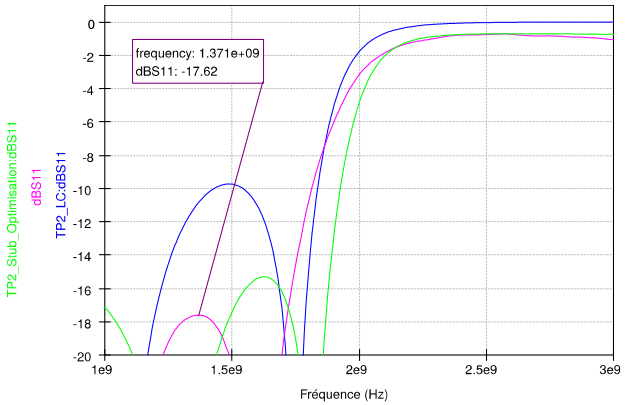
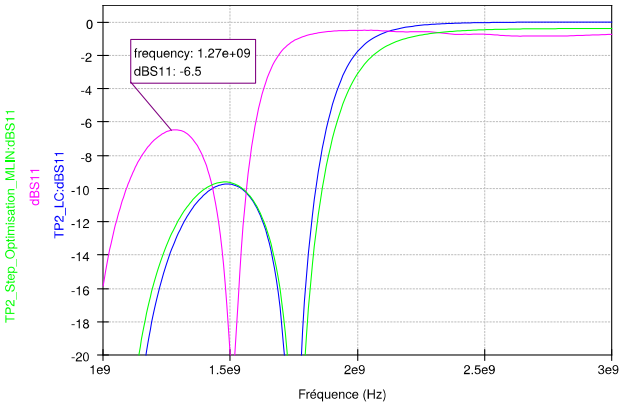
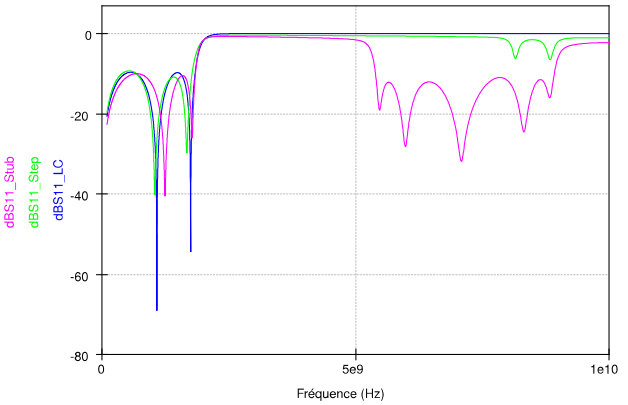
TP2_LC:dBS21: -0.4815
frequency: 1.839e+09
TP2_Stub_Optimisation:dBS21: -0.9041
frequency: 1.839e+09
dBS21: -2.089
frequency: 1.689e+09
dBS21: -1.072
frequency: 1.04e+09
dBS21: -0.511
TP2_Stub_Optimisation:dBS21
dBS21
TP2_LC:dBS21
Fréquence (Hz)


frequency: 1.839e+09
TP2_LC:dBS21: -0.4815
frequency: 1.839e+09
TP2_Step_Optimisation_MLIN:dBS21: -1.102
frequency: 1.577e+09
dBS21: -2.179
TP2_Step_Optimisation_MLIN:dBS21
dBS21
TP2_LC:dBS21
Fréquence (Hz)


dBS21_Stub
dBS21_Step
dBS21_LC
Fréquence (Hz)


frequency: 1.371e+09
dBS11: -17.62
TP2_Stub_Optimisation:dBS11
dBS11
TP2_LC:dBS11
Fréquence (Hz)


frequency: 1.27e+09
dBS11: -6.5
TP2_Step_Optimisation_MLIN:dBS11
dBS11
TP2_LC:dBS11
Fréquence (Hz)


dBS11_Stub
dBS11_Step
dBS11_LC
Fréquence (Hz)