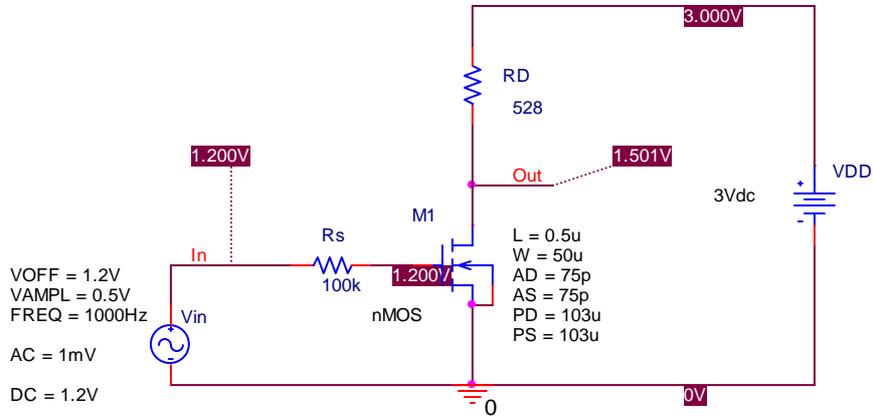# CS frequency response, small example   2010-02-02 /Bengt M.

CS gain stage with output resistance 100k from source generator

Changing table 2.1 MOS model, adding overlap capacitance CGS

```
.model nMOS NMOS
+ LEVEL=1      VTO=0.7      GAMMA=0.45    PHI=0.9
+ NSUB=9E+14   LD=0.08E-6   UO=350        LAMBDA=0.1
+ TOX=9E-9     PB=0.9       CJ=0.56E-3    CJSW=0.35E-11
+ MJ=0.45      MJSW=0.2     CGDO=0.4E-9   JS=1.0E-8
+ CGSO=0.4E-9
```

NAME	M_M1
MODEL	nMOS
ID	2.84E-03
VGS	1.20E+00
VDS	1.50E+00
VBS	0.00E+00
VTH	7.00E-01
VDSAT	5.00E-01
GM	1.14E-02
GDS	2.47E-04
GMB	2.69E-03
CBD	2.73E-14
CBS	4.24E-14
CGSOV	2.00E-14
CGDOV	2.00E-14
CGBOV	0.00E+00
CGS	4.35E-14
CGD	0.00E+00
CGB	0.00E+00

Capacitanses from simulation

$$C_{GS} = CGSOV + CGS = 2 \cdot 10^{-14} + 4.35 \cdot 10^{-14} =$$
$$= 6.35 \cdot 10^{-14} \ F$$

$$C_{GD} = CGDOV = 2 \cdot 10^{-14} \ F$$

$$C_{GB} = 0$$

$$C_{DB} = 2,73 \cdot 10^{-14} \ F$$

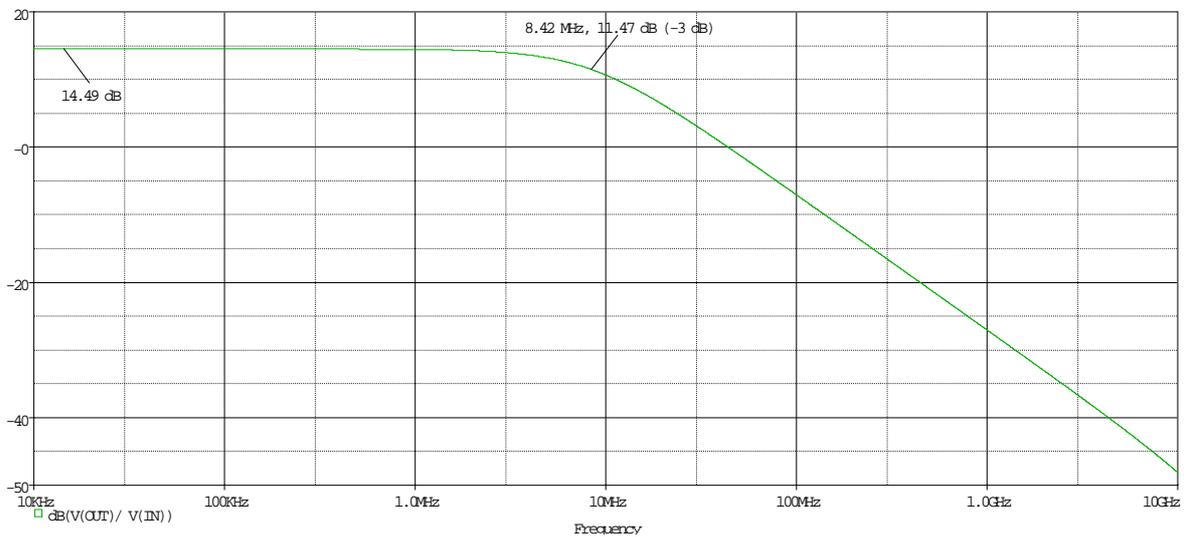$$r_o = \frac{1}{GDS} = 4049 \ \Omega$$

Input pole

$$f_{p,in} = \frac{1}{2\pi R_s \left(C_{GS} + \left(1 + g_m (R_D // r_0) \right) C_{GD} \right)} =$$

$$= \frac{1}{2\pi \cdot 100 \cdot 10^3 \left(6.35 \cdot 10^{-14} + \left(1 + 1.14 \cdot 10^{-2} \cdot 528 // 4049 \right) 2 \cdot 10^{-14} \right)} =$$

$$= 8.38 \text{ MHz}$$

Output pole

$$f_{p,out} = \frac{1}{2\pi R_D // r_0 \left(C_{GD} + C_{BD} \right)} =$$

$$= \frac{1}{2\pi \left(528 // 4049 \right) \left(2 \cdot 10^{-14} + 2.73 \cdot 10^{-14} \right)} =$$

$$= 7.2 \text{ GHz} \qquad f_{p,out} >> f_{p,in}$$

Dominating pole at 8,38 MHz from approximate analysis with poles associated to nodes.

Dominating pole at 8.42 MHz from simulation.