WEEK-2 PRESENTATION ANALOG DESIGN INTERNSHIP

Mentor
Dr G S Javed
Technical Lead @Intel

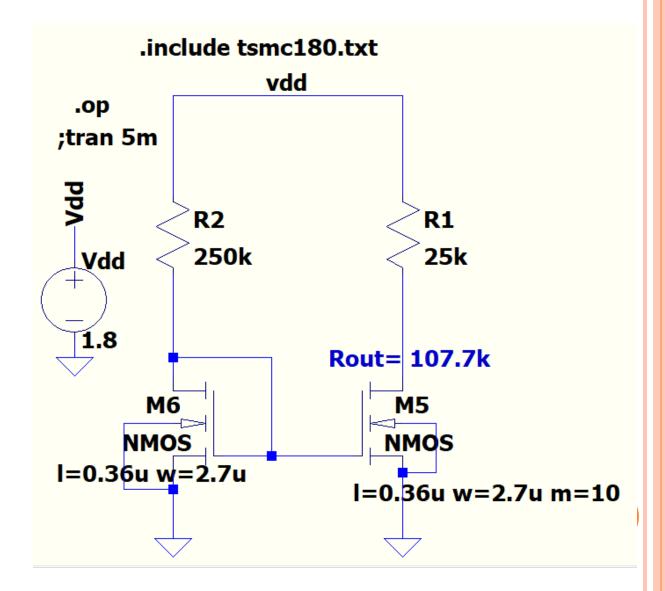
Prepared By:
Munazir Reza
B.Tech(Electronics engg.)
Z.H.C.E.T, A.M.U, Aligarh

CURRENT MIRROR

Iref=5 µA

 $I(R)=50 \mu A$

 $Ro5=107.7 K\Omega$

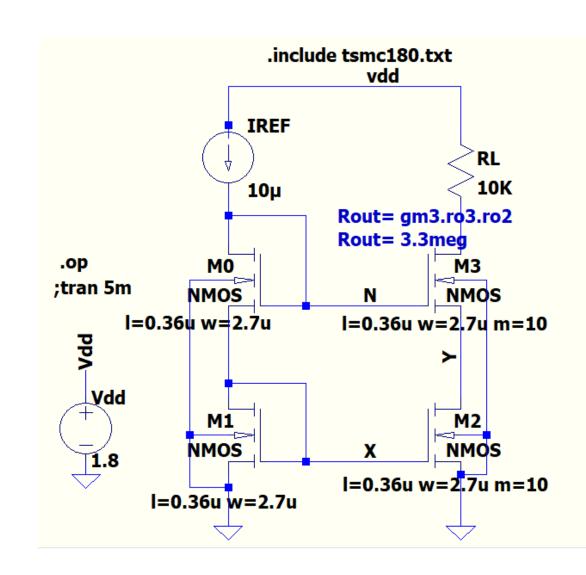


CURRENT MIRROR-II

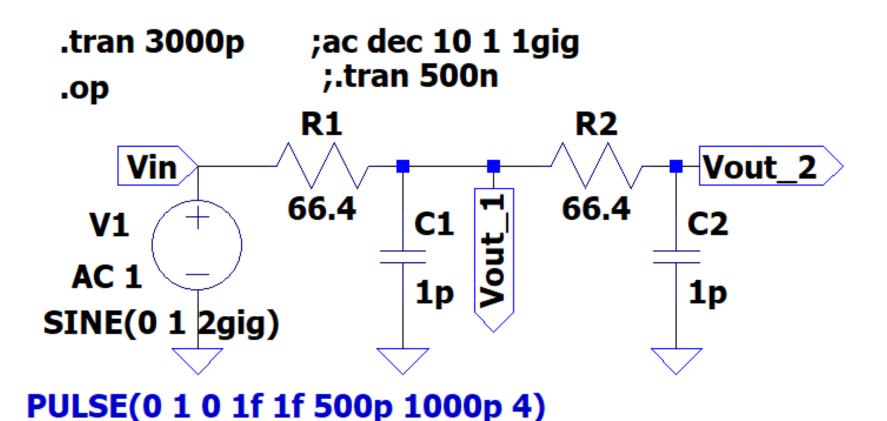
 $Iref=10\mu A$

 $I(RL)=100\mu A$

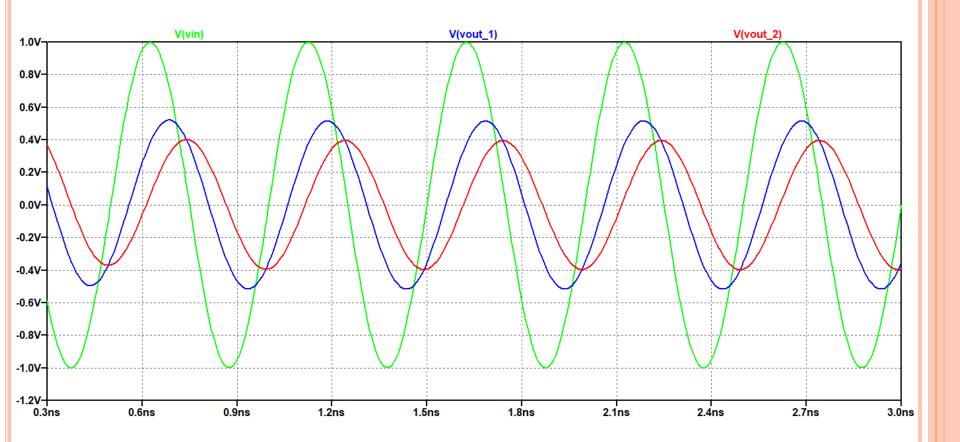
Rout=3.3 $M\Omega$

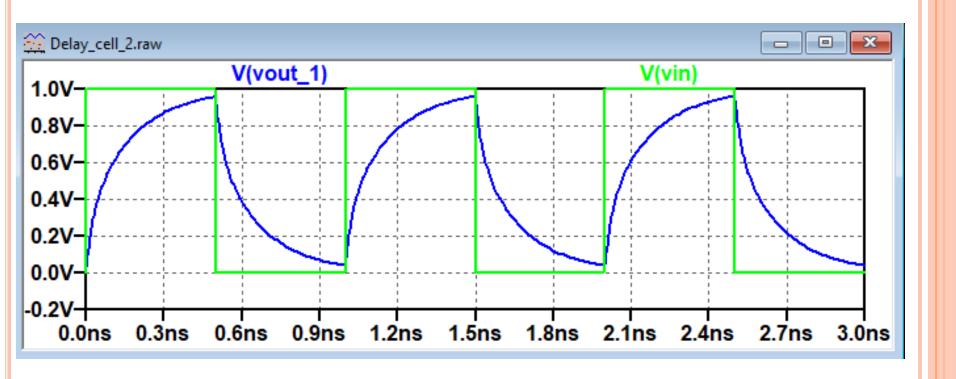


DELAY CELL



WAVEFORM





SOURCE FOLLOWER AMPLIFIER

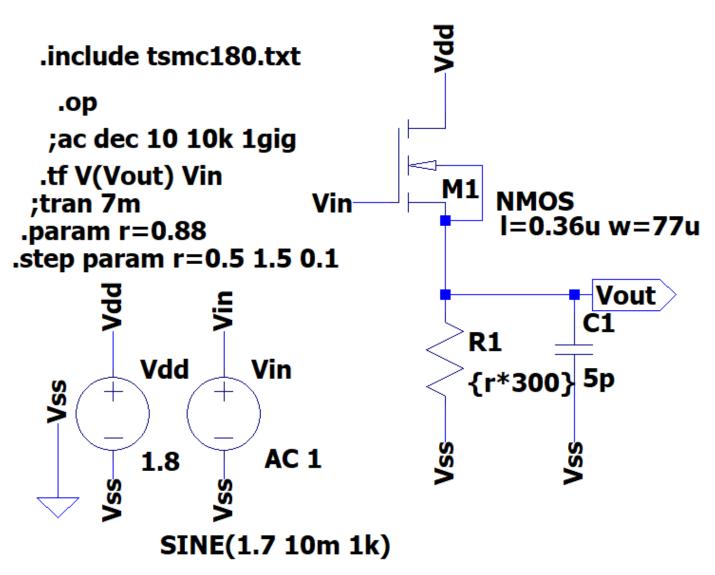
Specification Rout = 50Ω CL=5pF

Let gm= 15 mS
Gm/id = 5 (choose)
Id/wn= 37.7 (from chart)
Vov =
$$\frac{2.\text{Id}}{am}$$

$$\frac{gm}{id} = \frac{2}{Vov}$$

Vov = 0.4
Vin= 0.4 + 0.9 + 0.4= 1.7 V
Wn= 79 µm
$$Rs = \frac{0.9}{3mA} = 300 \Omega$$

SIMULATION



RESULT

${m eta}$ * C:\Users\ASUS\Desktop\Analog Design Internship\Week-2\CD_amp_with_R... \times

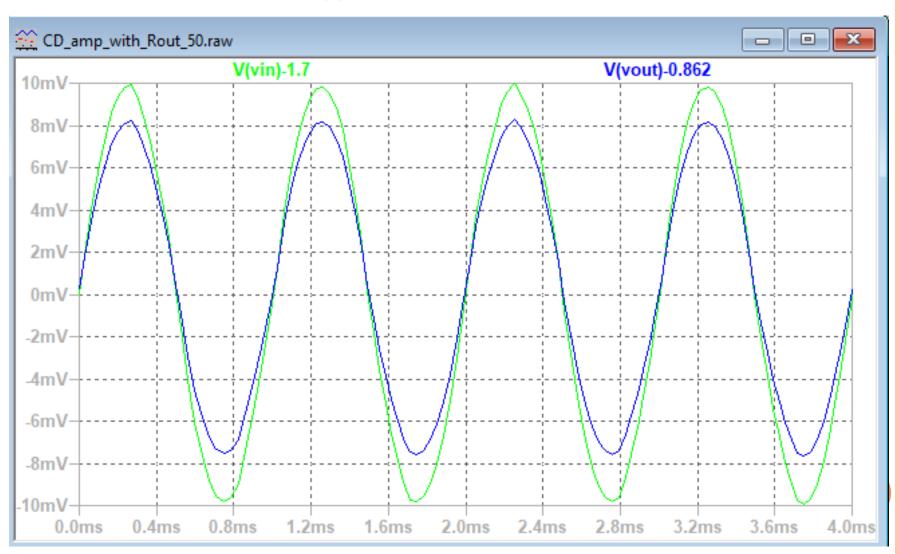
--- Transfer Function ---

Transfer_function: 0.798747 transfer vin#Input_impedance: 1e+020 impedance output_impedance_at_V(vout): 50.1305 impedance

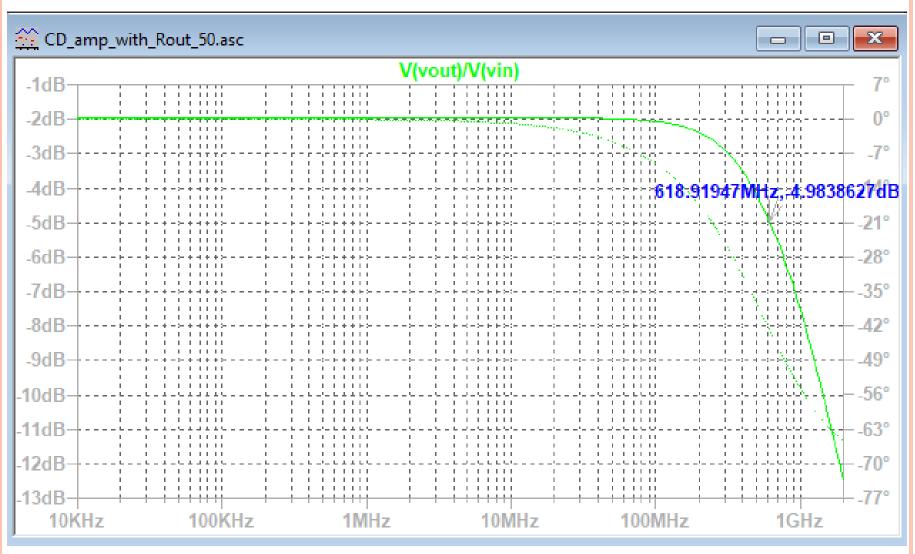
--- BSIM3 MOSFETS ---

m1Name: Model: nmos Id: 3.27e-03 8.38e-01 Vqs: Vds: 9.38e-01 Vbs: 0.00e+00Vth: 4.64e-01 Vdsat: 2.69e-01 Gm: 1.59e-02 Gds: 2.27e-04 Gmb 4.19e-03 Cbd: 0.00e+00Cbs: 0.00e+00 Cqsov: 5.93e-14 5.93e-14 Cgdov: Cgbov: 3.33e-19

WAVEFORM



FREQUENCY RESPONSE



COMMON SOURCE AMPLIFIER

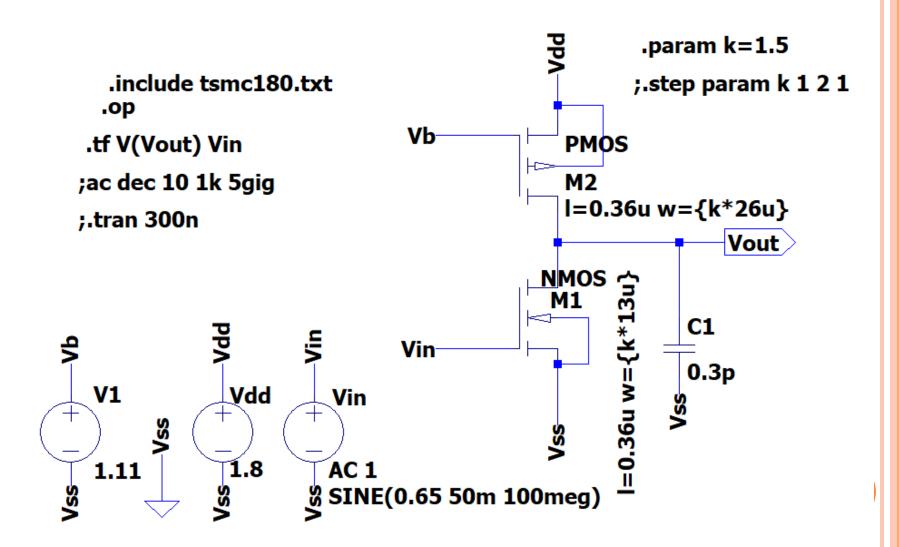
- Specification
- Gain(a.c) 10 at 100MHz
- Input $50 \text{mV} - \rightarrow \text{output} = 500 \text{mV}$
- \circ G.B.W = 1GHz
- Calculation
- \circ gm= 1.8mS (Assume)
- CL=0.3pF
- Vov=0.2
- \circ Vgs = 0.65
- $Id = \frac{gm.Vov}{2} = 180 \mu A$
- \circ Gm/id= 10
- Id/wn=13.9
- Wn=13μm
- Let, Wp=26μm

 $L=0.36\mu m$

Assume, Vov=0.2V for PMOS

Vb=1.13V

SIMULATION

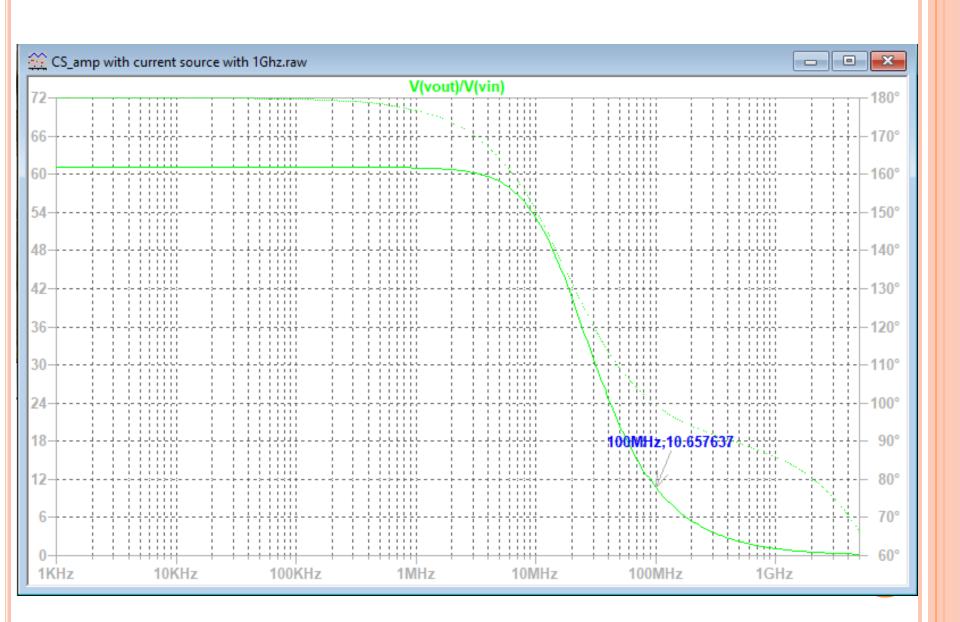


RESULT

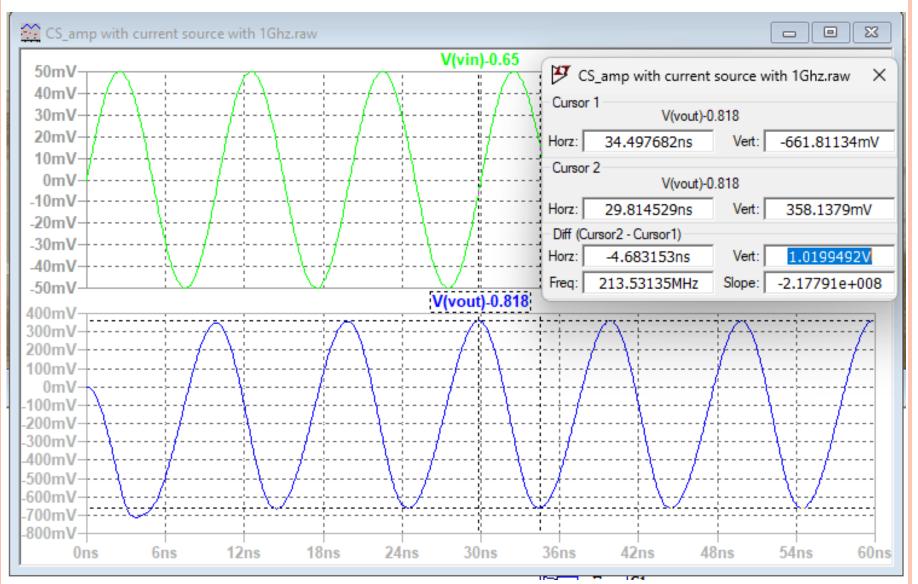
```
--- BSIM3 MOSFETS ---
Name:
             m2
                          m1
                                                      --- Transfer Function ---
Model:
            pmos
                         nmos
          -1.92e-04
Id:
                        1.92e-04
                                                  unsfer function:
                                                                               -61.0921
                                                                                              transfer
          -6.90e-01
                        6.50e-01
Vqs:
                                                  #Input impedance:
          -9.81e-01
                        8.19e-01
                                                                              1e+020
                                                                                              impedance
Vds:
                                                  :put impedance at V(vout):
                                                                              26210
                                                                                              impedance
Vbs:
           0.00e+00
                        0.00e+00
Vt.h:
          -4.73e-01
                        4.65e-01
          -1.94e-01
                        1.41e-01
Vdsat:
           1.64e-03
                        2.33e-03
Gm:
Gds:
           1.65e-05
                        2.17e-05
           5.25e-04
                        6.10e-04
Gmb
Cbd:
           0.00e+00
                        0.00e+00
Cbs:
           0.00e+00
                        0.00e+00
Cqsov:
           2.77e-14
                        1.50e-14
           2.77e-14
Cgdov:
                        1.50e-14
```

Operating Point= 0.818V Power Dissipation =345.6 μW

G.B.W = 1.1GHz



TRANSIENT ANALYSIS



FREQUENCY RESPONSE

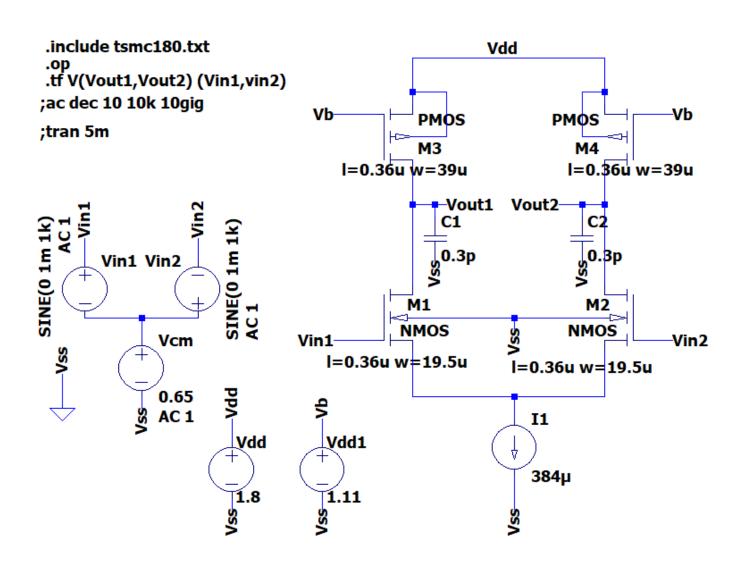


DIFFERENTIAL PAIR

Specification

- •Gain(a.c) 10 at 100MHz
- oInput 50 mV ---→ output =500 mV
 - \circ G.B.W = 1GHz

DIFFERENTIAL PAIR-I



RESULT

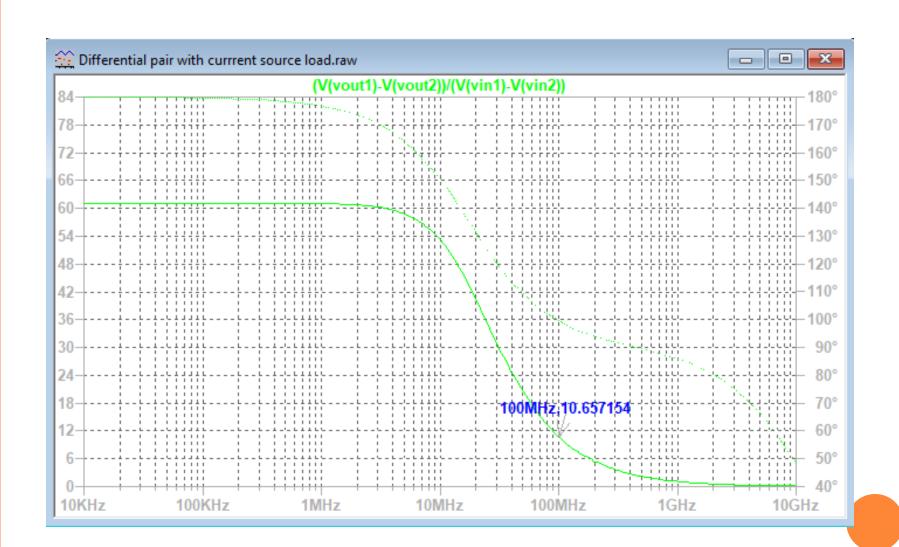
--- Transfer Function ---

Transfer_function: -61.1162 transfer vin1#Input_impedance: 1e+020 impedance

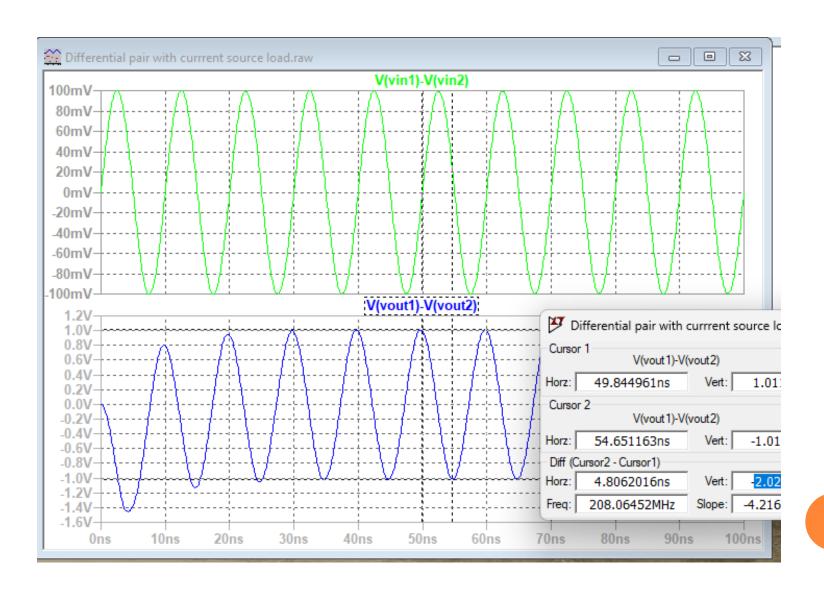
output_impedance_at_V(vout1,vout2): 52443.8 impedance

--- BSIM3 MOSFETS ---

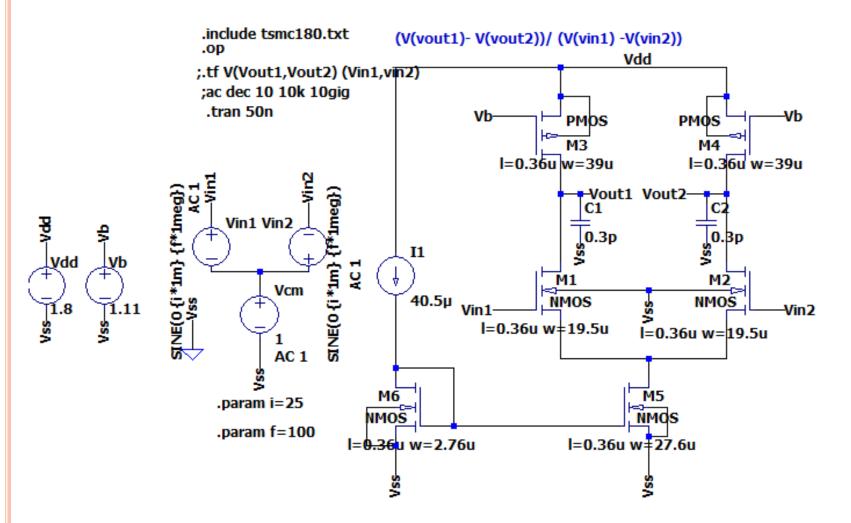
Name:	m4	m3	m2	m1
Model:	pmos	pmos	nmos	nmos
Id:	-1.92e-04	-1.92e-04	1.92e-04	1.92e-04
Vgs:	-6.90e-01	-6.90e-01	6.50e-01	6.50e-01
Vds:	-9.79e-01	-9.79e-01	8.21e-01	8.21e-01
Vbs:	0.00e+00	0.00e+00	-2.93e-05	-2.93e-05
Vth:	-4.73e-01	-4.73e-01	4.65e-01	4.65e-01
Vdsat:	-1.94e-01	-1.94e-01	1.41e-01	1.41e-01
Gm:	1.64e-03	1.64e-03	2.33e-03	2.33e-03
Gds:	1.65e-05	1.65e-05	2.17e-05	2.17e-05
Gmb	5.25e-04	5.25e-04	6.10e-04	6.10e-04
Cbd:	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cbs:	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cgsov:	2.77e-14	2.77e-14	1.50e-14	1.50e-14
Cgdov:	2.77e-14	2.77e-14	1.50e-14	1.50e-14
Cgbov:	3.11e-19	3.11e-19	3.33e-19	3.33e-19



TRANSIENT ANALYSIS



DIFFERENTIAL PAIR-II



RESULT

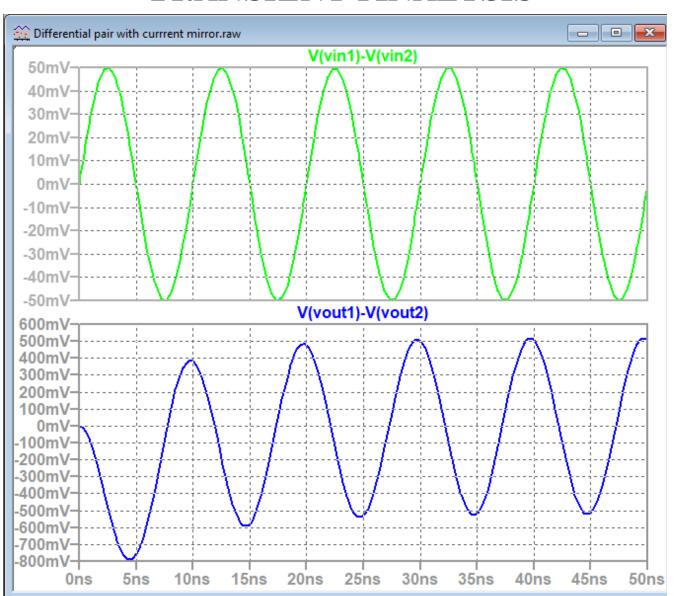
--- Transfer Function ---

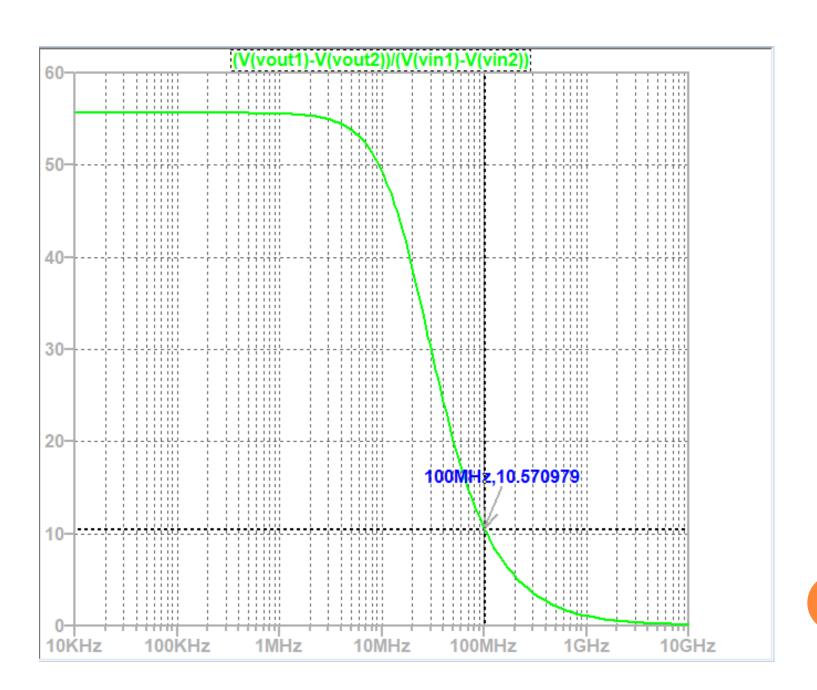
Transfer_function: -55.64 transfer vin1#Input_impedance: 1e+020 impedance output_impedance_at_V(vout1,vout2): 47990.8

		BSIM3	MOSFETS	-	
Name:	m4	m3	mб	m5	m2
Model:	pmos	pmos	nmos	nmos	nmos
Id:	-1.91e-04	-1.91e-04	4.05e-05	3.83e-04	1.91e-04
Vgs:	-6.90e-01	-6.90e-01	6.88e-01	6.88e-01	7.22e-01
Vds:	-9.43e-01	-9.43e-01	6.88e-01	2.78e-01	5.79e-01
Vbs:	0.00e+00	0.00e+00	0.00e+00	0.00e+00	-2.78e-01
Vth:	-4.73e-01	-4.73e-01	4.68e-01	4.65e-01	5.42e-01
Vdsat:	-1.94e-01	-1.94e-01	1.67e-01	1.69e-01	1.47e-01
Gm:	1.63e-03	1.63e-03	4.04e-04	3.75e-03	2.32e-03
Gds:	1.65e-05	1.65e-05	4.38e-06	1.16e-04	2.52e-05
Gmb	5.24e-04	5.24e-04	1.06e-04	9.83e-04	5.51e-04
Cbd:	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cbs:	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cgsov:	2.77e-14	2.77e-14	2.13e-15	2.13e-14	1.50e-14
Cgdov:	2.77e-14	2.77e-14	2.13e-15	2.13e-14	1.50e-14
Cgbov:	3.11e-19	3.11e-19	3.33e-19	3.33e-19	3.33e-19
dQgdVgb:	1.41e-13	1.41e-13	1.07e-14	1.08e-13	7.52e-14
dQgdVdb:	-2.77e-14	-2.77e-14	-2.13e-15	-2.17e-14	-1.50e-14
dQgdVsb:	-1.10e-13	-1.10e-13	-8.15e-15	-8.16e-14	-5.73e-14
dQddVgb:	-6.16e-14	-6.16e-14	-4.70e-15	-4.74e-14	-3.32e-14
dQddVdb:	2.77e-14	2.77e-14	2.13e-15	2.17e-14	1.50e-14
dQddVsb:	4.49e-14	4.49e-14	3.33e-15	3.34e-14	2.28e-14
dQbdVgb:	-1.77e-14	-1.77e-14	-1.33e-15	-1.29e-14	-8.93e-15
dQbdVdb:	-8.95e-18	-8.95e-18	-1.92e-18	-4.84e-16	-1.74e-17
dQbdVsb:	-7.45e-15	-7.45e-15	-6.35e-16	-6.41e-15	-3.34e-15

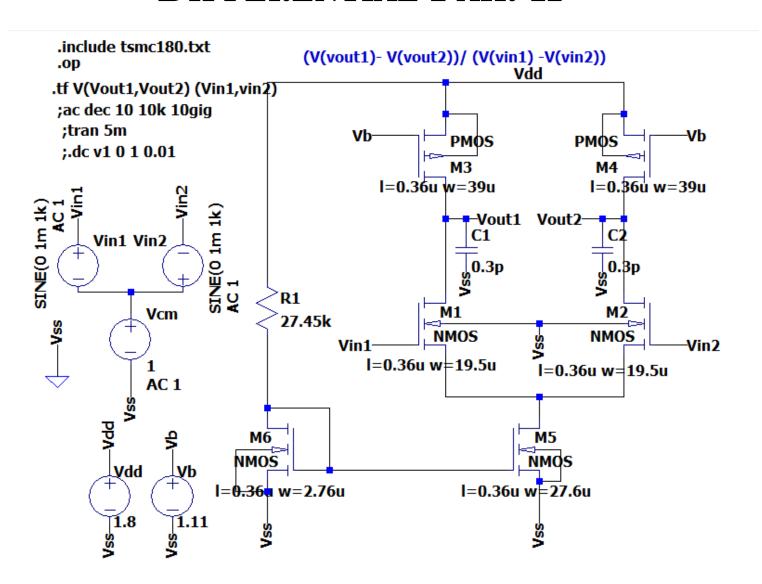
Name:	m1
Model:	nmos
Id:	1.91e-04
Vgs:	7.22e-01
Vds:	5.79e-01
Vbs:	-2.78e-01
Vth:	5.42e-01
Vdsat:	1.47e-01
Gm:	2.32e-03
Gds:	2.52e-05
Gmb	5.51e-04
Cbd:	0.00e+00
Cbs:	0.00e+00
Cgsov:	1.50e-14
Cgdov:	1.50e-14
Cabov:	3.33e-19

TRANSIENT ANALYSIS





DIFFERENTIAL PAIR-II



OPERATIONAL AMPLIFIER

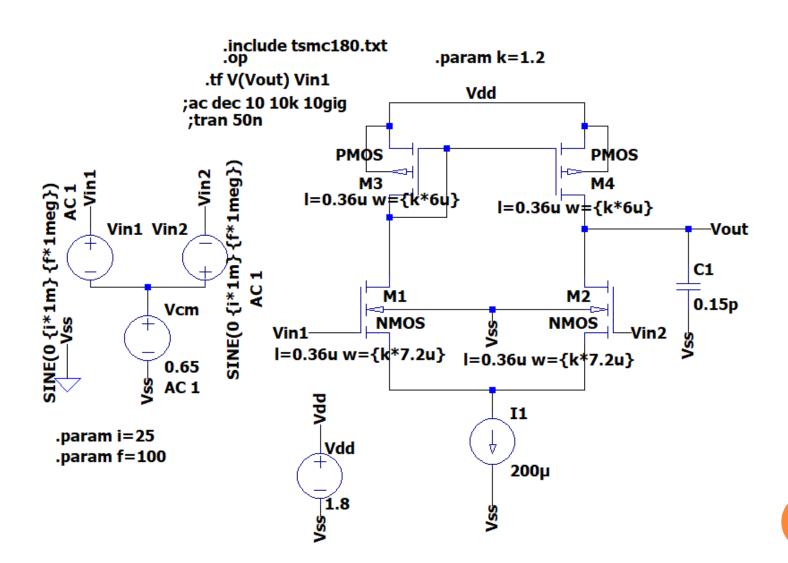
$$C=0.15pF$$

- Let gm=1mS
- \circ Vov=0.2V
- Vin+=0.65V
- Let $\frac{gm}{id} = 10$
- Id=100μ*A*
- Wn=7.2 μm
- o Gm=2π.GBW.C
- C=0.15pF
- For PMOS
- Wp=6.1μm

-- by sweeping method

 $\frac{id}{Wn}$ = 13.9 ---from chart

OPERATIONAL AMPLIFIER-I



RESULT

--- Transfer Function ---

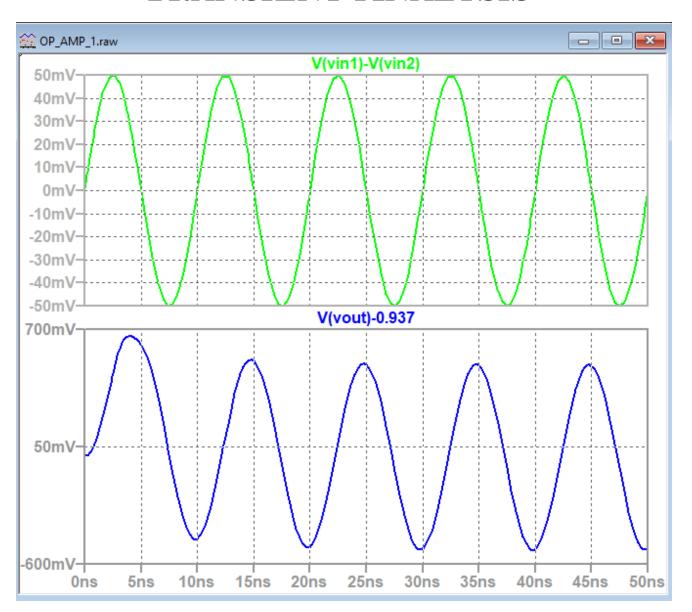
Transfer_function: 69.3097 vin1#Input_impedance: 1e+020 output_impedance_at V(vout): 48100.2

Simulation Results

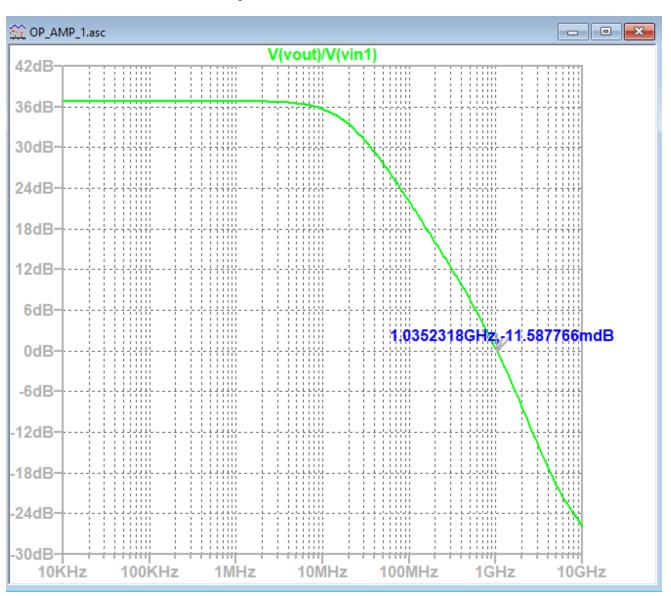
GBW=1.03 GHz V(operating point)= 1V Pd= 360 µW

		BSIM3	MOSFETS	
Name:	m4	m3	m2	m1
Model:	pmos	pmos	nmos	nmos
Id:	-1.00e-04	-1.00e-04	1.00e-04	1.00e-04
Vgs:	-7.51e-01	-7.51e-01	6.22e-01	6.22e-01
Vds:	-7.51e-01	-7.51e-01	1.02e+00	1.02e+00
Vbs:	0.00e+00	0.00e+00	-2.77e-02	-2.77e-02
Vth:	-4.73e-01	-4.73e-01	4.74e-01	4.74e-01
Vdsat:	-2.39e-01	-2.39e-01	1.16e-01	1.16e-01
Gm:	6.58e-04	6.58e-04	1.46e-03	1.46e-03
Gds:	8.70e-06	8.70e-06	1.23e-05	1.23e-05
Gmb	2.12e-04	2.12e-04	3.81e-04	3.81e-04
Cbd:	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cbs:	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cgsov:	9.38e-15	9.38e-15	1.22e-14	1.22e-14
Cgdov:	9.38e-15	9.38e-15	1.22e-14	1.22e-14
Cgbov:	3.11e-19	3.11e-19	3.33e-19	3.33e-19
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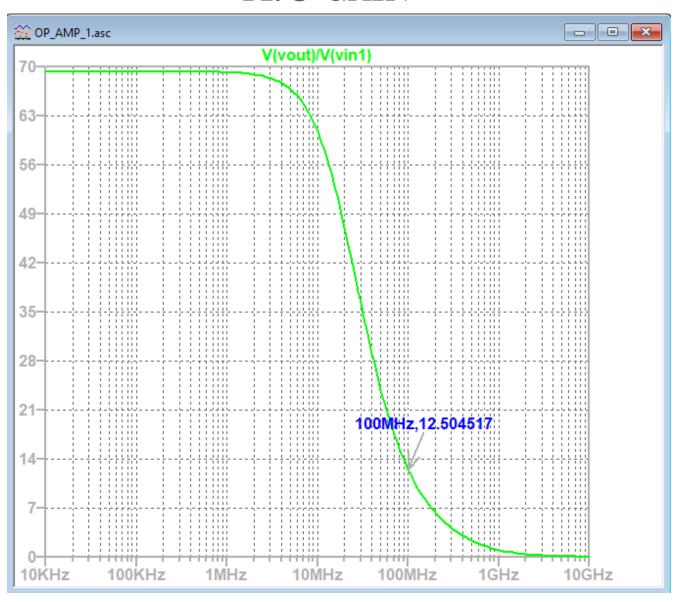
TRANSIENT ANALYSIS



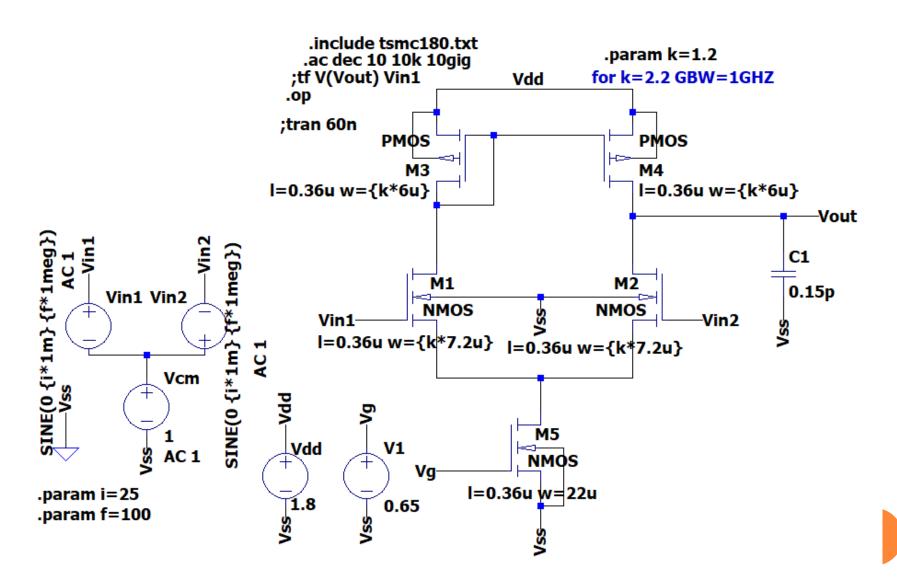
FREQUENCY ANALYSIS



A.C GAIN



OPERATIONAL AMPLIFIER-II



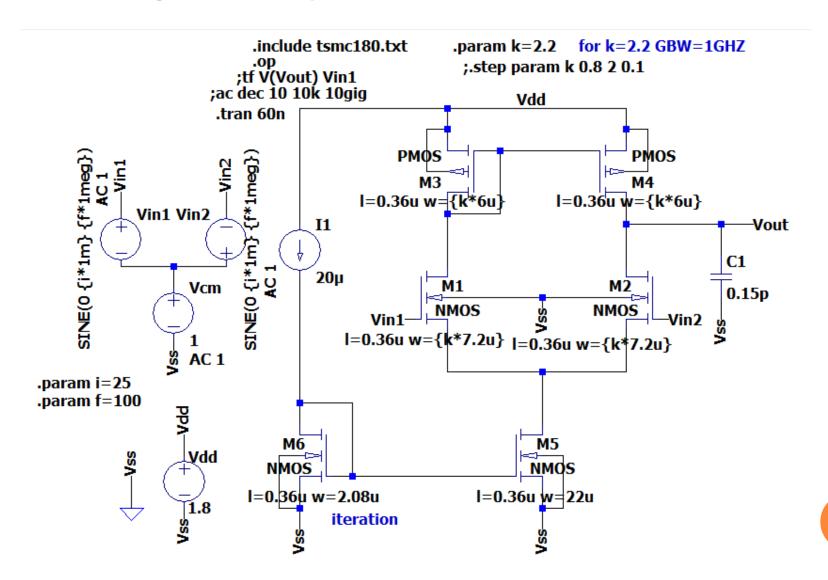
RESULT

--- Transfer Function ---

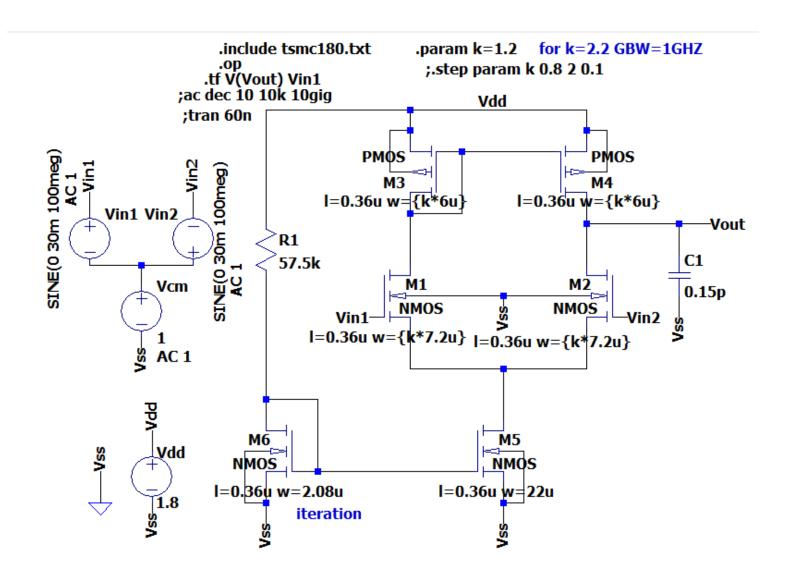
Transfer_function: 55.2737
vin1#Input_impedance: 1e+020
output_impedance_at_V(vout): 50397.4

		BSIM3	MOSFETS	-	
Name:	m4	m3	m5	m2	m1
Model:	pmos	pmos	nmos	nmos	nmos
Id:	-1.00e-04	-1.00e-04	2.00e-04	1.00e-04	1.00e-04
Vgs:	-8.62e-01	-8.62e-01	6.50e-01	7.33e-01	7.33e-01
Vds:	-8.62e-01	-8.62e-01	2.67e-01	6.71e-01	6.71e-01
Vbs:	0.00e+00	0.00e+00	0.00e+00	-2.67e-01	-2.67e-01
Vth:	-4.72e-01	-4.72e-01	4.65e-01	5.40e-01	5.40e-01
Vdsat:	-3.19e-01	-3.19e-01	1.41e-01	1.56e-01	1.56e-01
Gm:	4.55e-04	4.55e-04	2.45e-03	1.12e-03	1.12e-03
Gds:	8.21e-06	8.21e-06	5.58e-05	1.19e-05	1.19e-05
Gmb	1.49e-04	1.49e-04	6.42e-04	2.68e-04	2.68e-04
Cbd:	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cbs:	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cgsov:	5.12e-15	5.12e-15	1.69e-14	6.65e-15	6.65e-15
Cgdov:	5.12e-15	5.12e-15	1.69e-14	6.65e-15	6.65e-15
Cgbov:	3.11e-19	3.11e-19	3.33e-19	3.33e-19	3.33e-19

OPERATIONAL AMPLIFIER-III



OPERATIONAL AMPLIFIER-IV



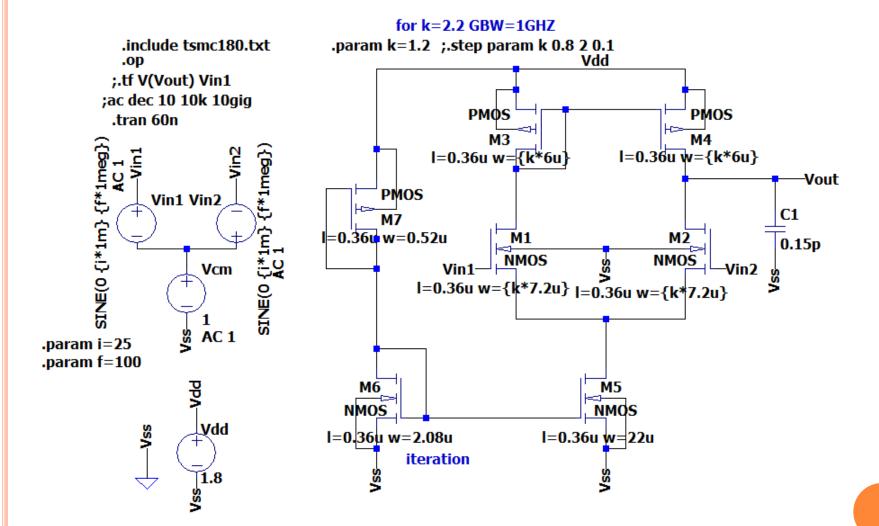
RESULT

--- Transfer Function ---

Transfer_function: 55.2136 vin1#Input_impedance: 1e+020 output_impedance_at_V(vout): 50275.7

		BSIM3	MOSFETS	-	
Name:	m4	m3	m6	m5	m2
Model:	pmos	pmos	nmos	nmos	nmos
Id:	-1.00e-04	-1.00e-04	2.00e-05	2.01e-04	1.00e-04
Vgs:	-8.63e-01	-8.63e-01	6.50e-01	6.50e-01	7.33e-01
Vds:	-8.63e-01	-8.63e-01	6.50e-01	2.67e-01	6.70e-01
Vbs:	0.00e+00	0.00e+00	0.00e+00	0.00e+00	-2.67e-01
Vth:	-4.72e-01	-4.72e-01	4.69e-01	4.65e-01	5.40e-01
Vdsat:	-3.19e-01	-3.19e-01	1.39e-01	1.42e-01	1.56e-01
Gm:	4.56e-04	4.56e-04	2.48e-04	2.45e-03	1.12e-03
Gds:	8.23e-06	8.23e-06	2.46e-06	5.61e-05	1.19e-05
Gmb	1.49e-04	1.49e-04	6.49e-05	6.43e-04	2.68e-04
Cbd:	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cbs:	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cgsov:	5.12e-15	5.12e-15	1.60e-15	1.69e-14	6.65e-15
Cgdov:	5.12e-15	5.12e-15	1.60e-15	1.69e-14	6.65e-15
Cgbov:	3.11e-19	3.11e-19	3.33e-19	3.33e-19	3.33e-19

OPERATIONAL AMPLIFIER-V



Thank you