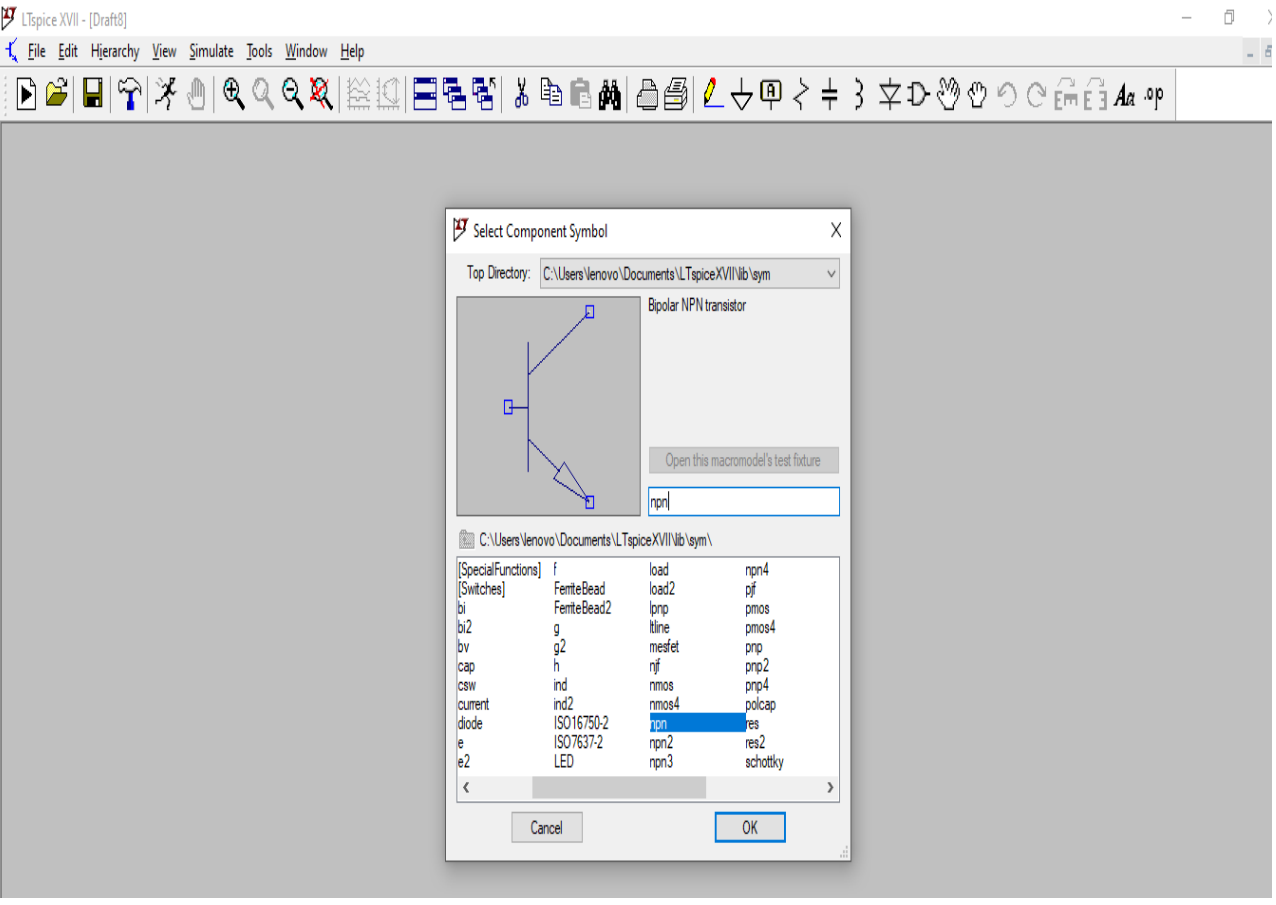
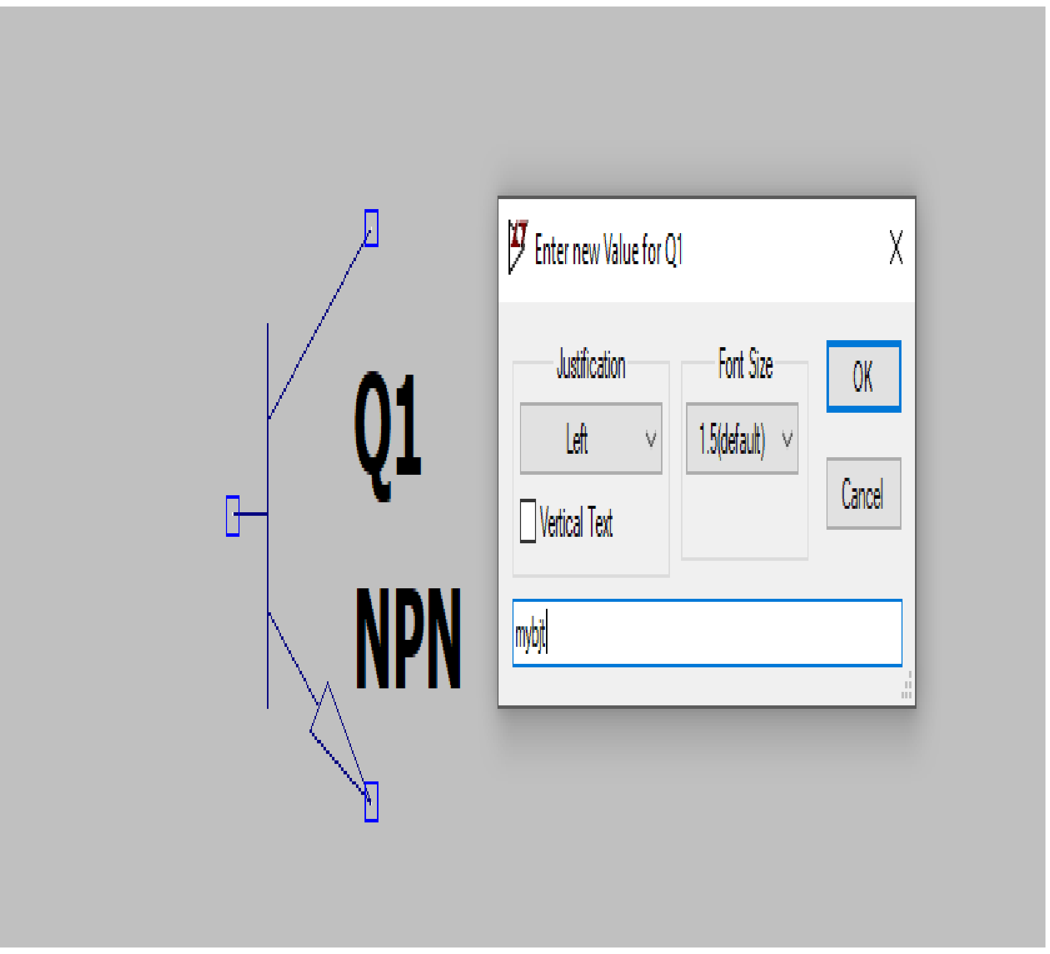
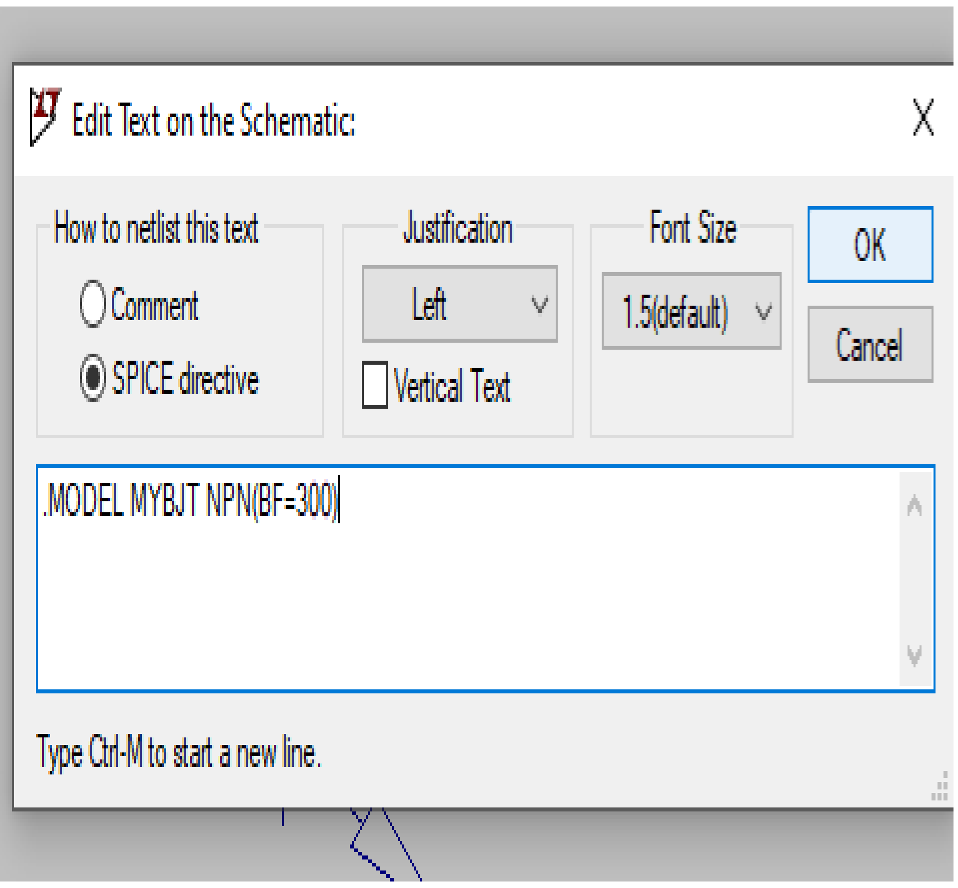
CREATING A MODEL:



1.Select the **component** from the task bar.



3. Right click on “**npn”** to change the device name as you desire.



4. Now Click on **.op** and there type as shown in figure.

- Here bf is the beta of the transistor.
- If you want to give saturation current then you should add extra terms like below.
- **.model mybjt npn(bf=300 is=12.5f)**

- Like this we can define many parameter values of the components instead of default values.

CE AMPLIFIER

Design specifications:

1.voltage gain(Av)=-120V/V

2.Lower cut-off frequency=300Hz

3.Higher cut-off frequency=300KHz

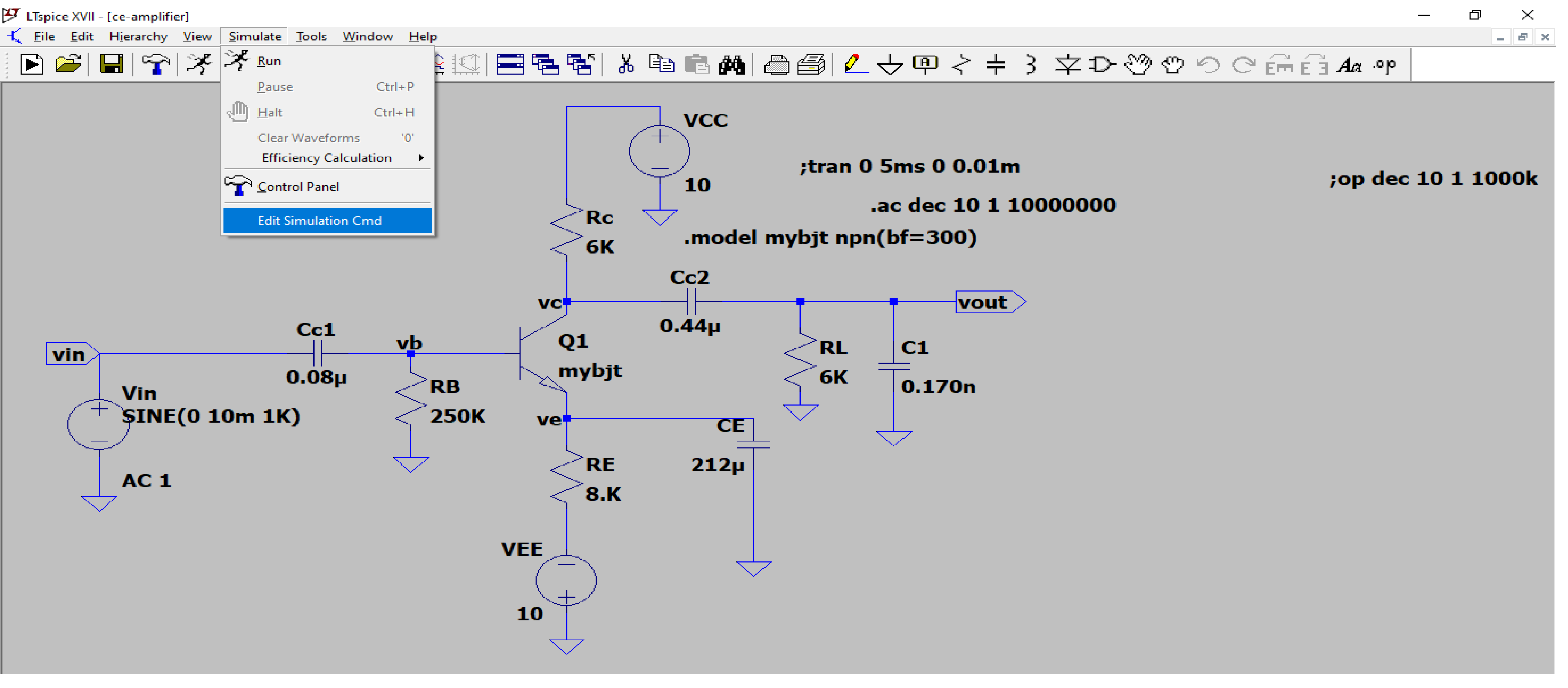
Design parameters:

Beta(bf)=300,RC=6K Ohm, RL=6K Ohm, RB=250K Ohm,RE=8.5K Ohm

CC1=0.08uF ,CC2= 0.44uF ,CE= 212uF ,CL=0.170nF

1. Select the Components And connect the circuit as shown in figure.

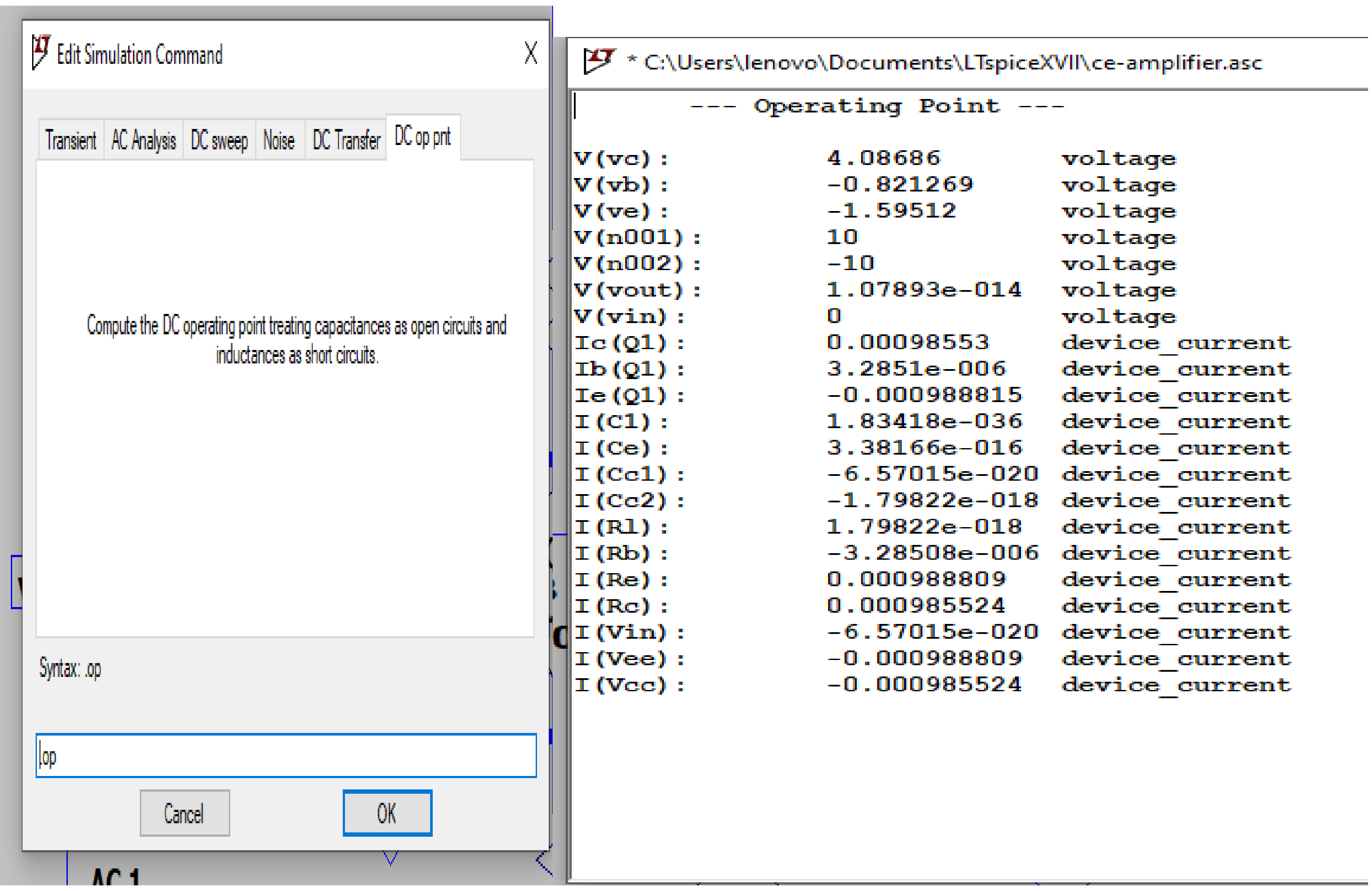
2.Label the nodes ,input and output ports for the convenience while simulation.



DC Analysis:

4. For checking the dc Operating Point(VCEQ, ICQ,) select **DC OP pnt.**

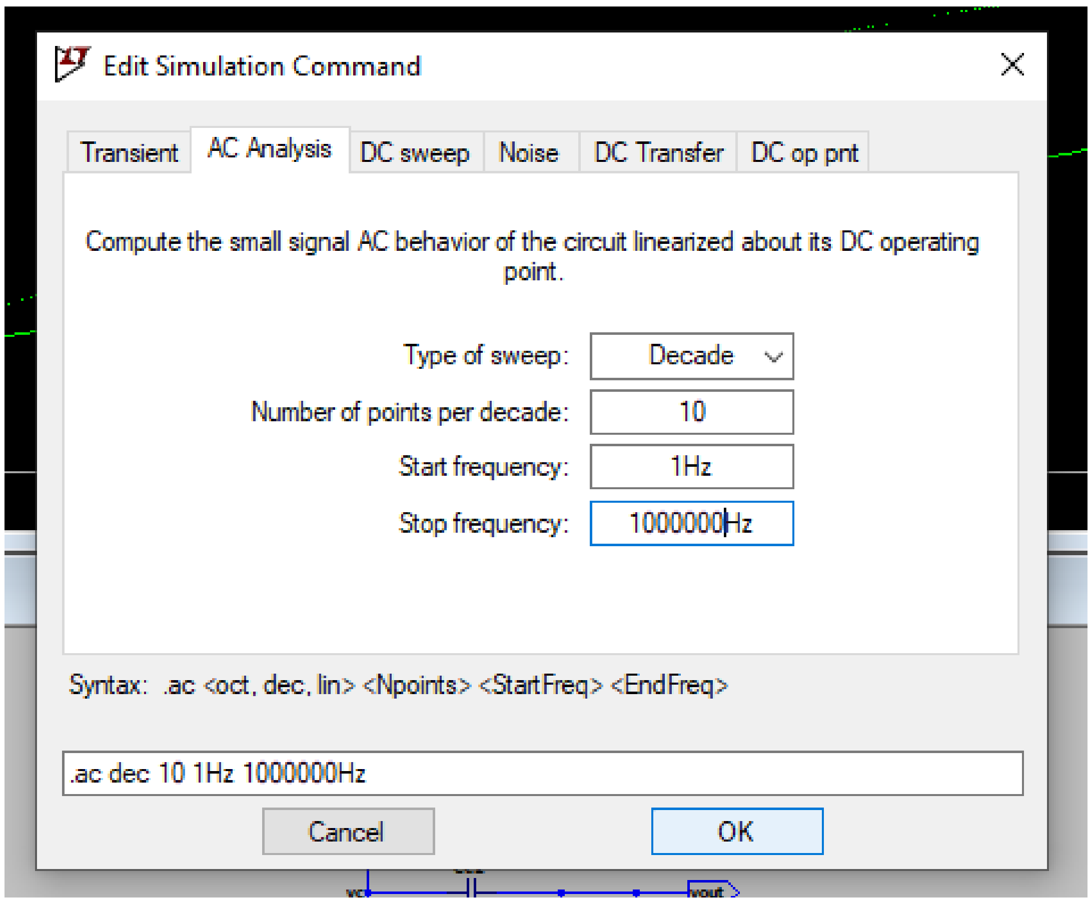
ICQ=1mA,VCEQ=5.5V

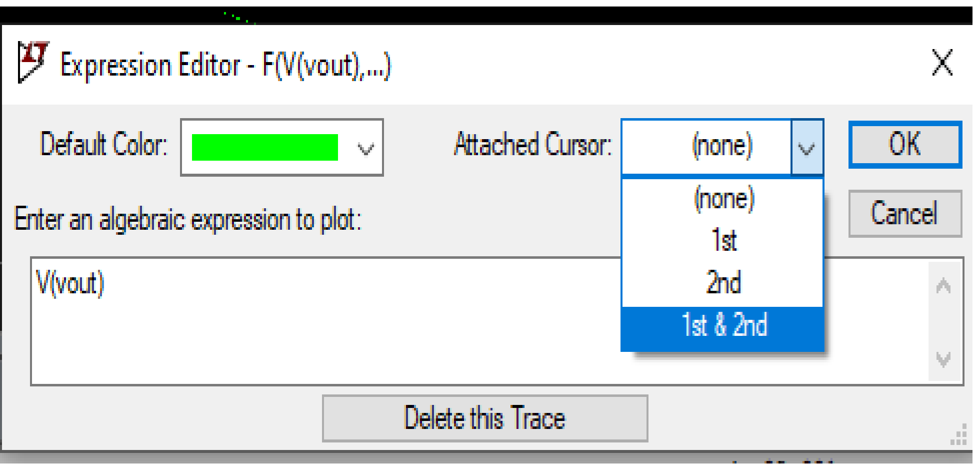


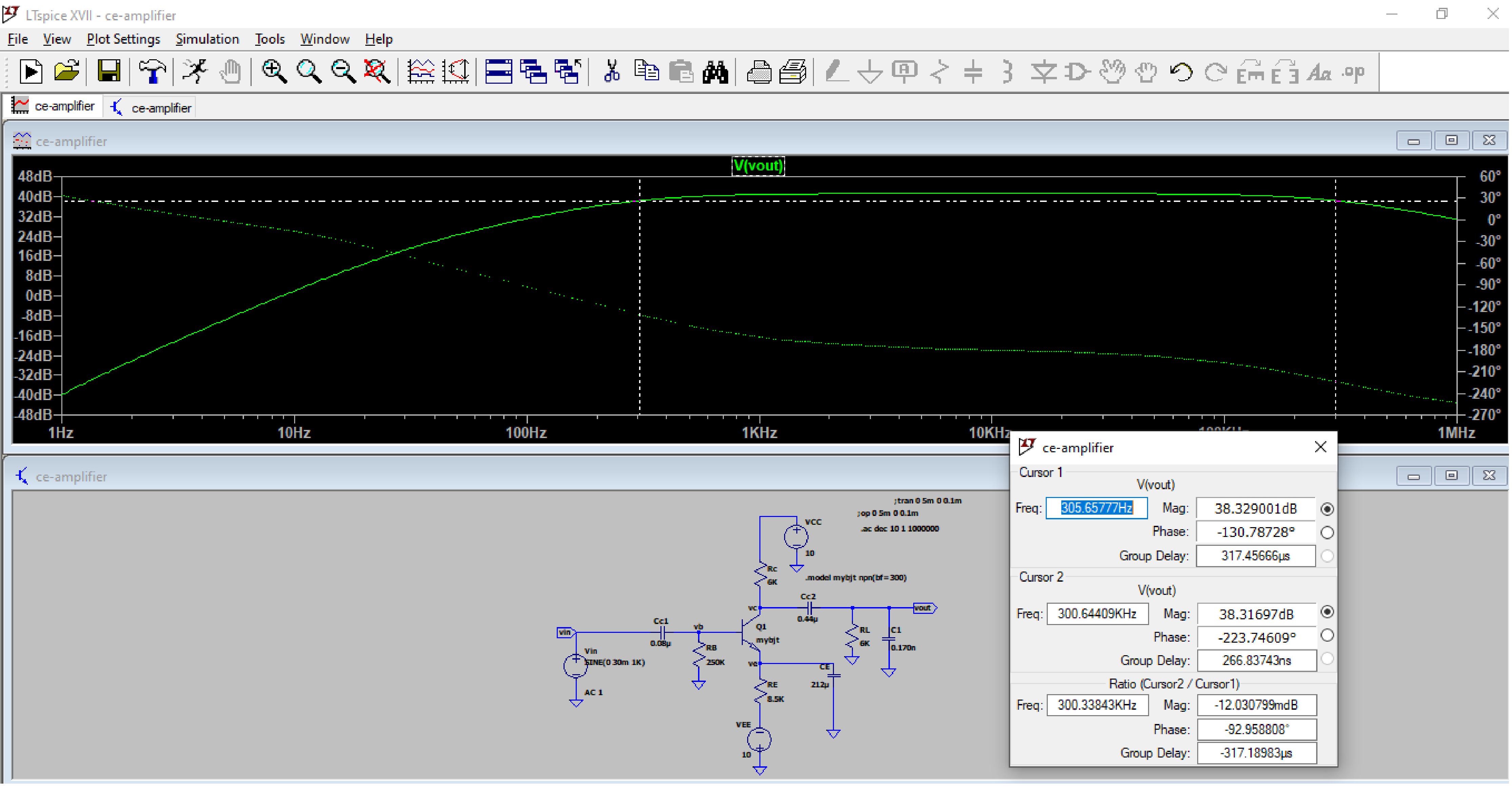
AC Analysis:

- AC ANALAYSIS is the output response with respect to frequency.
- HERE we observe the gain of the amplifier at different frequencies and calculate the lower and higher cut-off frequencies.

- Right click on the V(vout) in the Graph
- Here we want two cursors to calculate


Edit Simulation Command
Transient
AC Analysis
DC sweep
Noise
DC Transfer
DC op pnt
Compute the small signal AC behavior of the circuit linearized about its DC operating point.
Type of sweep:
Decade
Number of points per decade:
10
Start frequency:
1Hz
Stop frequency:
1000000Hz
Syntax: .ac <oct, dec, lin> <Npoints> <StartFreq> <EndFreq>
.ac dec 10 1Hz 1000000Hz
Cancel
OK

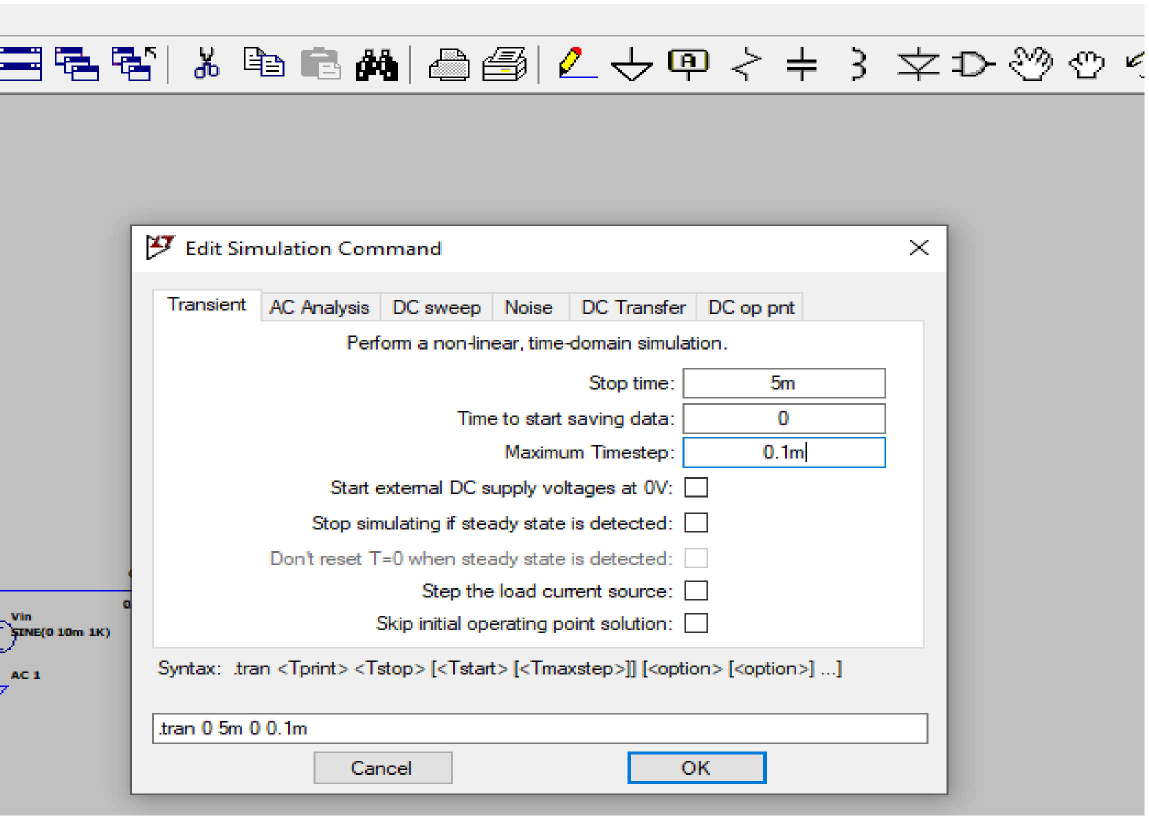

Expression Editor - F(V(vout),...)
Default Color:
Attached Cursor:
(none)
OK
Cancel
Enter an algebraic expression to plot:
V(vout)
(none)
1st
2nd
1st & 2nd
Delete this Trace


LTspice XVII - ce-amplifier
File View Plot Settings Simulation Tools Window Help
ce-amplifier
V(vout)
48dB 40dB 32dB 24dB 16dB 8dB 0dB -8dB -16dB -24dB -32dB -40dB -48dB
60° 30° 0° -30° -60° -90° -120° -150° -180° -210° -240° -270°
1Hz 10Hz 100Hz 1KHz 10KHz 1MHz
;tran 0 5m 0 0.1m
;op 0 5m 0 0.1m
.ac dec 10 1 1000000
.model mybjt npn(bf=300)
Cursor 1
V(vout)
Freq: 305.65777Hz
Mag: 38.329001dB
Phase: -130.78728°
Group Delay: 317.45666µs
Cursor 2
V(vout)
Freq: 300.64409KHz
Mag: 38.31697dB
Phase: -223.74609°
Group Delay: 266.83743ns
Ratio (Cursor2 / Cursor1)
Freq: 300.33843KHz
Mag: -12.030799mdB
Phase: -92.958808°
Group Delay: -317.18983µs

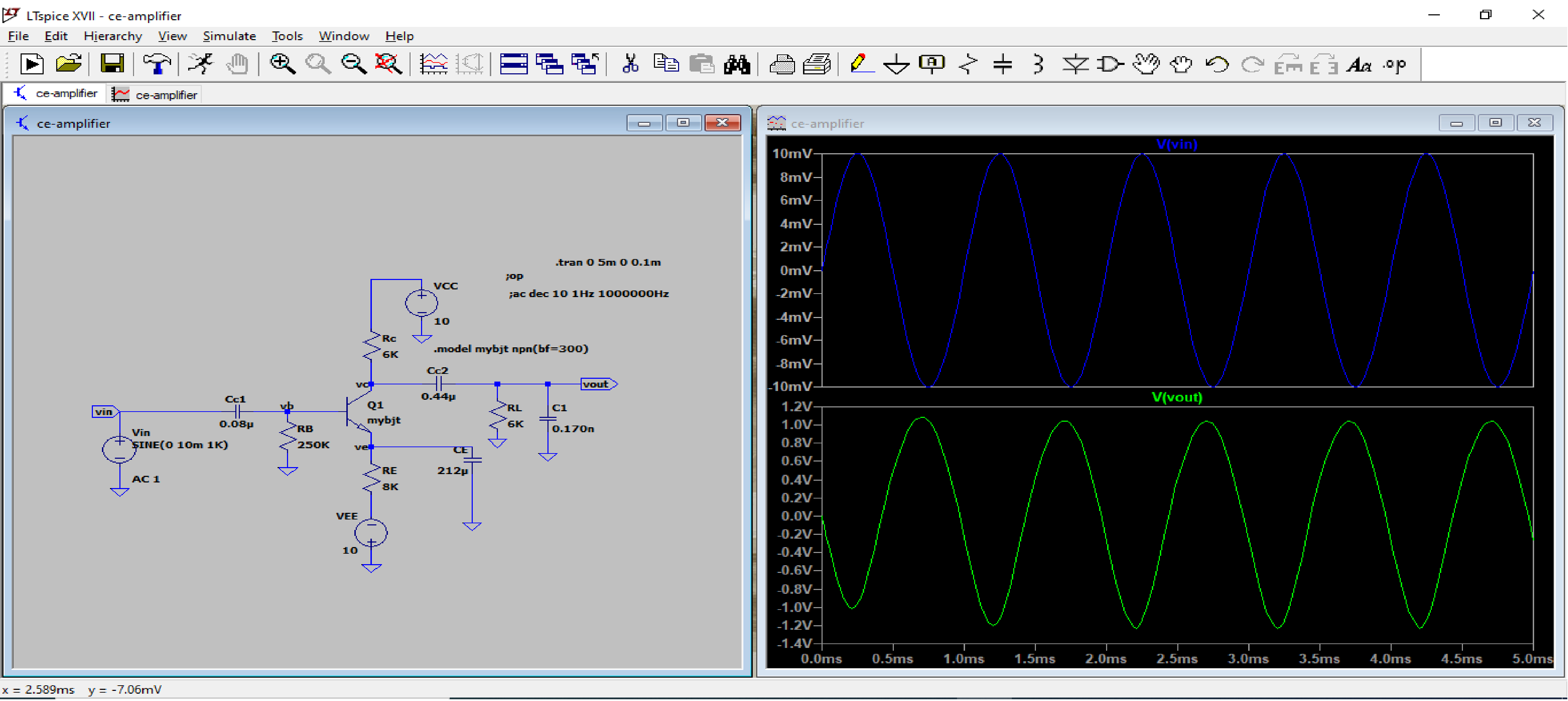
Lower cut-off frequency=305 Hz

Higher cut-off frequency=300 KHz

TRANSIENT ANALYSIS:



Transient analysis is the output response with respect to time.



5.observe that there is a phase difference of 180 degrees between input And output

6.make sure that the input voltage is within the maximum input voltage (for this design max i/p voltage=25mV).

CB AMPLIFIER:

DESIGN SPECIFICATIONS:

1. Voltage Gain(Av)=120 v/v

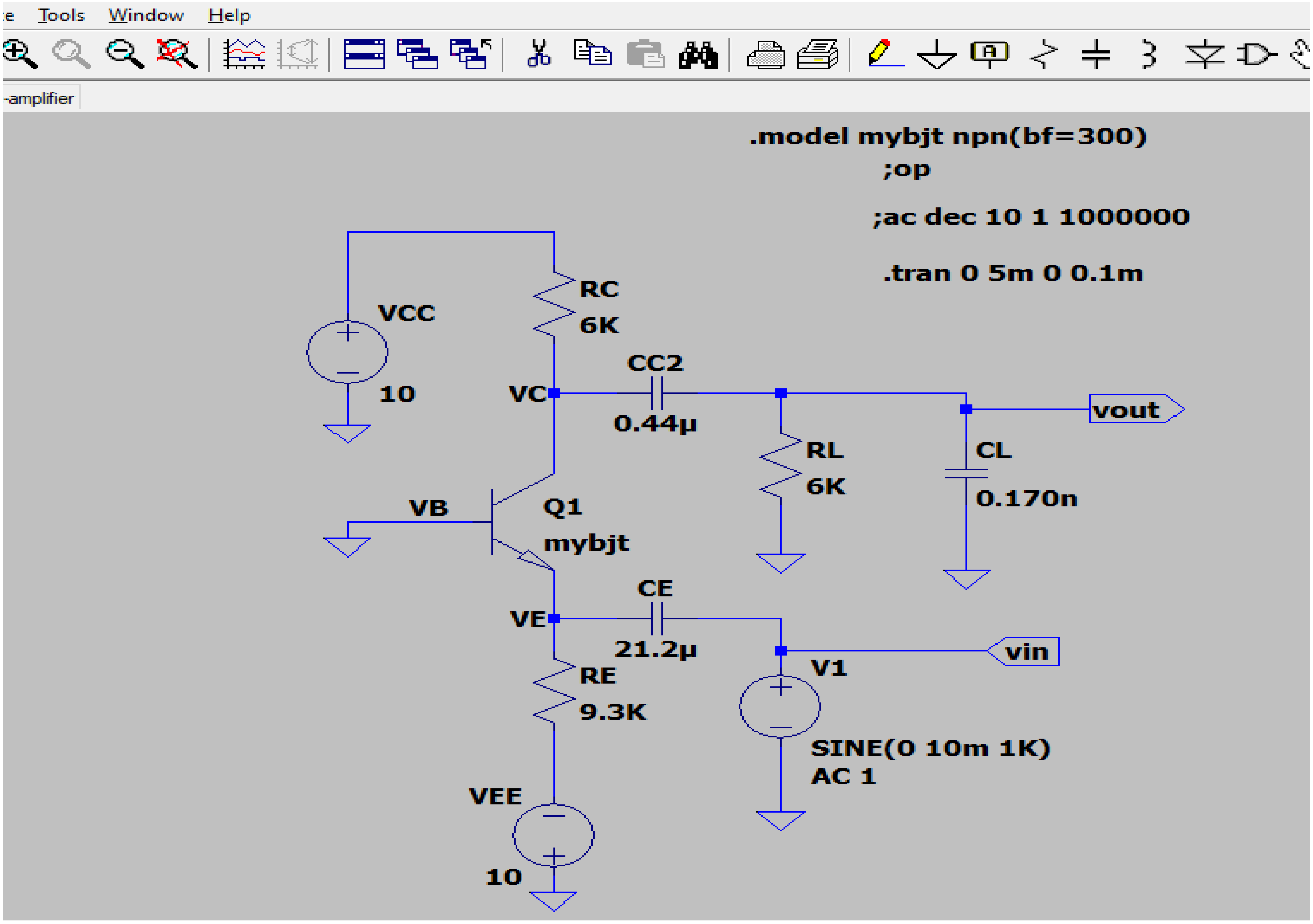
2. Lower Cut-off frequency=300 Hz

3. Higher Cut-off frequency=300 KHz

RL=6K Ohm

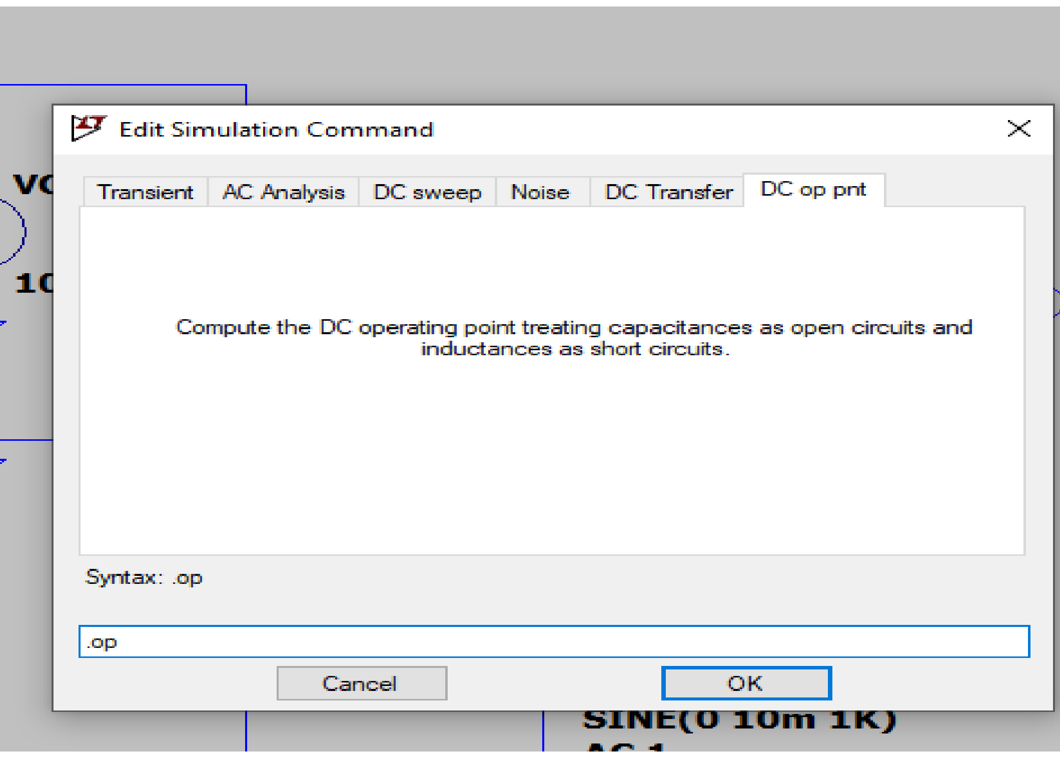
DESIGN VALUES:

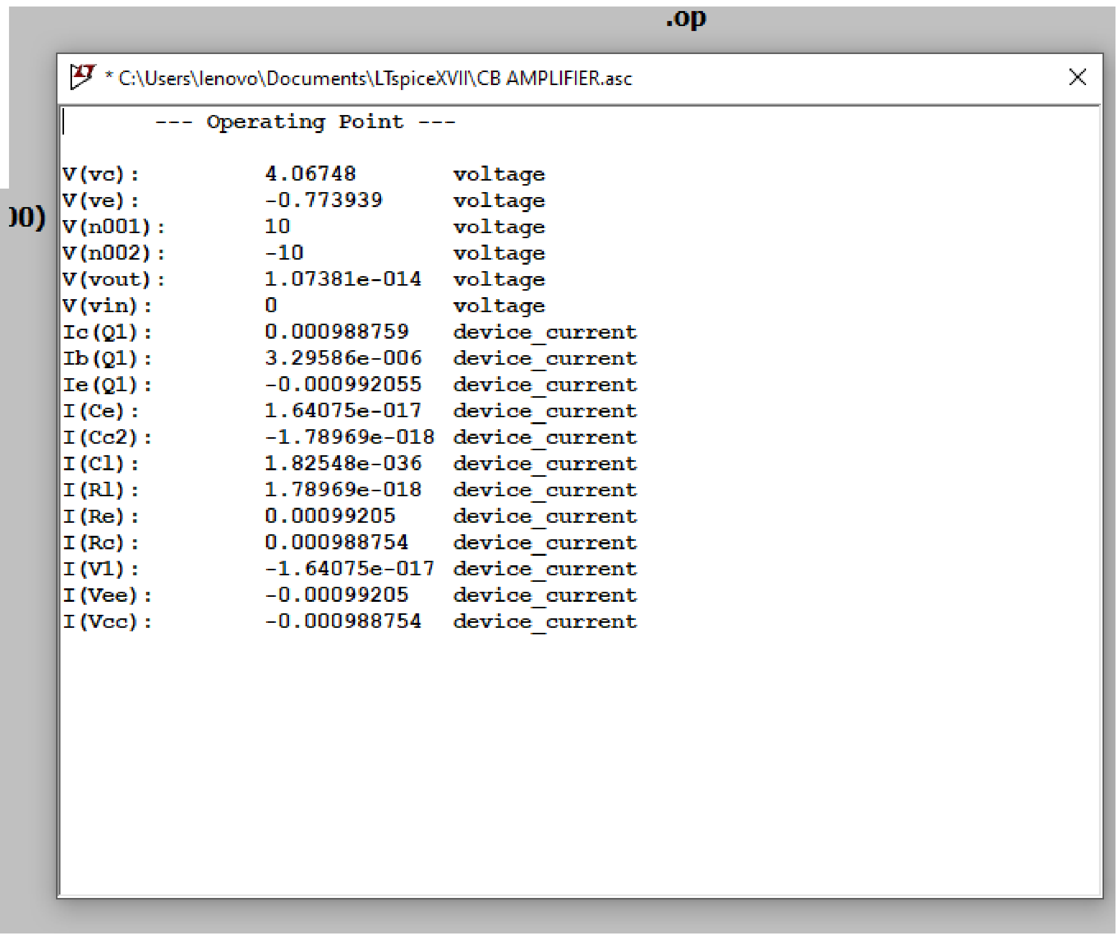
- RC=6K Ohm, RE=9.3K Ohm
- CE=21.2uF,CC2=0.44uF,CL=0.170nF
- VCC=VEE=10V



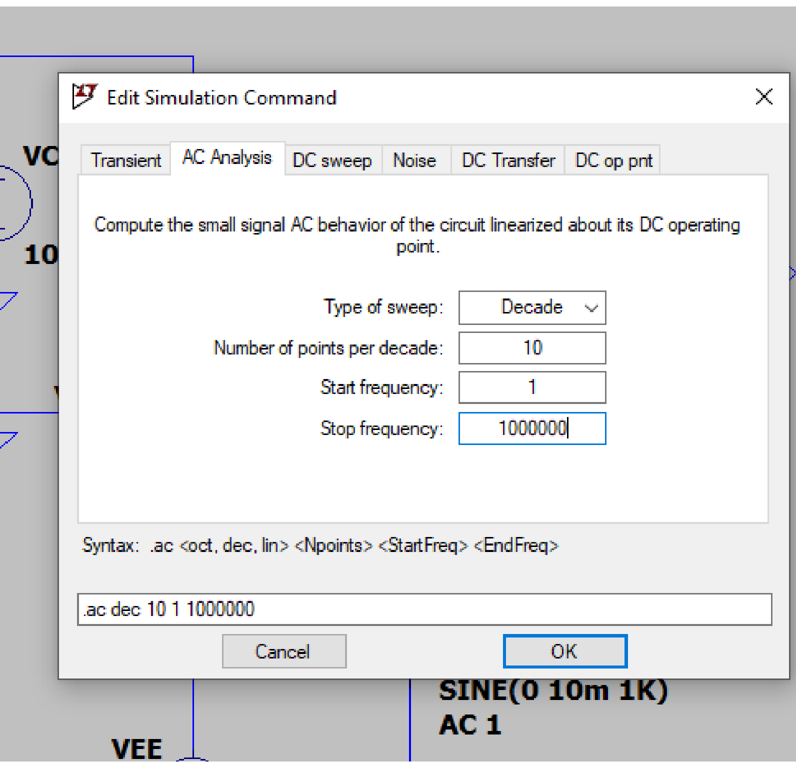
DC ANALYSIS

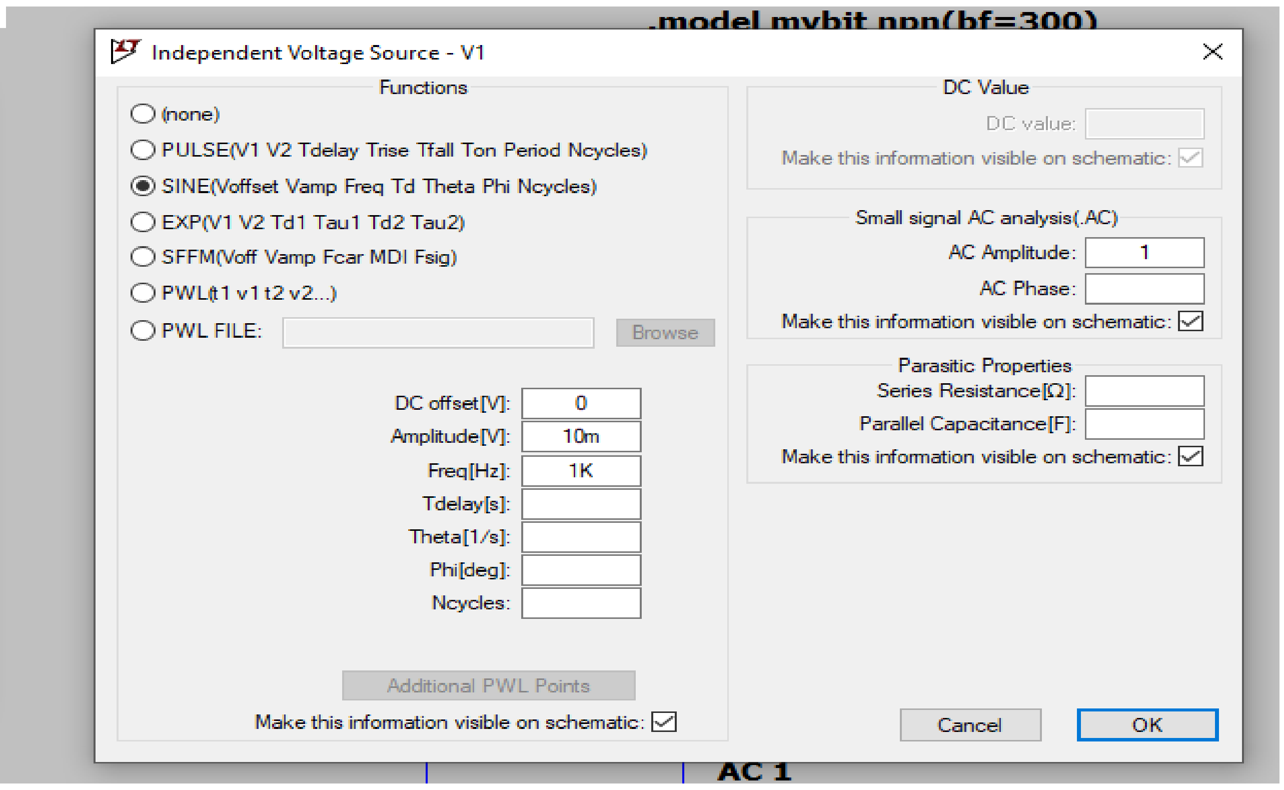
- Check the Q-point (VCE,ICQ) =(4.7V, 1mA)

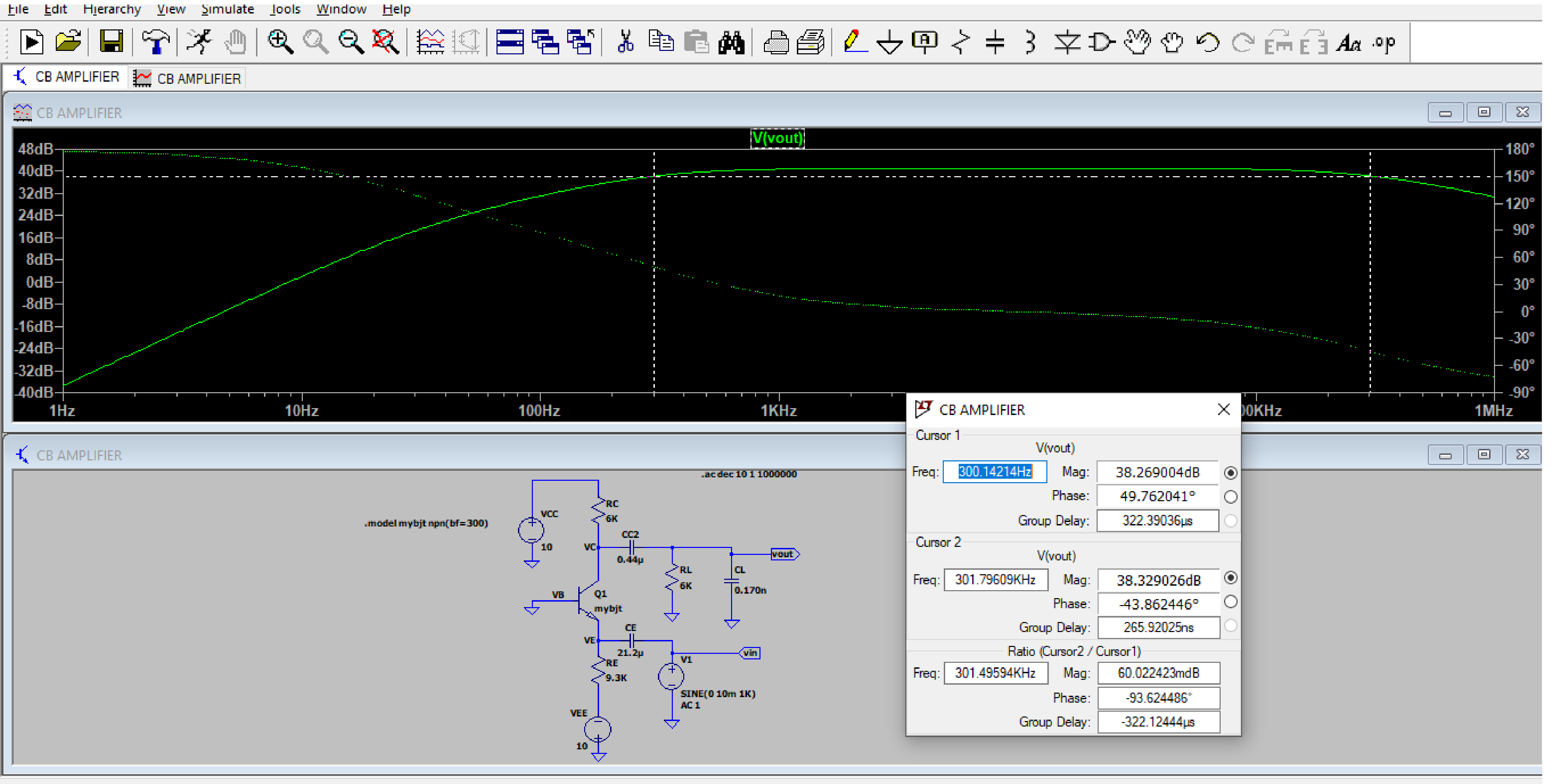

Edit Simulation Command
Transient
AC Analysis
DC sweep
Noise
DC Transfer
DC op pnt
Compute the DC operating point treating capacitances as open circuits and inductances as short circuits.
Syntax: .op
.op
Cancel
OK
SINE(0 10m 1K)


.op
* C:\Users\lenovo\Documents\LTspiceXVII\CB AMPLIFIER.asc
--- Operating Point ---
V(vc): 4.06748 voltage
V(ve): -0.773939 voltage
V(n001): 10 voltage
V(n002): -10 voltage
V(vout): 1.07381e-014 voltage
V(vin): 0 voltage
Ic(Q1): 0.000988759 device_current
Ib(Q1): 3.29586e-006 device_current
Ie(Q1): -0.000992055 device_current
I(Ce): 1.64075e-017 device_current
I(Cc2): -1.78969e-018 device_current
I(Cl): 1.82548e-036 device_current
I(Rl): 1.78969e-018 device_current
I(Re): 0.00099205 device_current
I(Rc): 0.000988754 device_current
I(V1): -1.64075e-017 device_current
I(Vee): -0.00099205 device_current
I(Vcc): -0.000988754 device_current

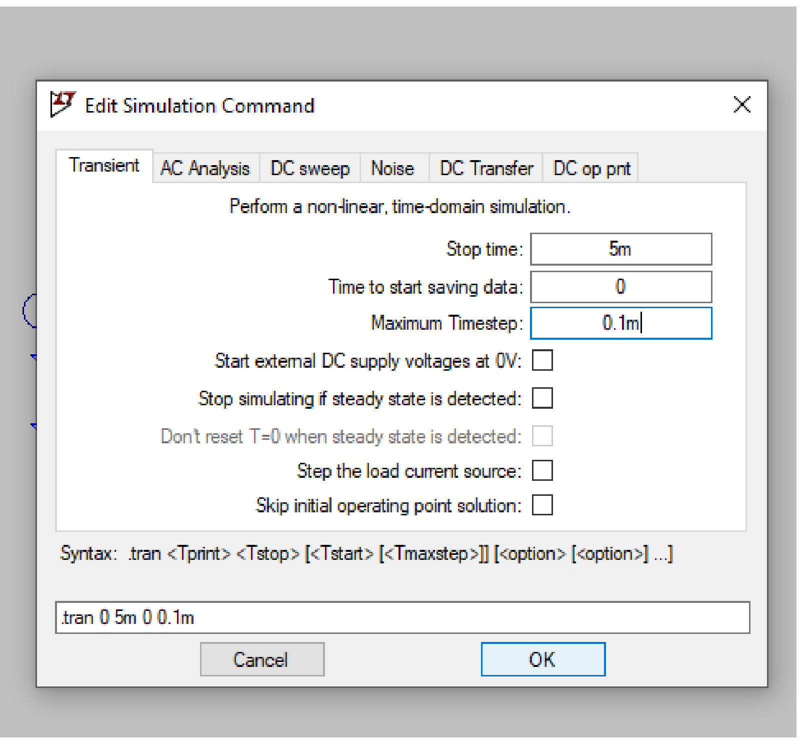
AC ANALYSIS


Edit Simulation Command
Transient
AC Analysis
DC sweep
Noise
DC Transfer
DC op pnt
Compute the small signal AC behavior of the circuit linearized about its DC operating point.
Type of sweep: Decade
Number of points per decade: 10
Start frequency: 1
Stop frequency: 1000000
Syntax: .ac <oct, dec, lin> <Npoints> <StartFreq> <EndFreq>
.ac dec 10 1 1000000
Cancel
OK
SINE(0 10m 1K)
AC 1
VEE

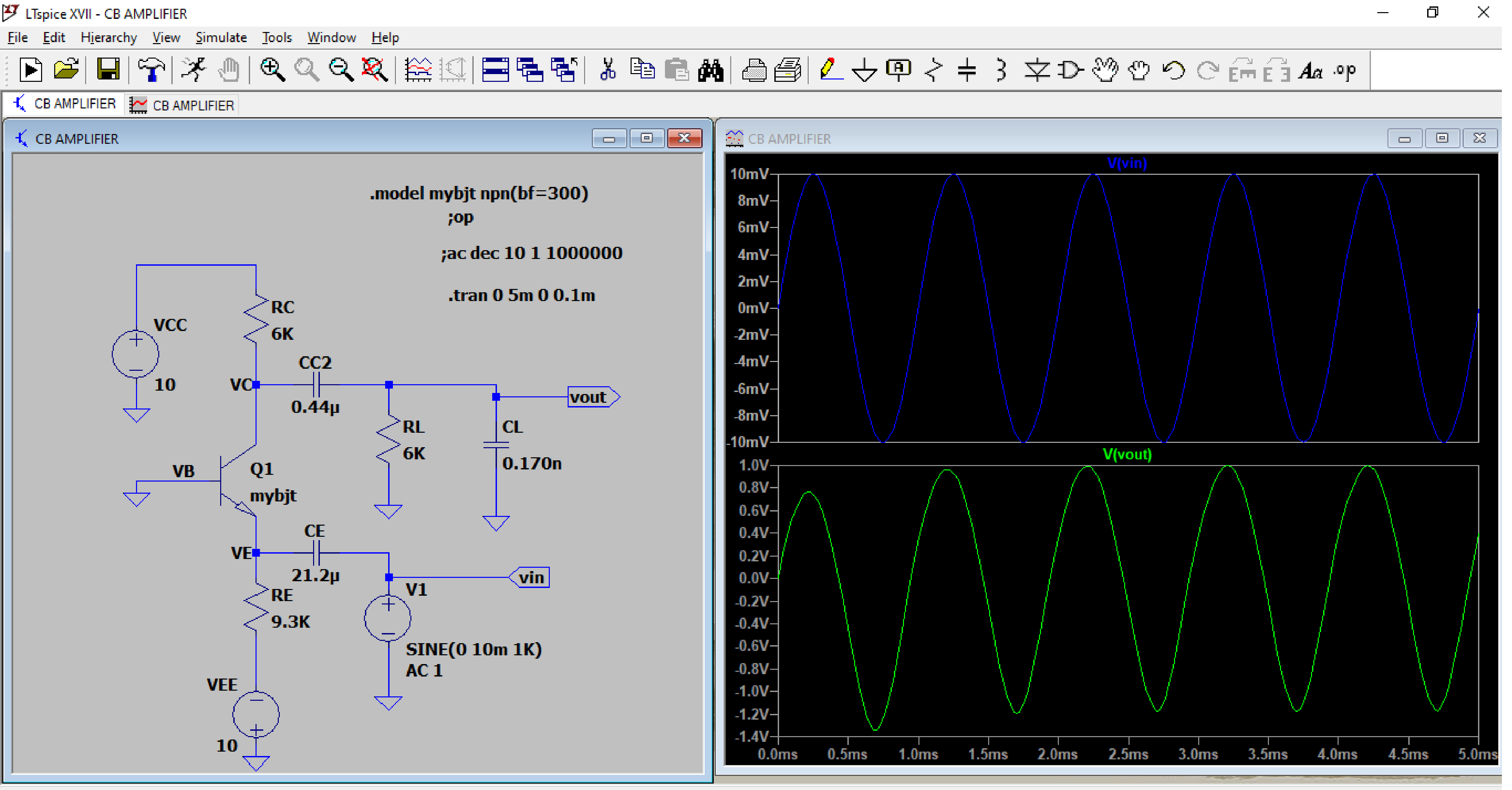

.model mybit npn(bf=300)
Independent Voltage Source - V1
Functions
(none)
PULSE(V1 V2 Tdelay Trise Tfall Ton Period Ncycles)
SINE(Voffset Vamp Freq Td Theta Phi Ncycles)
EXP(V1 V2 Td1 Tau1 Td2 Tau2)
SFFM(Voff Vamp Fcar MDI Fsig)
PWL(t1 v1 t2 v2...)
PWL FILE:
Browse
DC offset[V]: 0
Amplitude[V]: 10m
Freq[Hz]: 1K
Tdelay[s]:
Theta[1/s]:
Phi[deg]:
Ncycles:
Additional PWL Points
Make this information visible on schematic:
DC Value
DC value:
Make this information visible on schematic:
Small signal AC analysis(.AC)
AC Amplitude: 1
AC Phase:
Make this information visible on schematic:
Parasitic Properties
Series Resistance[Ω]:
Parallel Capacitance[F]:
Make this information visible on schematic:
Cancel
OK
AC 1



File Edit Hierarchy View Simulate Tools Window Help
CB AMPLIFIER
CB AMPLIFIER
V(vout)
48dB
40dB
32dB
24dB
16dB
8dB
0dB
-8dB
-16dB
-24dB
-32dB
-40dB
180°
150°
120°
90°
60°
30°
0°
-30°
-60°
-90°
1Hz
10Hz
100Hz
1KHz
1MHz
.ac dec 10 1 1000000
.model mybjt npn(bf=300)
VCC
10
RC
6K
VC
CC2
0.44µ
vout
RL
6K
CL
0.170n
VB
Q1
mybjt
CE
21.2µ
VE
RE
9.3K
V1
vin
SINE(0 10m 1K)
AC 1
VEE
10
CB AMPLIFIER
Cursor 1
V(vout)
Freq: 300.14214Hz
Mag: 38.269004dB
Phase: 49.762041°
Group Delay: 322.39036µs
Cursor 2
V(vout)
Freq: 301.79609KHz
Mag: 38.329026dB
Phase: -43.862446°
Group Delay: 265.92025ns
Ratio (Cursor2 / Cursor1)
Freq: 301.49594KHz
Mag: 60.022423mdB
Phase: -93.624486°
Group Delay: -322.12444µs



Edit Simulation Command
Transient
AC Analysis
DC sweep
Noise
DC Transfer
DC op pnt
Perform a non-linear, time-domain simulation.
Stop time: 5m
Time to start saving data: 0
Maximum Timestep: 0.1m
Start external DC supply voltages at 0V:
Stop simulating if steady state is detected:
Don't reset T=0 when steady state is detected:
Step the load current source:
Skip initial operating point solution:
Syntax: .tran <Tprint> <Tstop> [<Tstart> [<Tmaxstep>]] [<option> [<option>] ...]
.tran 0 5m 0 0.1m
Cancel
OK


LTspice XVII - CB AMPLIFIER
File Edit Hierarchy View Simulate Tools Window Help
CB AMPLIFIER
.model mybjt npn(bf=300)
;op
;ac dec 10 1 1000000
.tran 0 5m 0 0.1m
VCC
10
RC
6K
VC
CC2
0.44µ
RL
6K
CL
0.170n
vout
VB
Q1
mybjt
VE
CE
21.2µ
vin
V1
SINE(0 10m 1K)
AC 1
RE
9.3K
VEE
10
V(vin)
V(vout)
0.0ms
0.5ms
1.0ms
1.5ms
2.0ms
2.5ms
3.0ms
3.5ms
4.0ms
4.5ms
5.0ms

CC AMPLIFIEER:

DESIGN SPECIFCATIONS:

Voltage gain(Av)=1v/v;

Lower cut-off frequency=200Hz

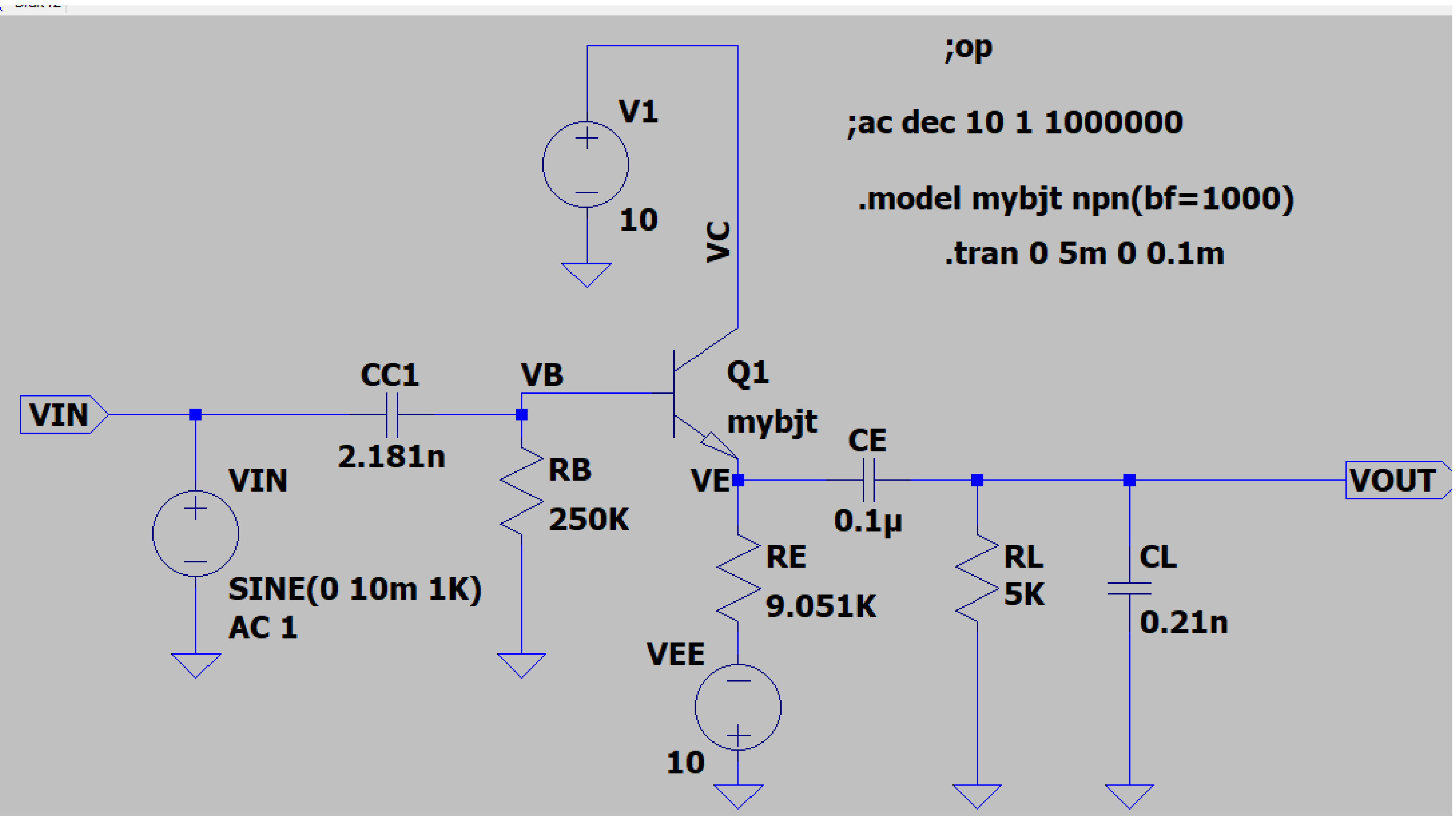
Higher cut-off frequncy=200KHz

DESIGNED VALUES:

RE=9K Ohm,RB=250K Ohm,RL=5K Ohm

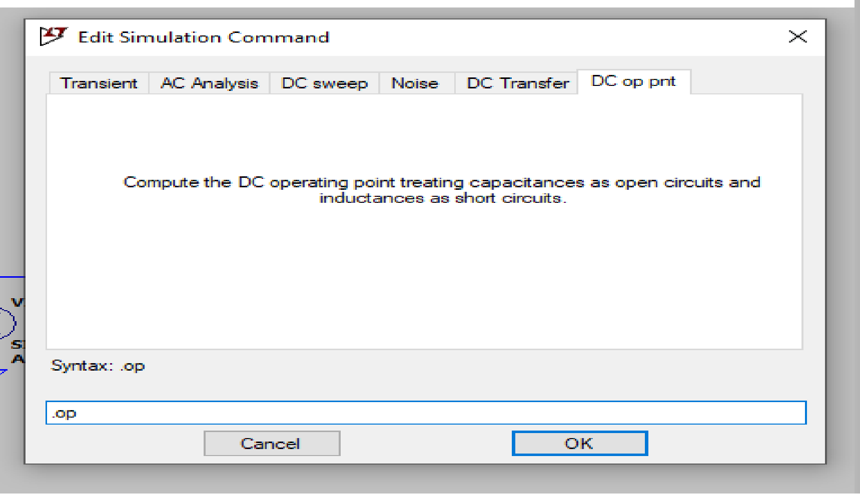
CC1=2.181nF,CE=0.1Uf,CL=0.21nF

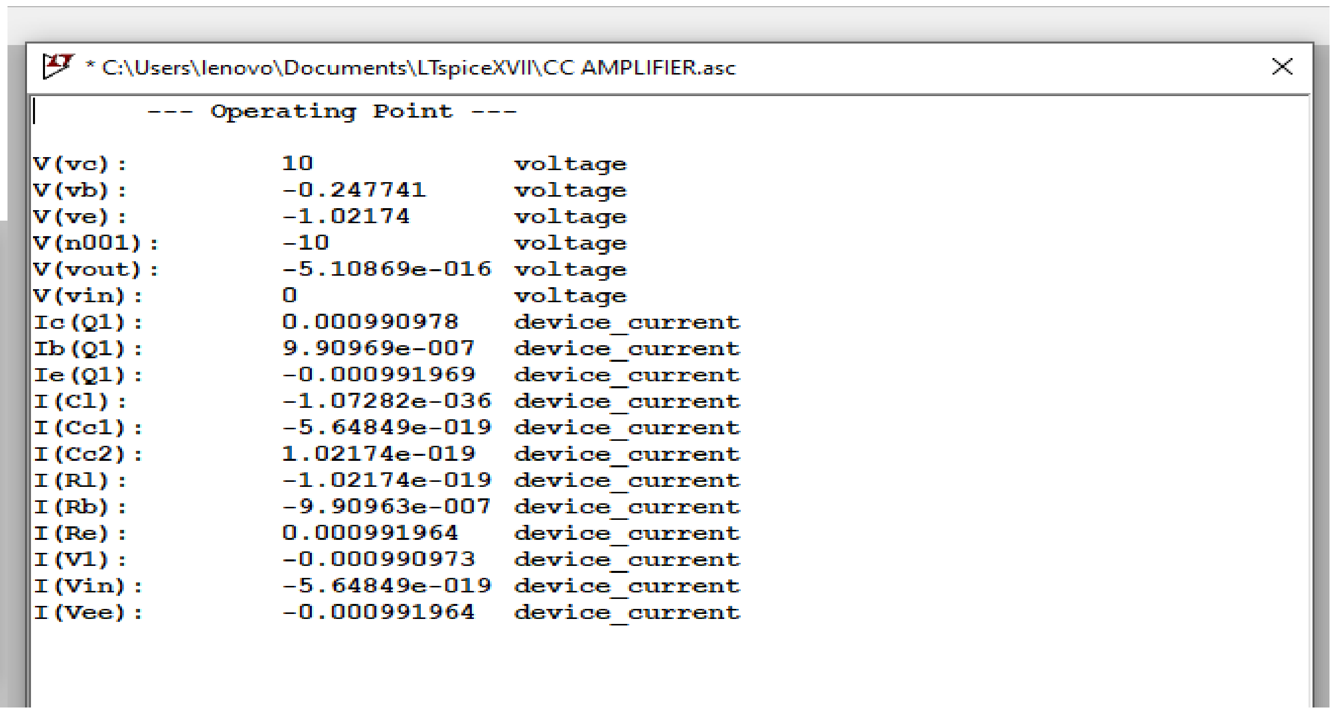
VCC=VEE=10V

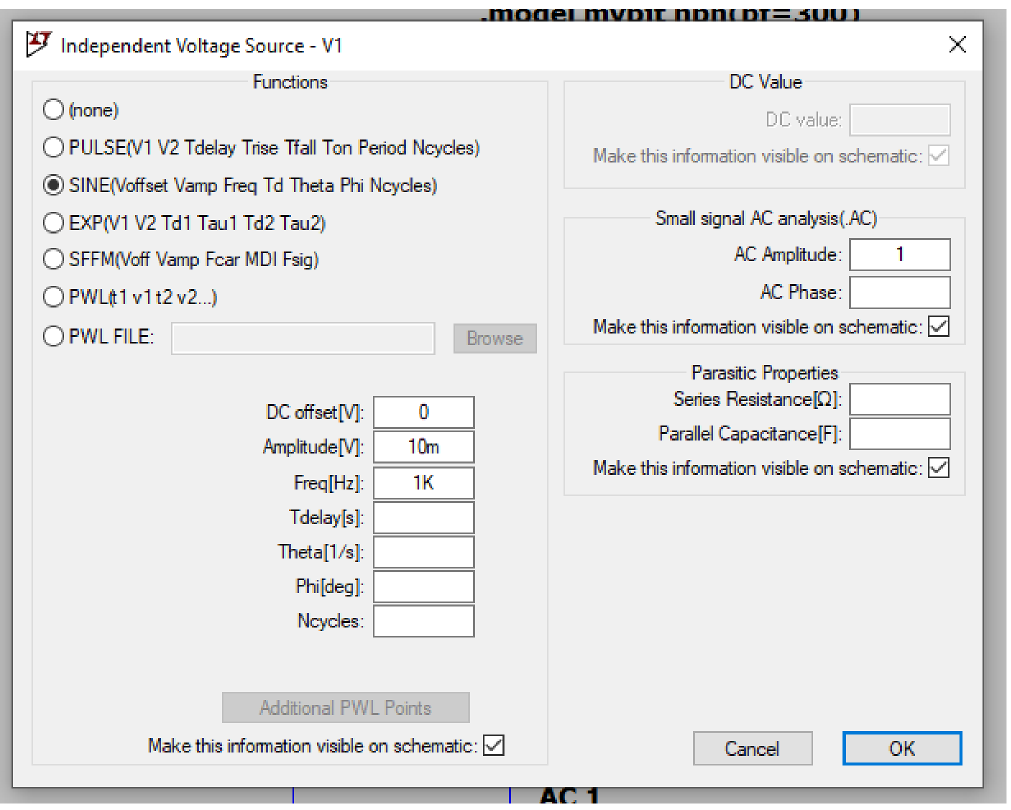


DC ANALYSIS:

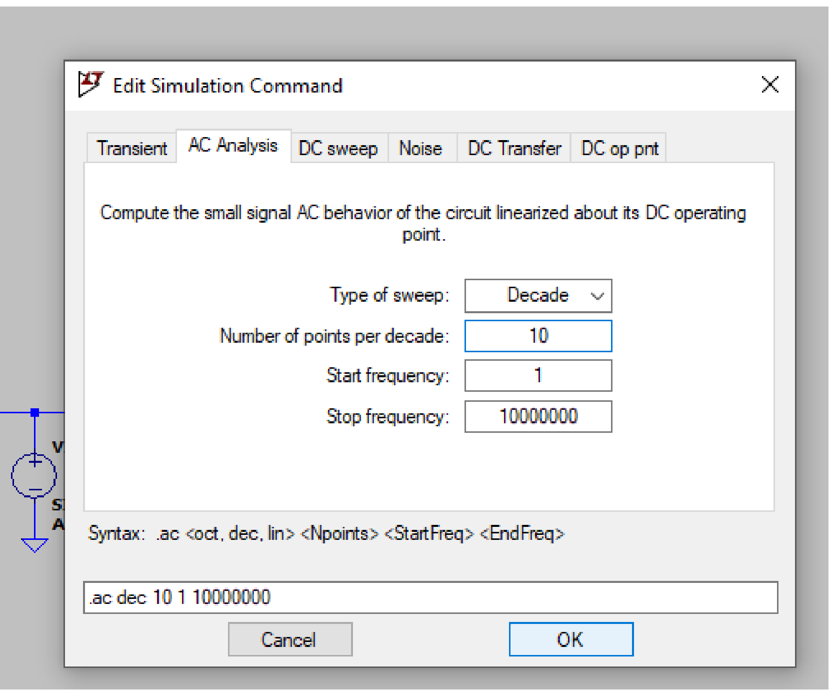
Q-POINT ICQ=1mA ,VCEQ=10.949V

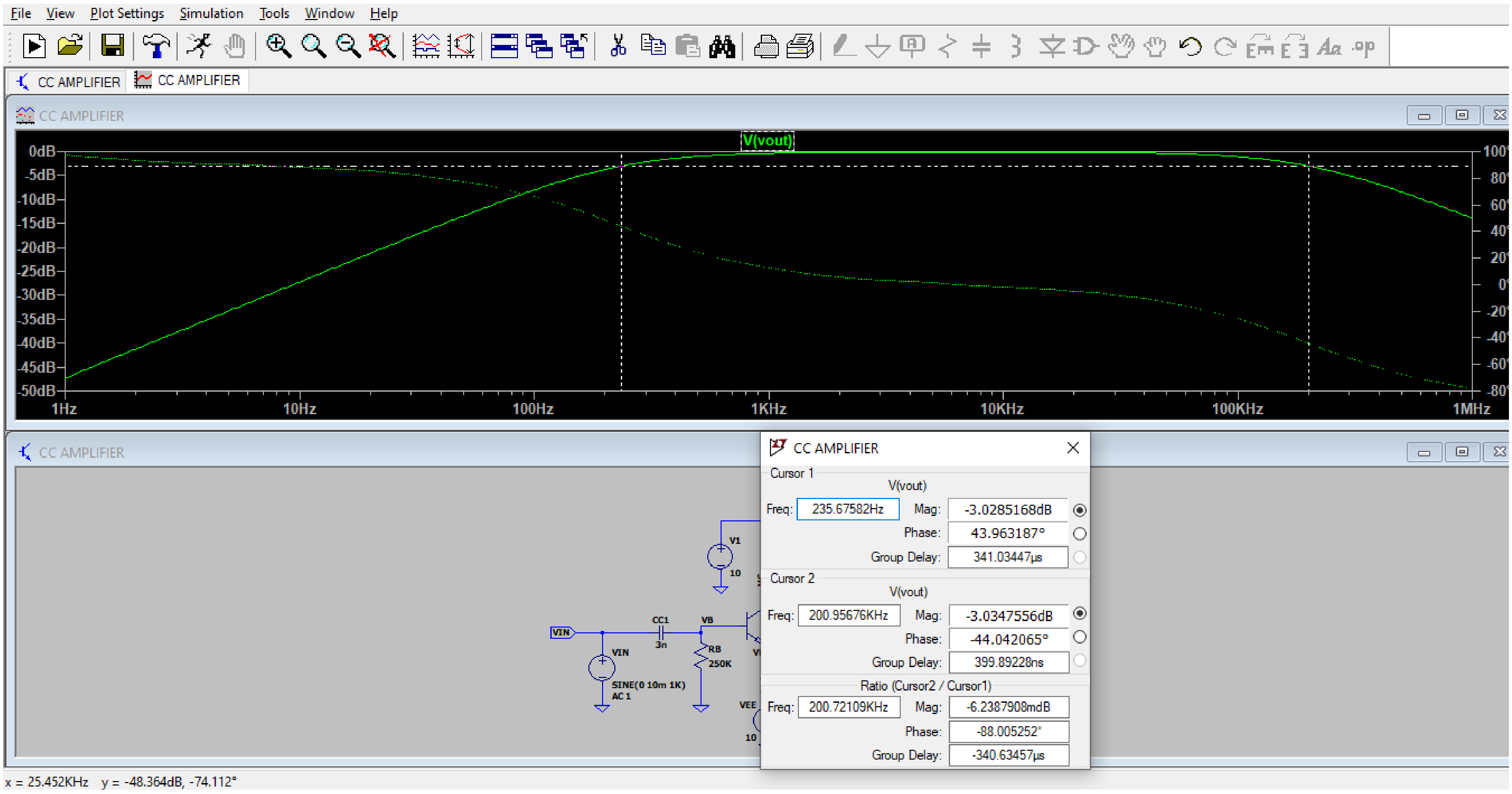

Edit Simulation Command
Transient
AC Analysis
DC sweep
Noise
DC Transfer
DC op pnt
Compute the DC operating point treating capacitances as open circuits and inductances as short circuits.
Syntax: .op
.op
Cancel
OK


* C:\Users\lenovo\Documents\LTspiceXVII\CC AMPLIFIER.asc
--- Operating Point ---
V(vc): 10 voltage
V(vb): -0.247741 voltage
V(ve): -1.02174 voltage
V(n001): -10 voltage
V(vout): -5.10869e-016 voltage
V(vin): 0 voltage
Ic(Q1): 0.000990978 device_current
Ib(Q1): 9.90969e-007 device_current
Ie(Q1): -0.000991969 device_current
I(Cl): -1.07282e-036 device_current
I(Cc1): -5.64849e-019 device_current
I(Cc2): 1.02174e-019 device_current
I(Rl): -1.02174e-019 device_current
I(Rb): -9.90963e-007 device_current
I(Re): 0.000991964 device_current
I(V1): -0.000990973 device_current
I(Vin): -5.64849e-019 device_current
I(Vee): -0.000991964 device_current

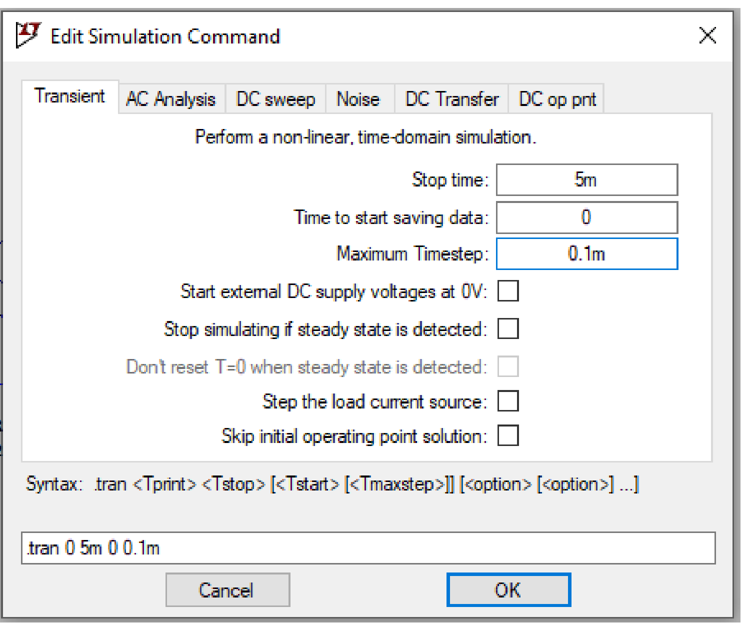

.model mybjt npn(bf=300)
Independent Voltage Source - V1
Functions
(none)
PULSE(V1 V2 Tdelay Trise Tfall Ton Period Ncycles)
SINE(Voffset Vamp Freq Td Theta Phi Ncycles)
EXP(V1 V2 Td1 Tau1 Td2 Tau2)
SFFM(Voff Vamp Fcar MDI Fsig)
PWL(t1 v1 t2 v2...)
PWL FILE:
Browse
DC offset[V]: 0
Amplitude[V]: 10m
Freq[Hz]: 1K
Tdelay[s]:
Theta[1/s]:
Phi[deg]:
Ncycles:
Additional PWL Points
Make this information visible on schematic:
DC Value
DC value:
Make this information visible on schematic:
Small signal AC analysis(.AC)
AC Amplitude: 1
AC Phase:
Make this information visible on schematic:
Parasitic Properties
Series Resistance[Ω]:
Parallel Capacitance[F]:
Make this information visible on schematic:
Cancel
OK
AC 1

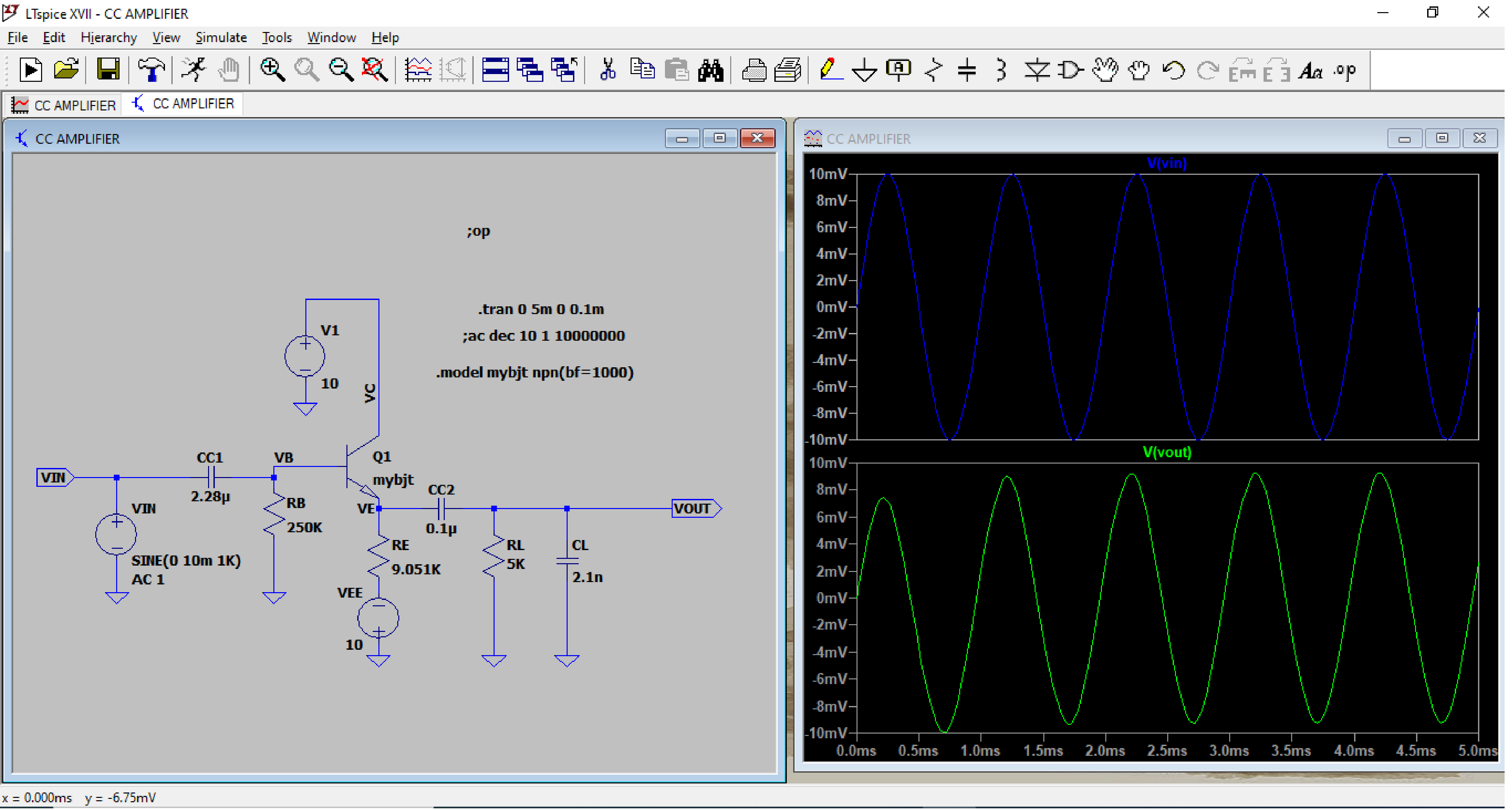
AC ANALYSIS:


Edit Simulation Command
Transient
AC Analysis
DC sweep
Noise
DC Transfer
DC op pnt
Compute the small signal AC behavior of the circuit linearized about its DC operating point.
Type of sweep: Decade
Number of points per decade: 10
Start frequency: 1
Stop frequency: 10000000
Syntax: .ac <oct, dec, lin> <Npoints> <StartFreq> <EndFreq>
.ac dec 10 1 10000000
Cancel
OK



TRANSIENT ANALYSIS:





4.CASCADED AMPLIFIER:

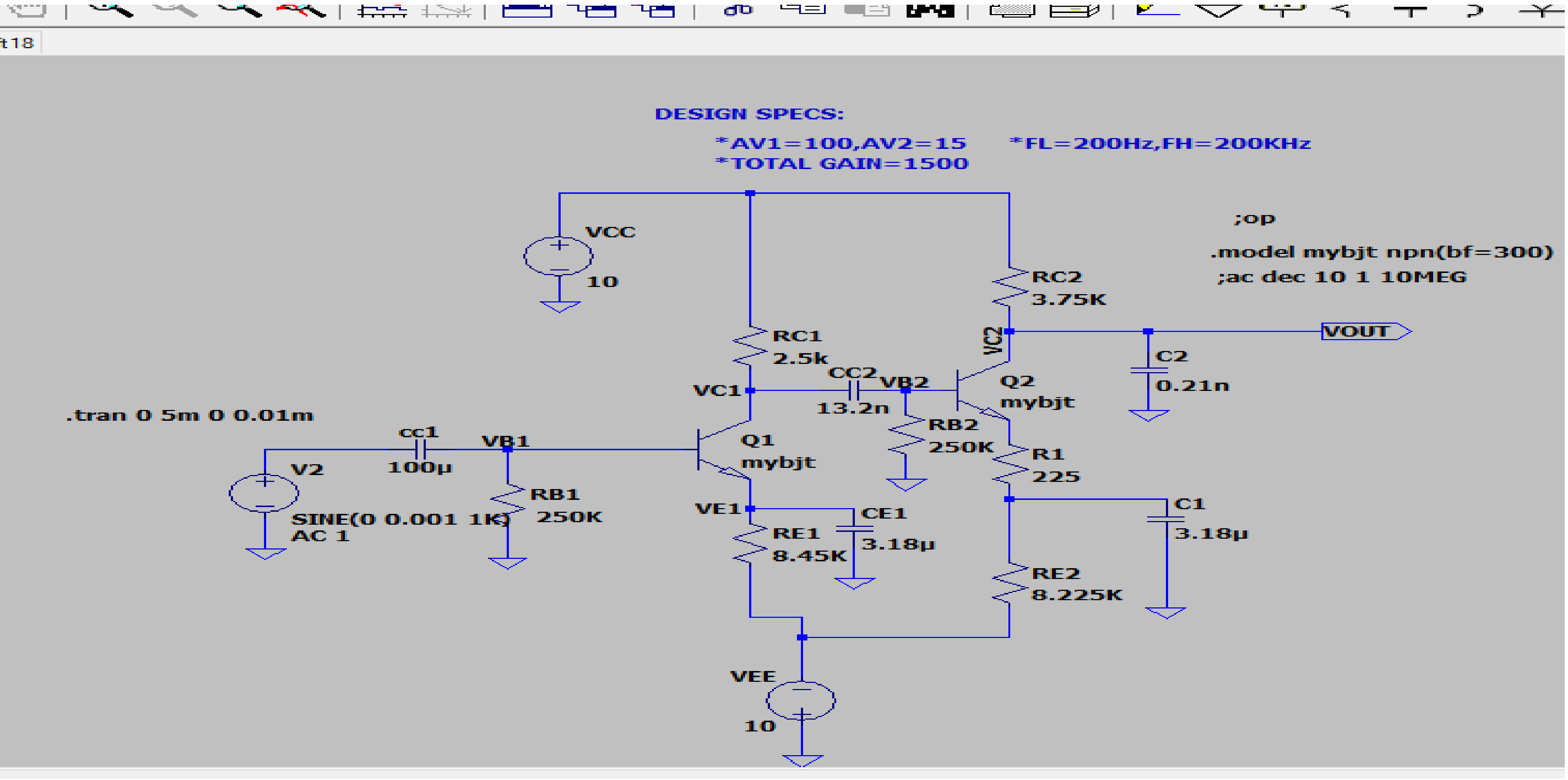
DESIGN SPECIFICATIONS:

Total gain=1500

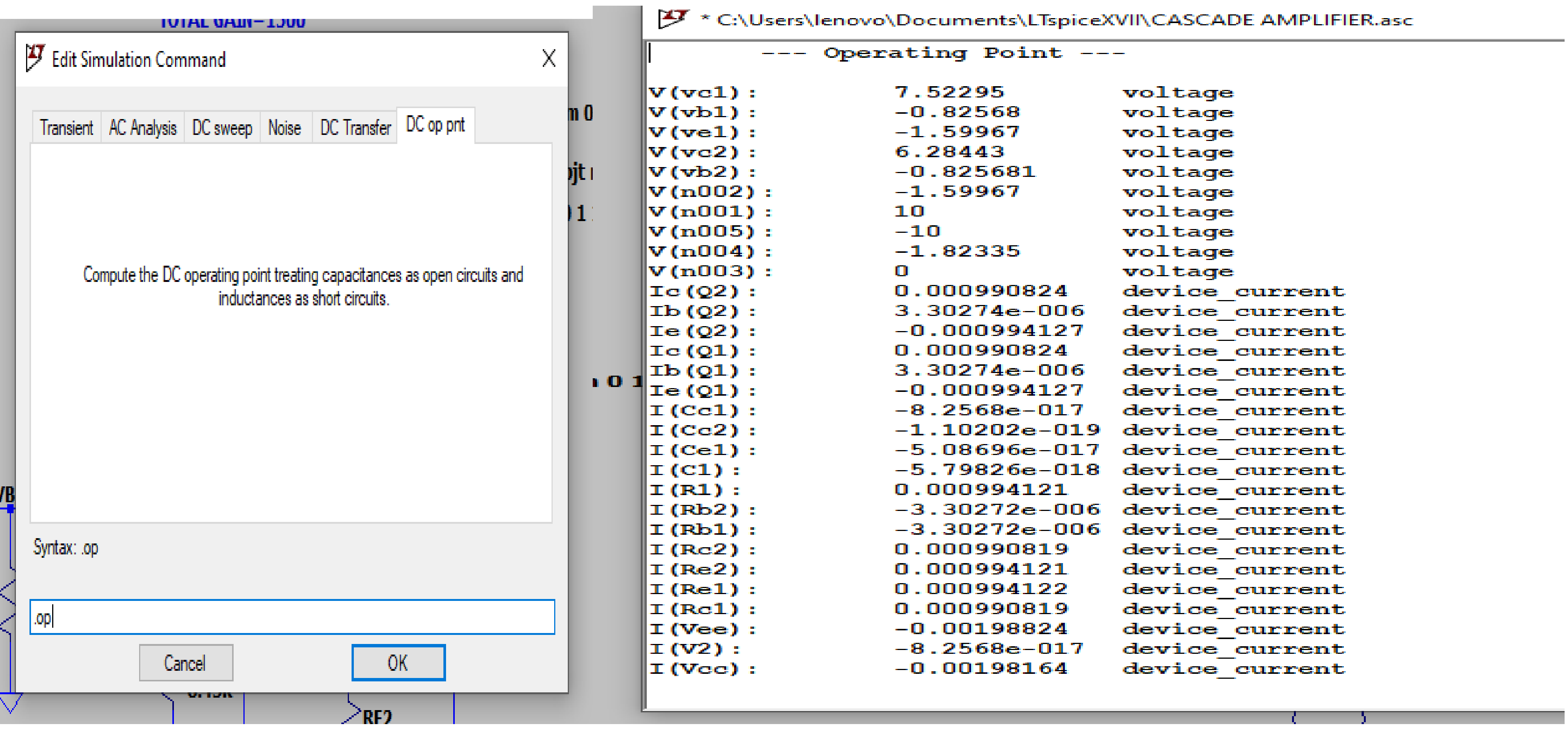
Gain of first stage=100,Gain of second stage=15.

Lower cut-off frequency=200Hz

Higher cut-off frequency=200KHz

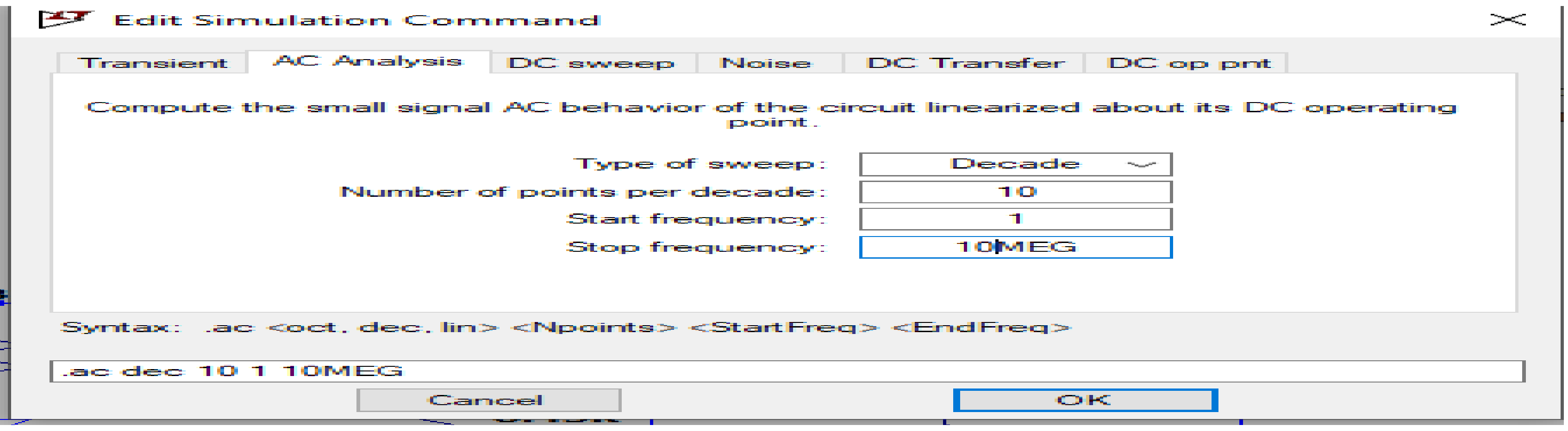


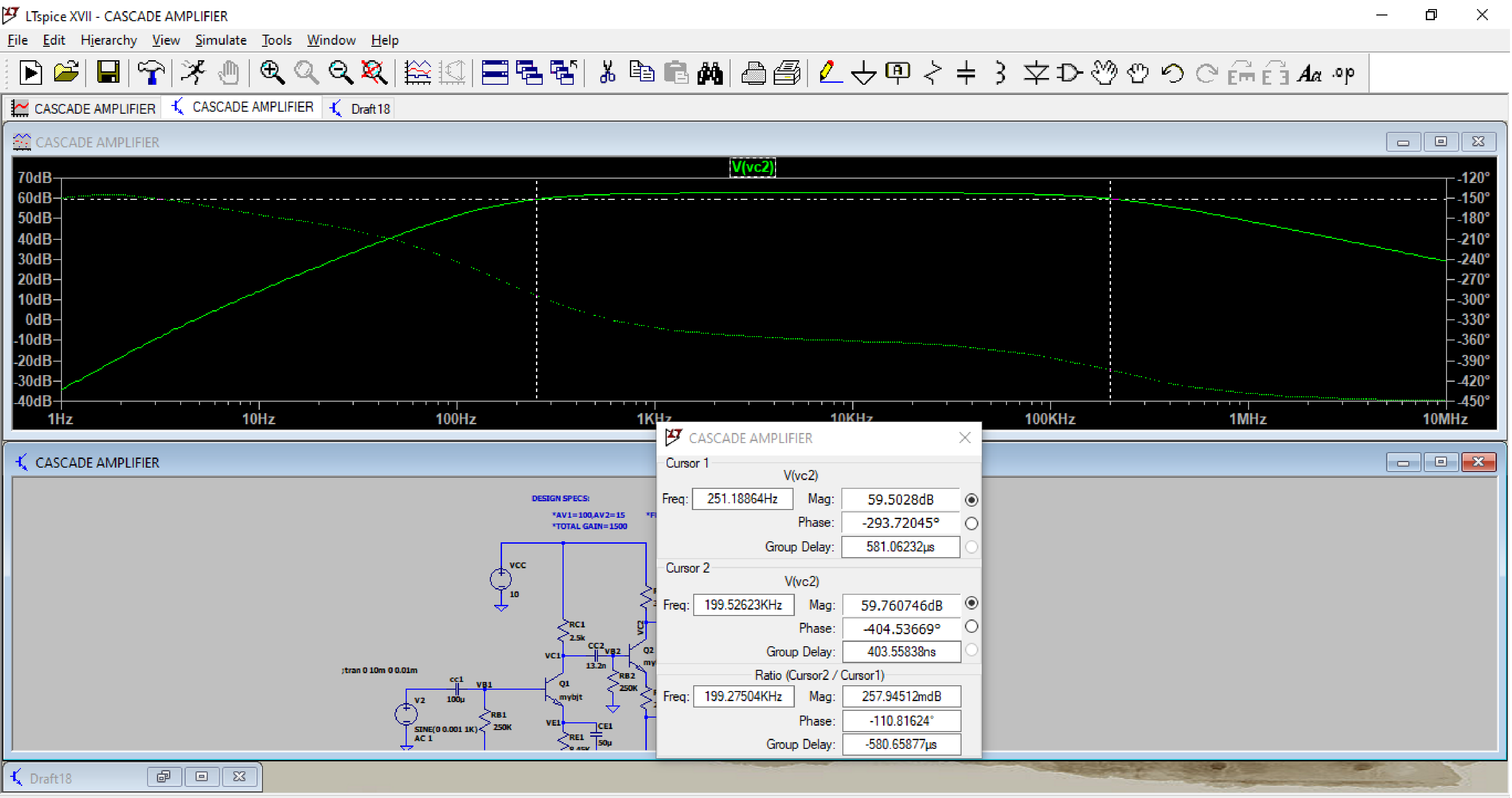
DC ANALYSIS:

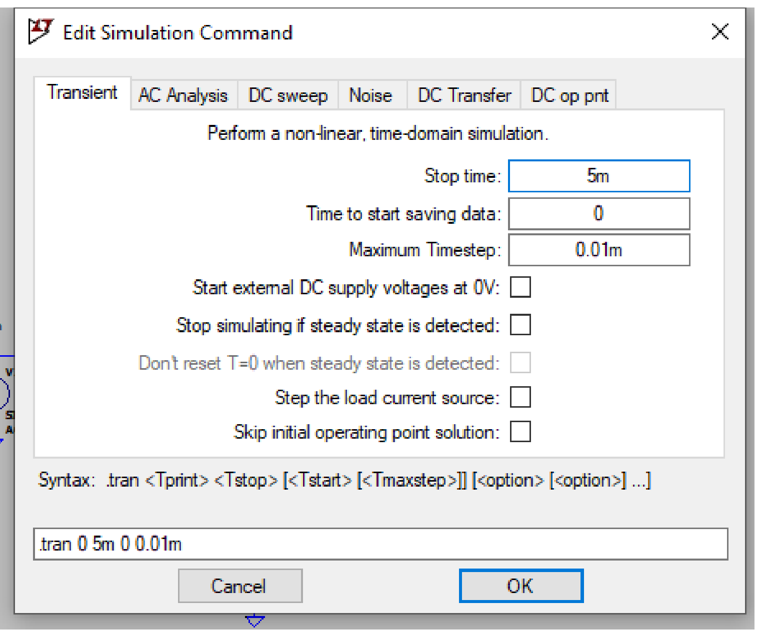


V(vc1):	7.52295	voltage
V(vb1):	-0.82568	voltage
V(ve1):	-1.59967	voltage
V(vc2):	6.28443	voltage
V(vb2):	-0.825681	voltage
V(n002):	-1.59967	voltage
V(n001):	10	voltage
V(n005):	-10	voltage
V(n004):	-1.82335	voltage
V(n003):	0	voltage
Ic(Q2):	0.000990824	device_current
Ib(Q2):	3.30274e-006	device_current
Ie(Q2):	-0.000994127	device_current
Ic(Q1):	0.000990824	device_current
Ib(Q1):	3.30274e-006	device_current
Ie(Q1):	-0.000994127	device_current
I(Cc1):	-8.2568e-017	device_current
I(Cc2):	-1.10202e-019	device_current
I(Ce1):	-5.08696e-017	device_current
I(C1):	-5.79826e-018	device_current
I(R1):	0.000994121	device_current
I(Rb2):	-3.30272e-006	device_current
I(Rb1):	-3.30272e-006	device_current
I(Rc2):	0.000990819	device_current
I(Re2):	0.000994121	device_current
I(Re1):	0.000994122	device_current
I(Rc1):	0.000990819	device_current
I(Vee):	-0.00198824	device_current
I(V2):	-8.2568e-017	device_current
I(Vcc):	-0.00198164	device_current

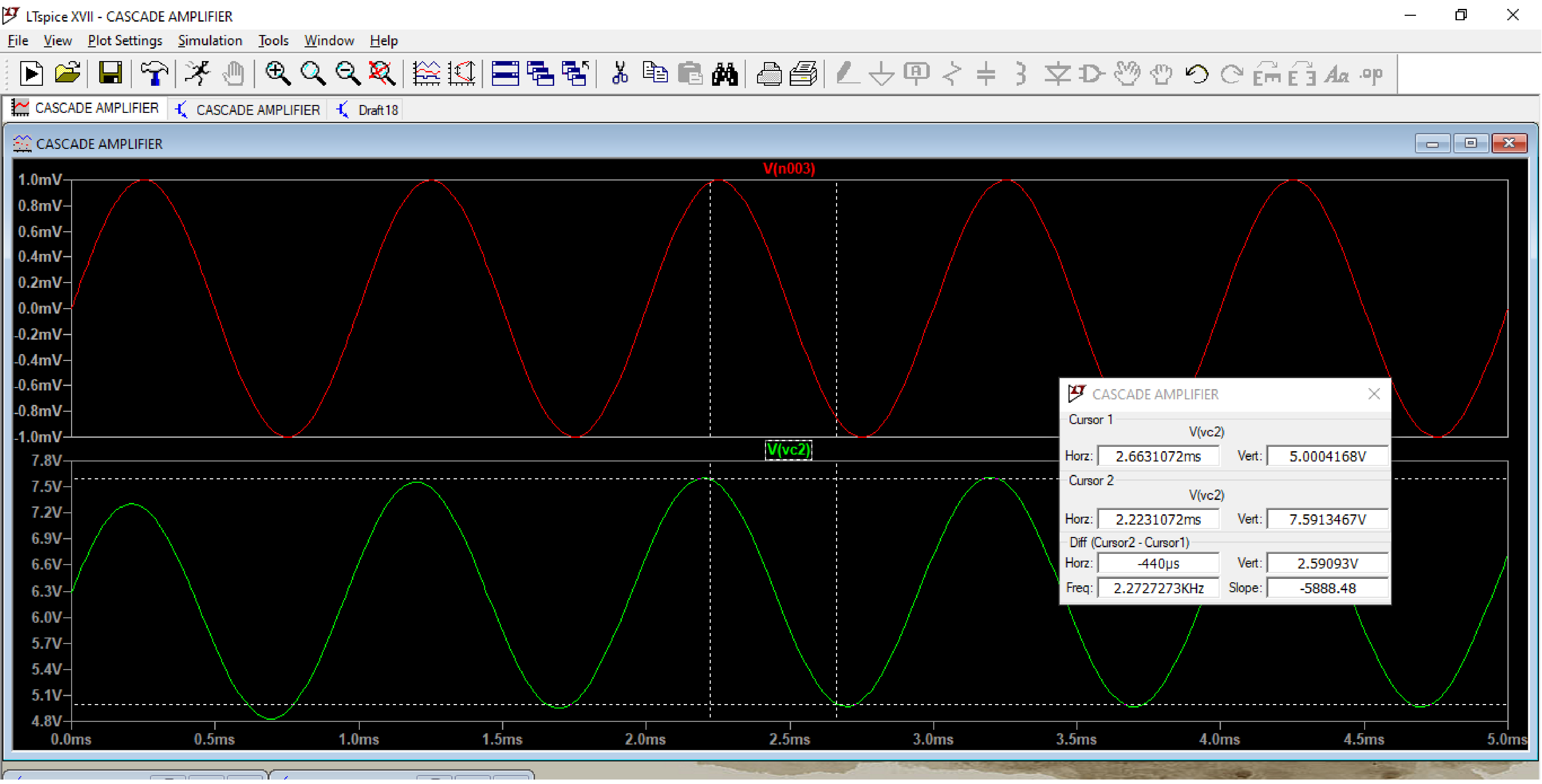
AC ANALYSIS:



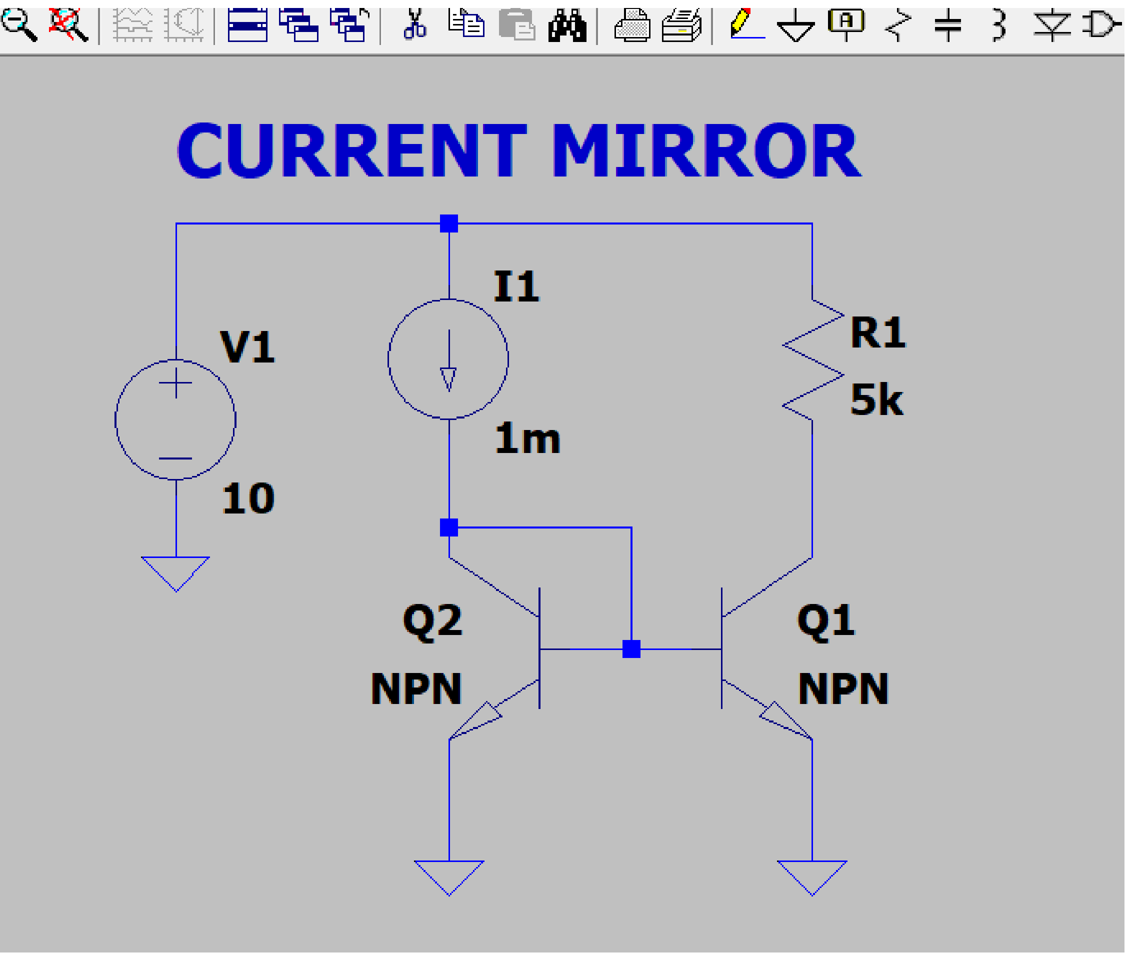




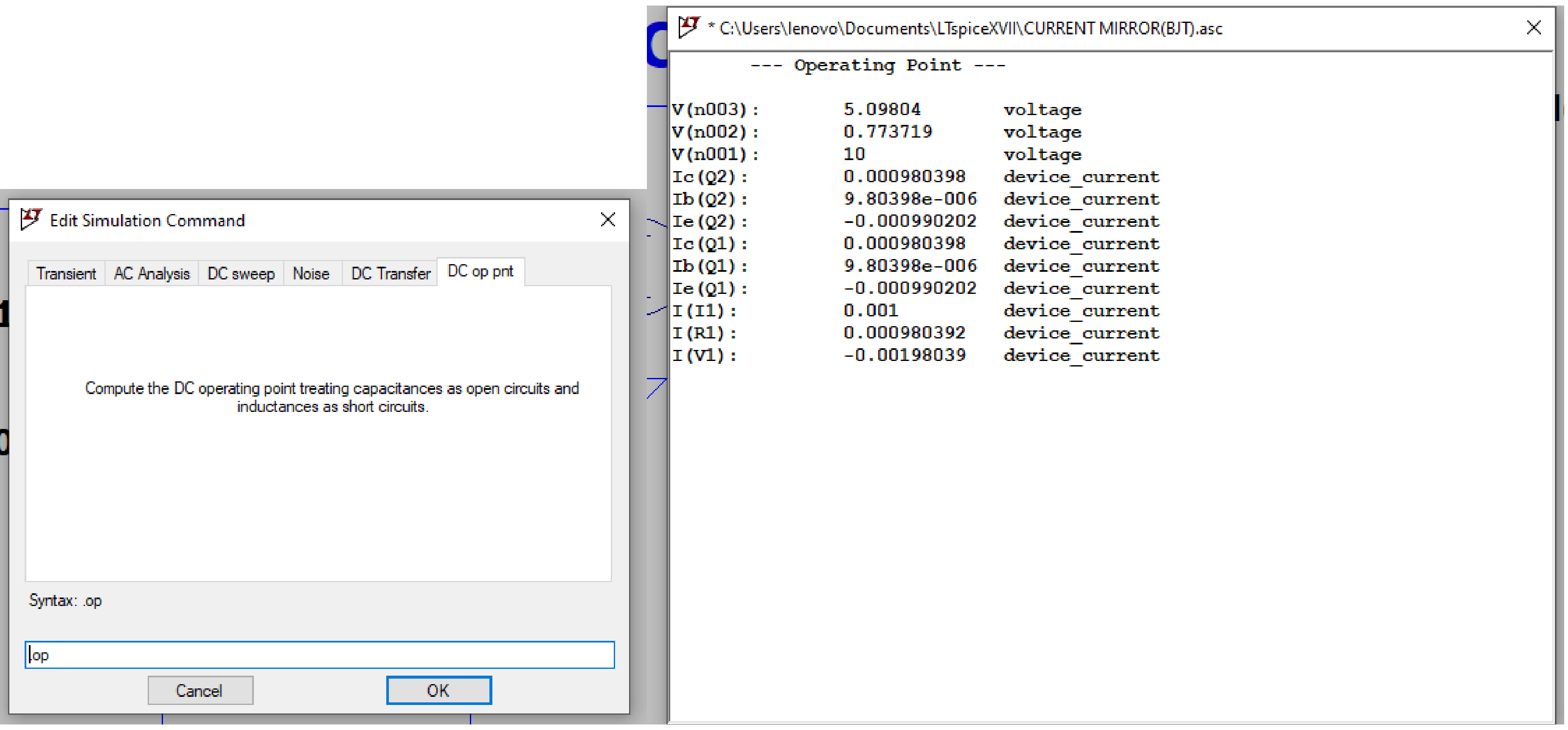
TRANSIENT ANALYSIS:



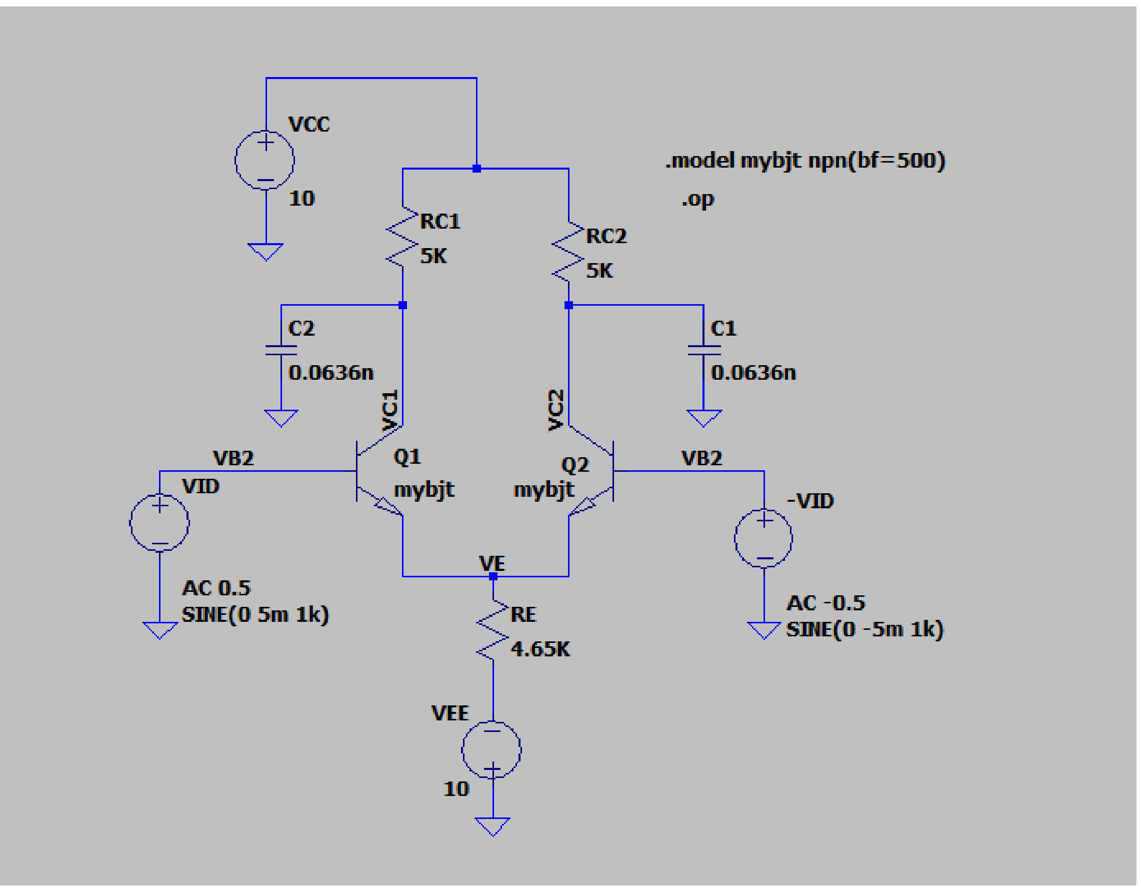
CURRENT MIRROR:



DC ANALYSIS:



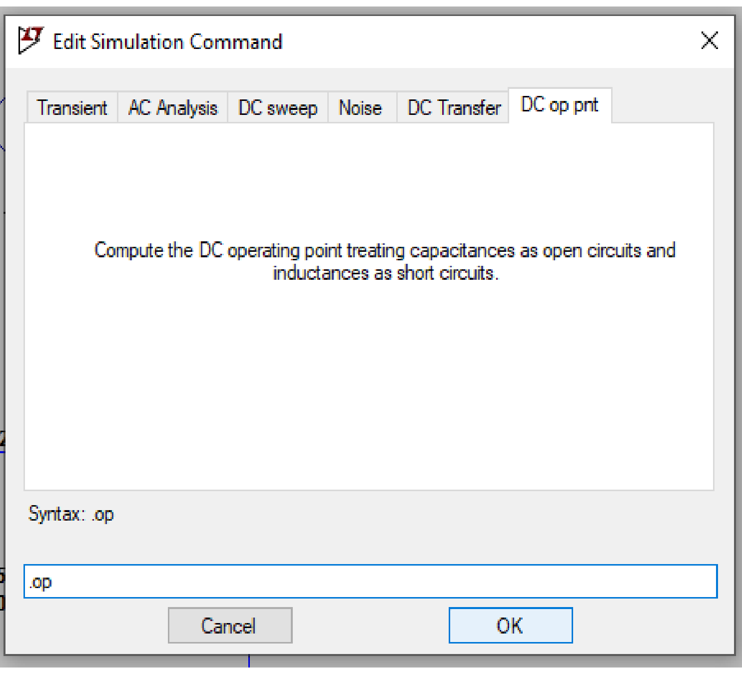
DIFFERENTIAL AMPLIFIER:

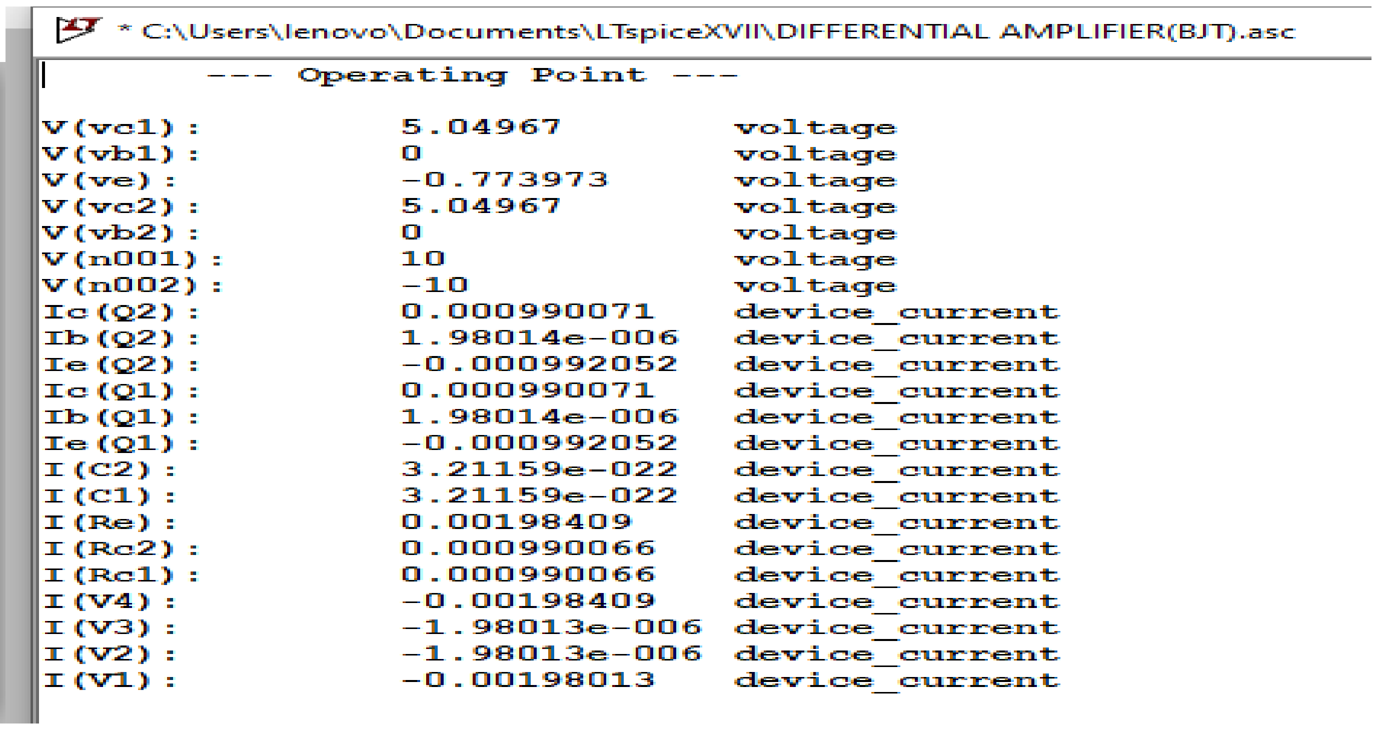


DESIGN SPECIFICATIONS:

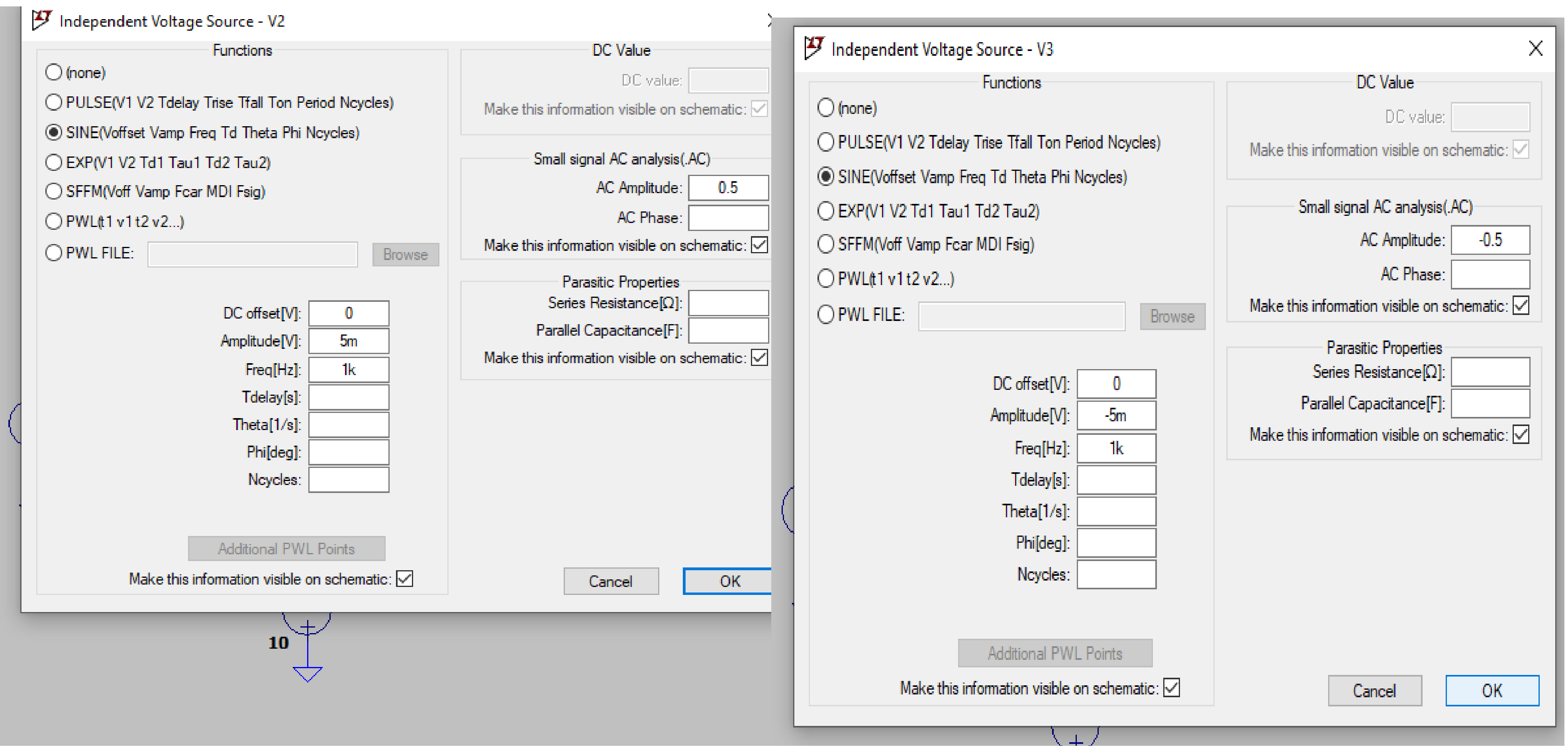
Differential voltage Gain=-200V/V.

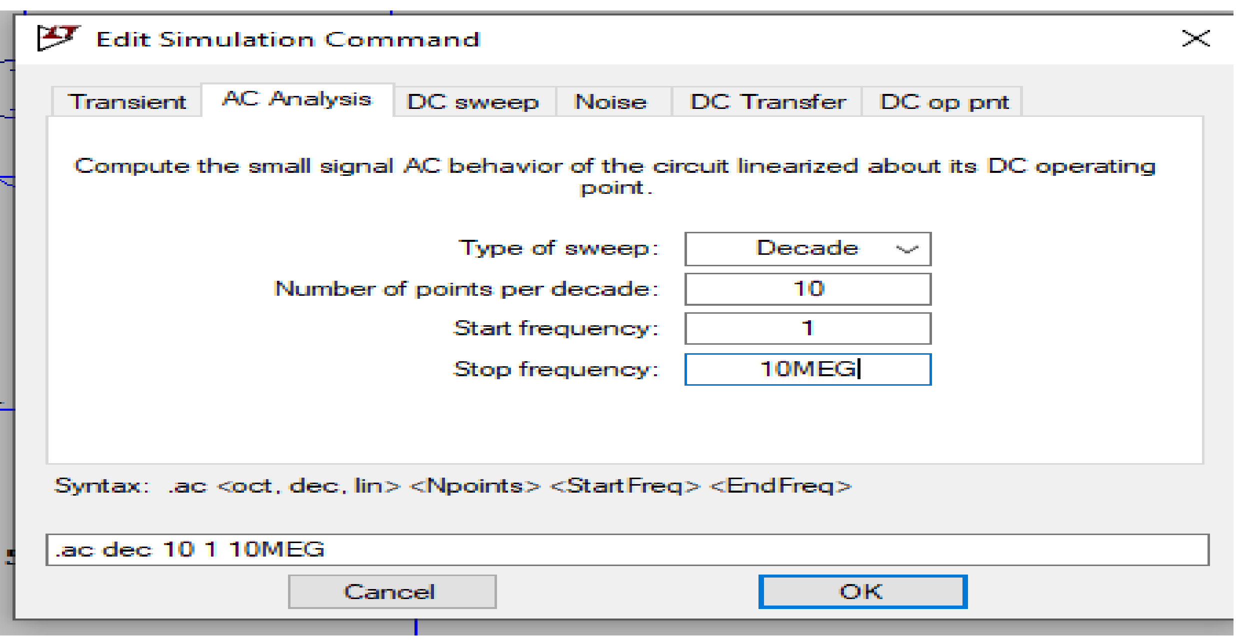
DC ANALYSIS:(ICQ=1mA ,VCEQ=5.7V)

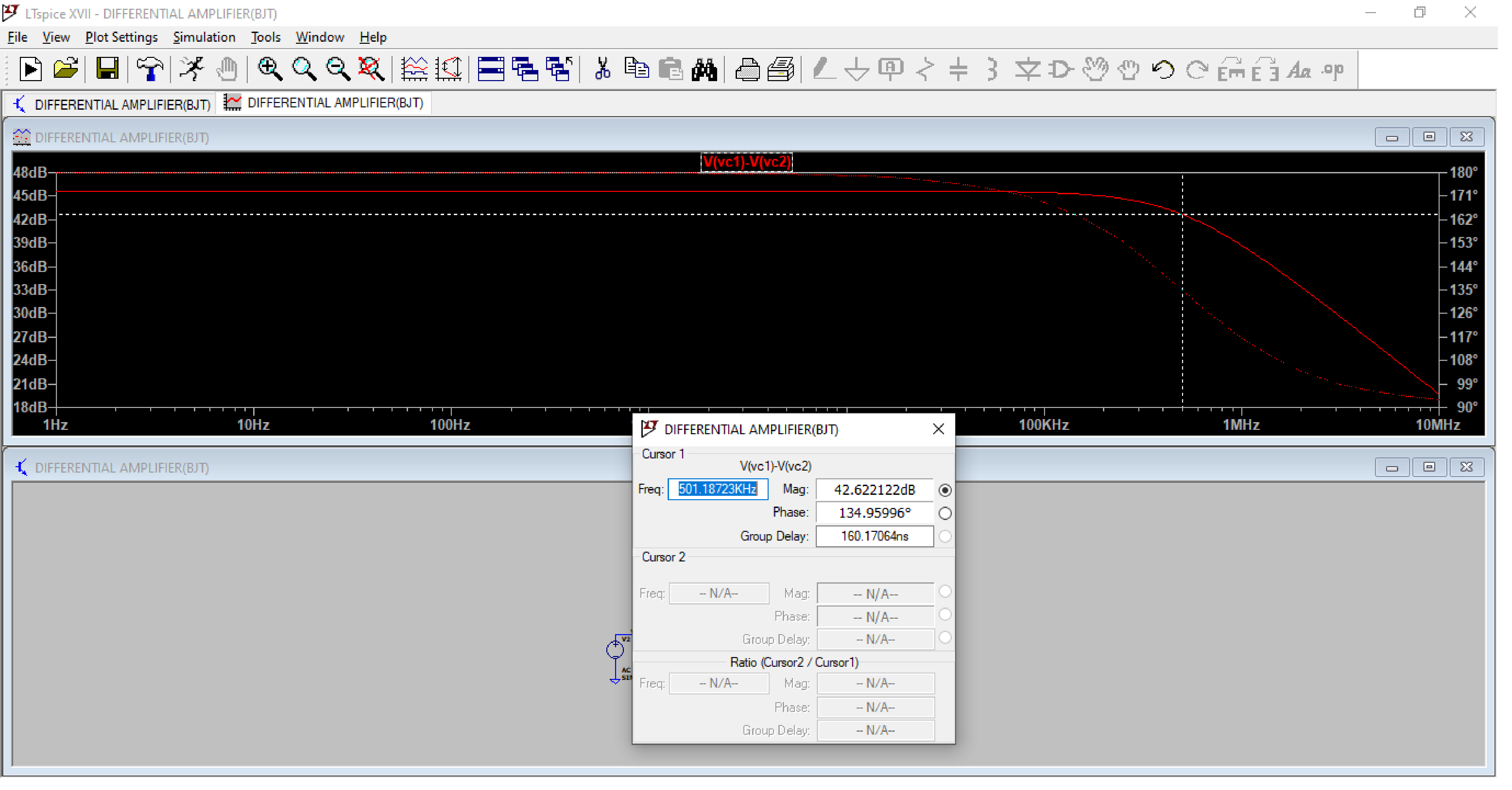

Edit Simulation Command
Transient
AC Analysis
DC sweep
Noise
DC Transfer
DC op pnt
Compute the DC operating point treating capacitances as open circuits and inductances as short circuits.
Syntax: .op
.op
Cancel
OK


* C:\Users\lenovo\Documents\LTspiceXVII\DIFFERENTIAL AMPLIFIER(BJT).asc
--- Operating Point ---
V(vc1): 5.04967 voltage
V(vb1): 0 voltage
V(ve): -0.773973 voltage
V(vc2): 5.04967 voltage
V(vb2): 0 voltage
V(n001): 10 voltage
V(n002): -10 voltage
Ic(Q2): 0.000990071 device_current
Ib(Q2): 1.98014e-006 device_current
Ie(Q2): -0.000992052 device_current
Ic(Q1): 0.000990071 device_current
Ib(Q1): 1.98014e-006 device_current
Ie(Q1): -0.000992052 device_current
I(C2): 3.21159e-022 device_current
I(C1): 3.21159e-022 device_current
I(Re): 0.00198409 device_current
I(Rc2): 0.000990066 device_current
I(Rc1): 0.000990066 device_current
I(V4): -0.00198409 device_current
I(V3): -1.98013e-006 device_current
I(V2): -1.98013e-006 device_current
I(V1): -0.00198013 device_current

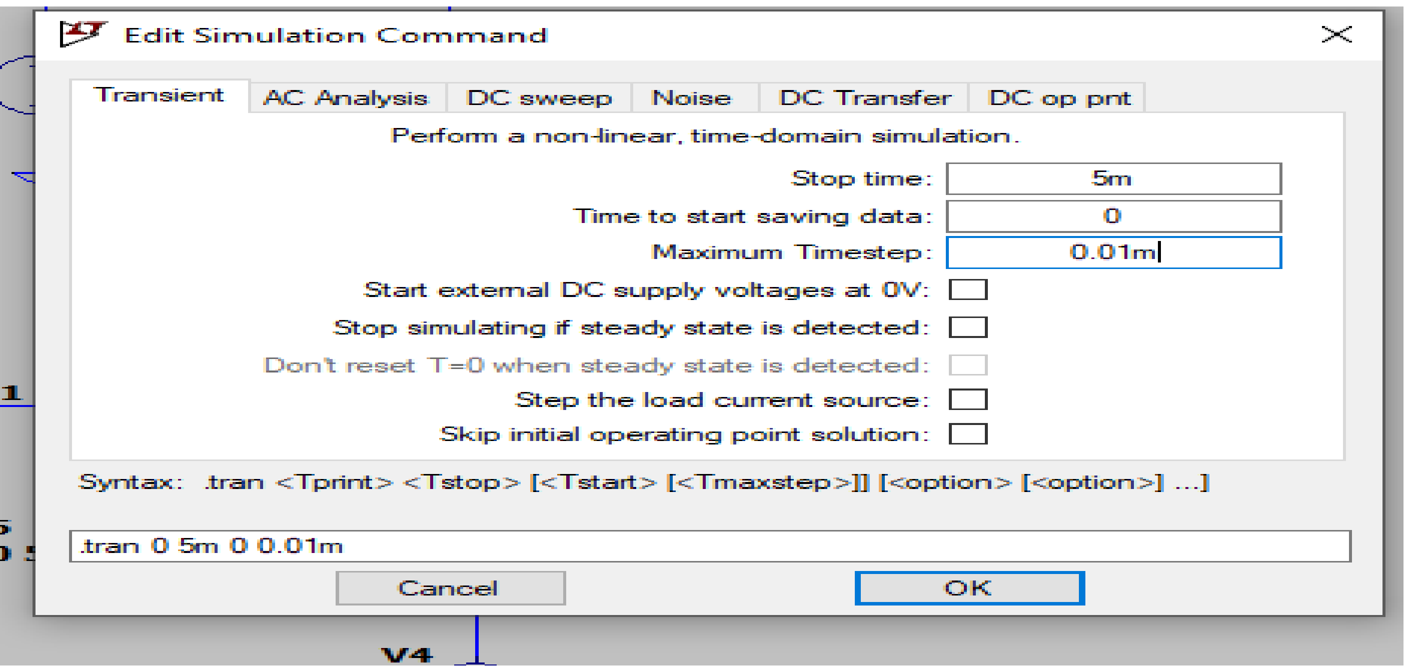
AC ANALYSIS:


Independent Voltage Source - V2
Functions
(none)
PULSE(V1 V2 Tdelay Trise Tfall Ton Period Ncycles)
SINE(Voffset Vamp Freq Td Theta Phi Ncycles)
EXP(V1 V2 Td1 Tau1 Td2 Tau2)
SFFM(Voff Vamp Fcar MDI Fsig)
PWL(t1 v1 t2 v2...)
PWL FILE:
Browse
DC offset[V]: 0
Amplitude[V]: 5m
Freq[Hz]: 1k
Tdelay[s]:
Theta[1/s]:
Phi[deg]:
Ncycles:
Additional PWL Points
Make this information visible on schematic:
DC Value
DC value:
Make this information visible on schematic:
Small signal AC analysis(.AC)
AC Amplitude: 0.5
AC Phase:
Make this information visible on schematic:
Parasitic Properties
Series Resistance[Ω]:
Parallel Capacitance[F]:
Make this information visible on schematic:
Cancel
OK
10
Independent Voltage Source - V3
Functions
(none)
PULSE(V1 V2 Tdelay Trise Tfall Ton Period Ncycles)
SINE(Voffset Vamp Freq Td Theta Phi Ncycles)
EXP(V1 V2 Td1 Tau1 Td2 Tau2)
SFFM(Voff Vamp Fcar MDI Fsig)
PWL(t1 v1 t2 v2...)
PWL FILE:
Browse
DC offset[V]: 0
Amplitude[V]: -5m
Freq[Hz]: 1k
Tdelay[s]:
Theta[1/s]:
Phi[deg]:
Ncycles:
Additional PWL Points
Make this information visible on schematic:
DC Value
DC value:
Make this information visible on schematic:
Small signal AC analysis(.AC)
AC Amplitude: -0.5
AC Phase:
Make this information visible on schematic:
Parasitic Properties
Series Resistance[Ω]:
Parallel Capacitance[F]:
Make this information visible on schematic:
Cancel
OK

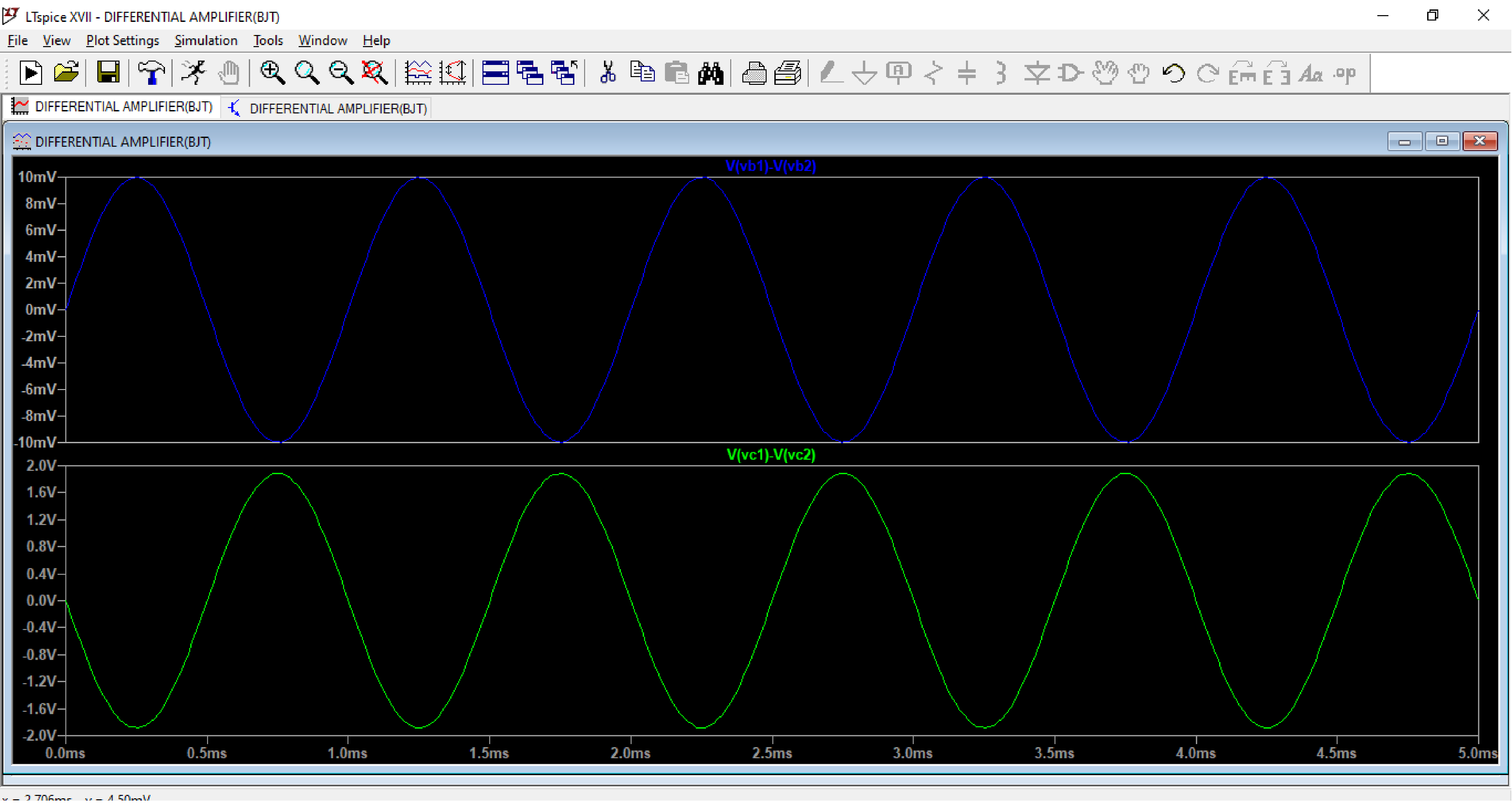

Edit Simulation Command
Transient
AC Analysis
DC sweep
Noise
DC Transfer
DC op pnt
Compute the small signal AC behavior of the circuit linearized about its DC operating point.
Type of sweep: Decade
Number of points per decade: 10
Start frequency: 1
Stop frequency: 10MEG
Syntax: .ac <oct, dec, lin> <Npoints> <StartFreq> <EndFreq>
.ac dec 10 1 10MEG
Cancel
OK



TRANSIENT ANALYSIS:

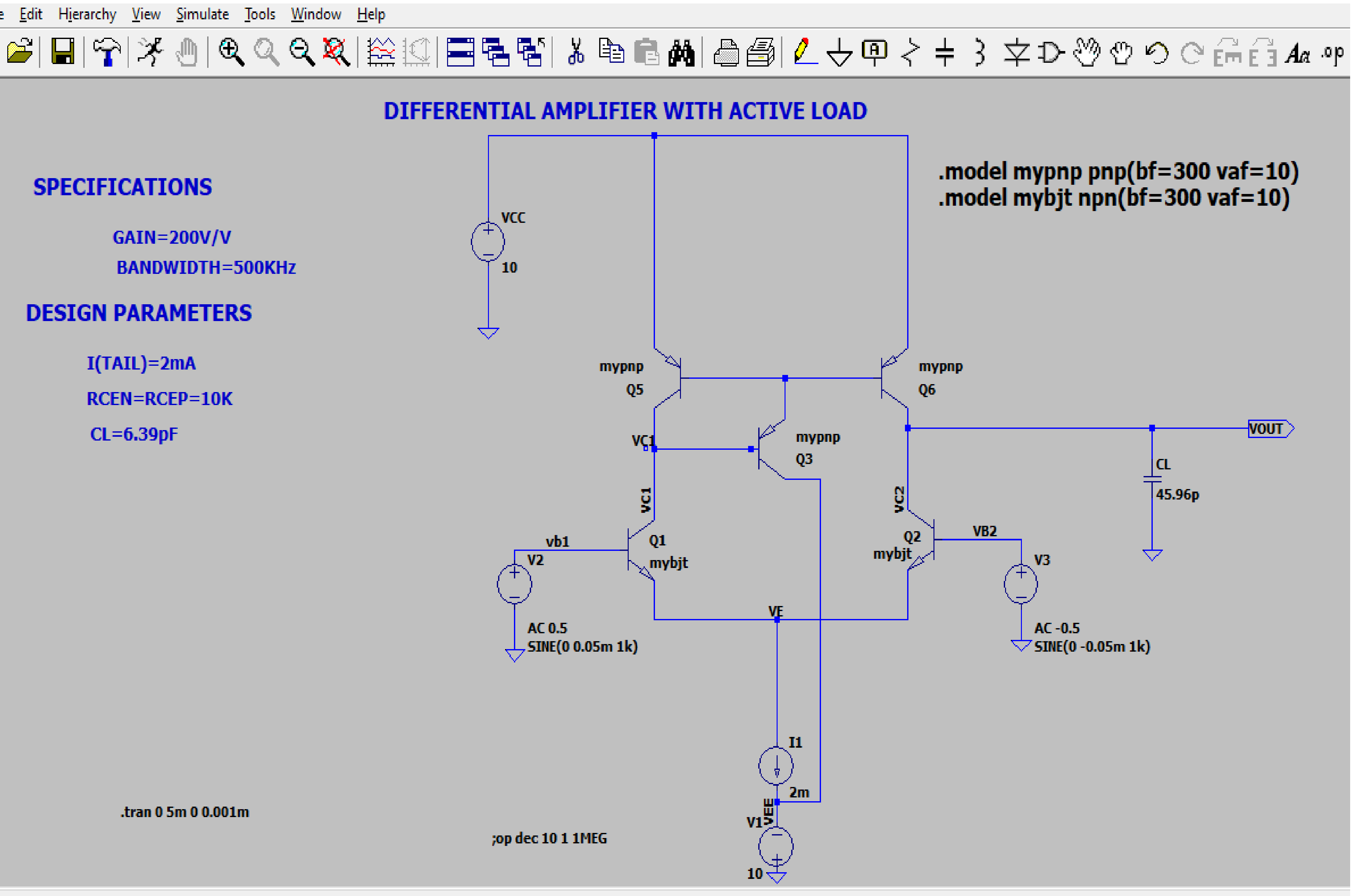


Edit Simulation Command
Transient
AC Analysis
DC sweep
Noise
DC Transfer
DC op pnt
Perform a non-linear, time-domain simulation.
Stop time: 5m
Time to start saving data: 0
Maximum Timestep: 0.01m
Start external DC supply voltages at 0V:
Stop simulating if steady state is detected:
Don't reset T=0 when steady state is detected:
Step the load current source:
Skip initial operating point solution:
Syntax: .tran <Tprint> <Tstop> [<Tstart> [<Tmaxstep>]] [<option> [<option>] ...]
.tran 0 5m 0 0.01m
Cancel
OK
V4

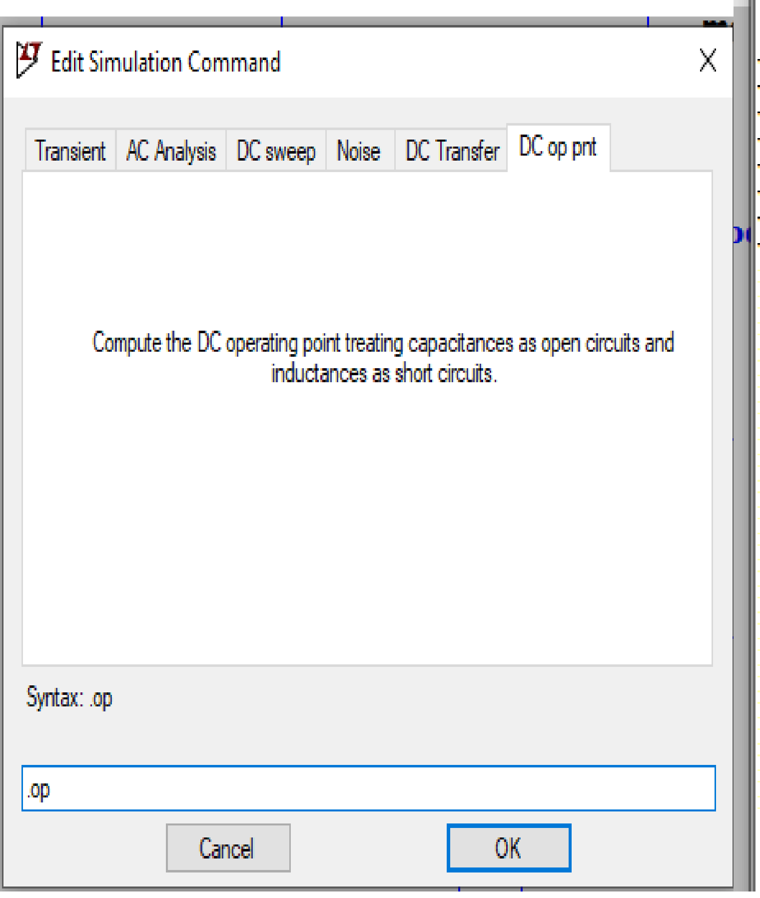


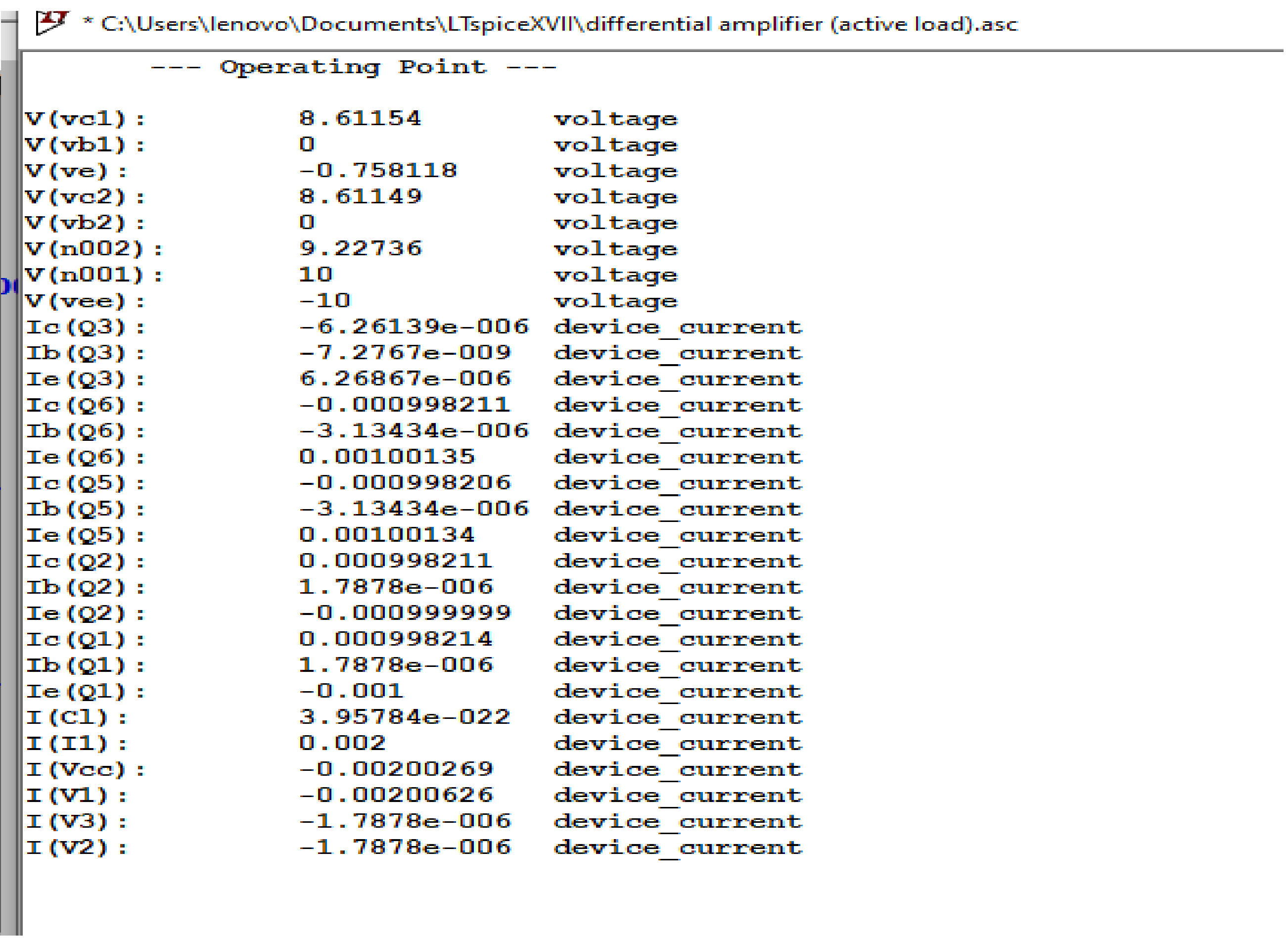
LTspice XVII - DIFFERENTIAL AMPLIFIER(BJT)
File View Plot Settings Simulation Tools Window Help
DIFFERENTIAL AMPLIFIER(BJT)
DIFFERENTIAL AMPLIFIER(BJT)
DIFFERENTIAL AMPLIFIER(BJT)
V(vb1)-V(vb2)
10mV
8mV
6mV
4mV
2mV
0mV
-2mV
-4mV
-6mV
-8mV
-10mV
V(vc1)-V(vc2)
2.0V
1.6V
1.2V
0.8V
0.4V
0.0V
-0.4V
-0.8V
-1.2V
-1.6V
-2.0V
0.0ms
0.5ms
1.0ms
1.5ms
2.0ms
2.5ms
3.0ms
3.5ms
4.0ms
4.5ms
5.0ms

DIFFERENTIAL AMPLIFIER WITH ACTIVE LOAD:



DC ANALYSIS:



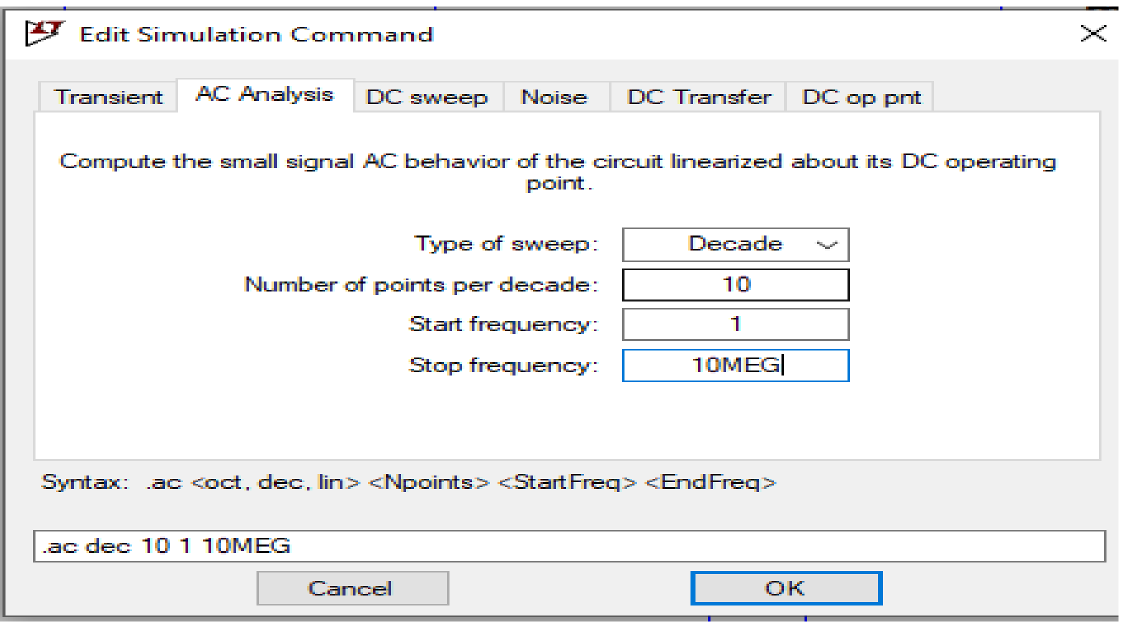


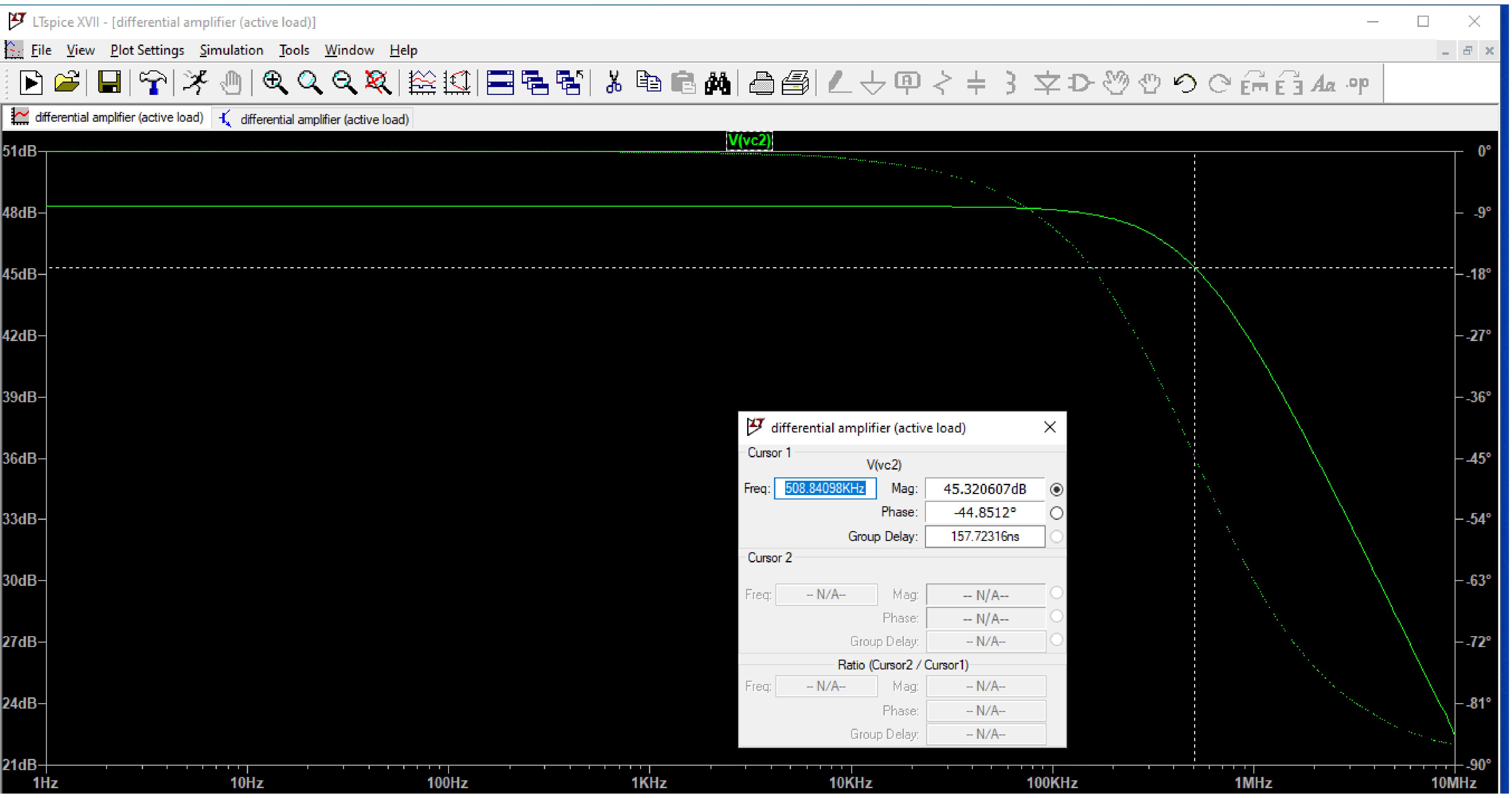
* C:\Users\lenovo\Documents\LTspiceXVII\differential amplifier (active load).asc

--- Operating Point ---

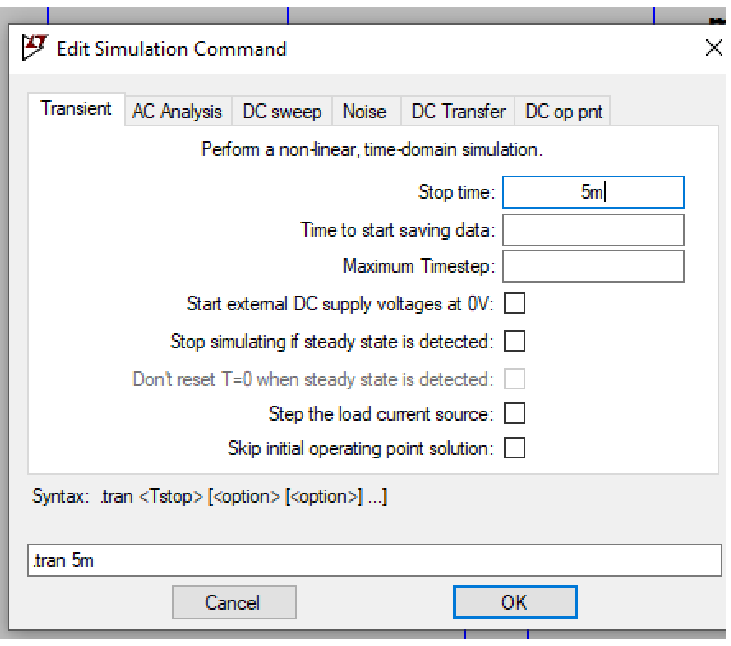
V(vc1):	8.61154	voltage
V(vb1):	0	voltage
V(ve):	-0.758118	voltage
V(vc2):	8.61149	voltage
V(vb2):	0	voltage
V(n002):	9.22736	voltage
V(n001):	10	voltage
V(vee):	-10	voltage
Ic(Q3):	-6.26139e-006	device_current
Ib(Q3):	-7.2767e-009	device_current
Ie(Q3):	6.26867e-006	device_current
Ic(Q6):	-0.000998211	device_current
Ib(Q6):	-3.13434e-006	device_current
Ie(Q6):	0.00100135	device_current
Ic(Q5):	-0.000998206	device_current
Ib(Q5):	-3.13434e-006	device_current
Ie(Q5):	0.00100134	device_current
Ic(Q2):	0.000998211	device_current
Ib(Q2):	1.7878e-006	device_current
Ie(Q2):	-0.000999999	device_current
Ic(Q1):	0.000998214	device_current
Ib(Q1):	1.7878e-006	device_current
Ie(Q1):	-0.001	device_current
I(Cl):	3.95784e-022	device_current
I(I1):	0.002	device_current
I(Vcc):	-0.00200269	device_current
I(V1):	-0.00200626	device_current
I(V3):	-1.7878e-006	device_current
I(V2):	-1.7878e-006	device_current

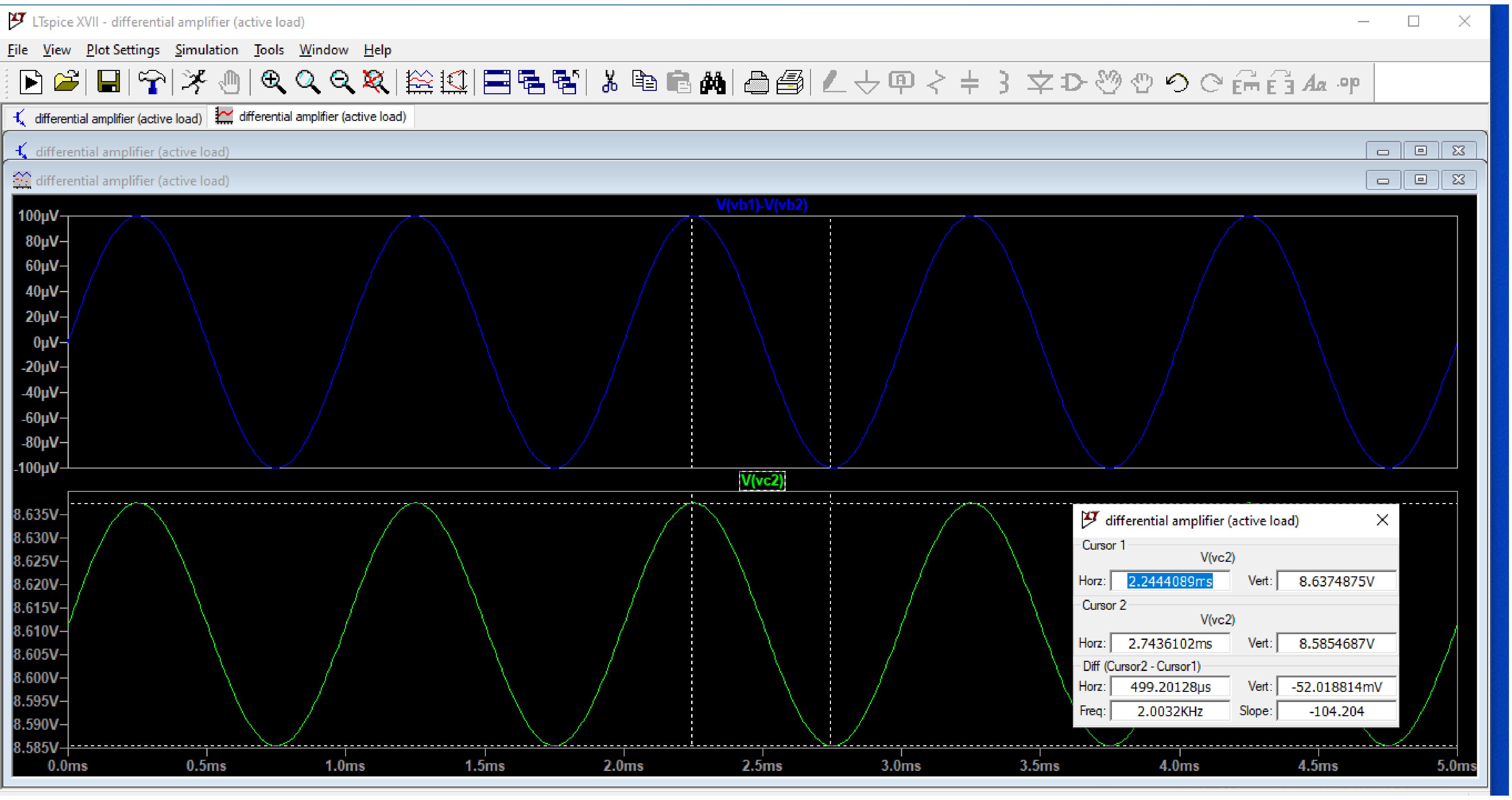
AC ANALYIS:





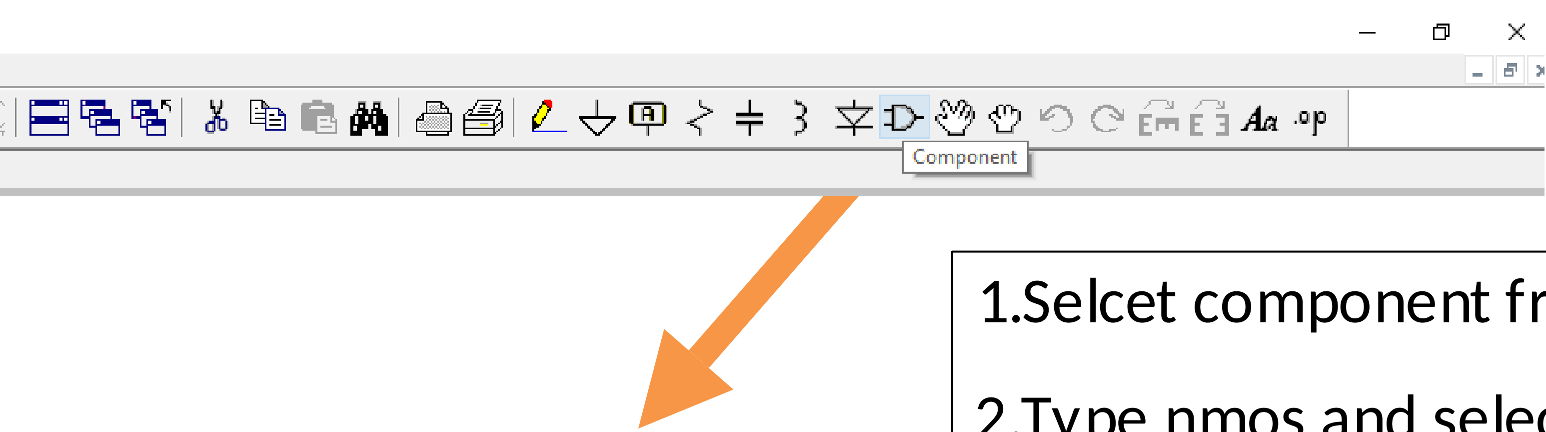
TRANSIENT ANALYSIS:





MOSFET AMPLIFIERS

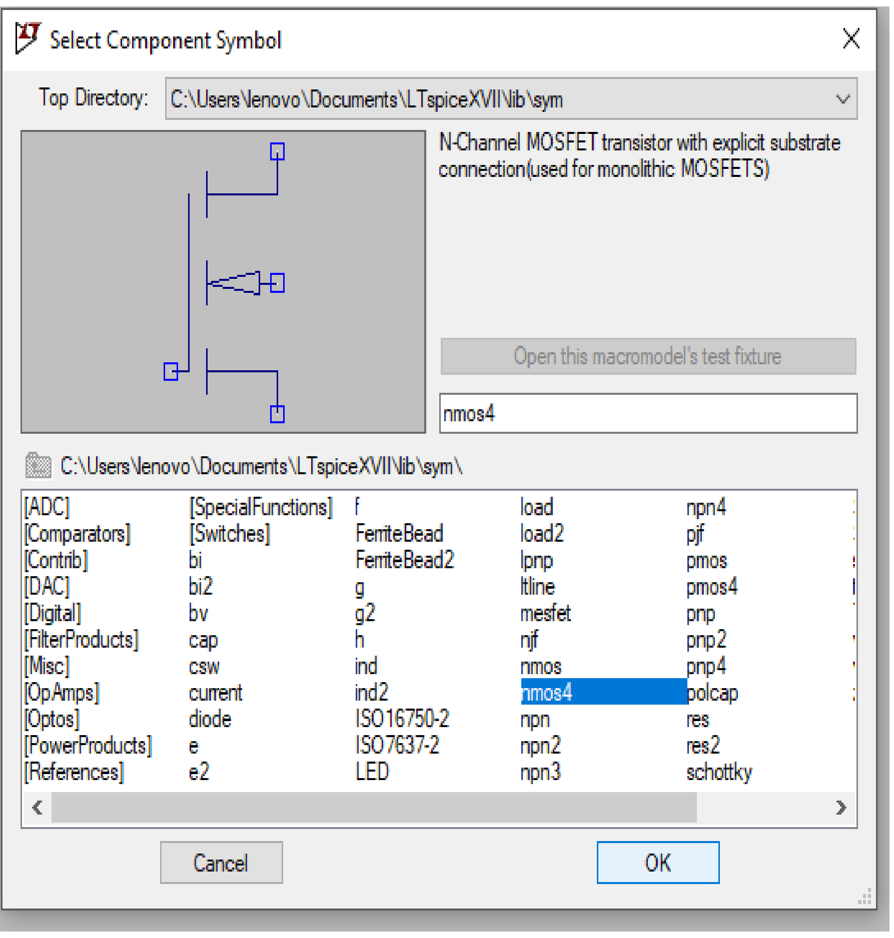
CREATING A MODEL:

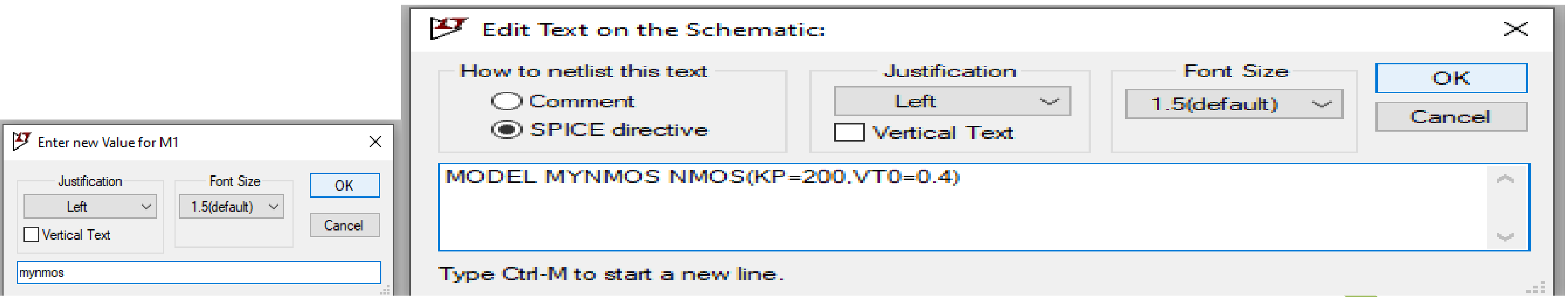


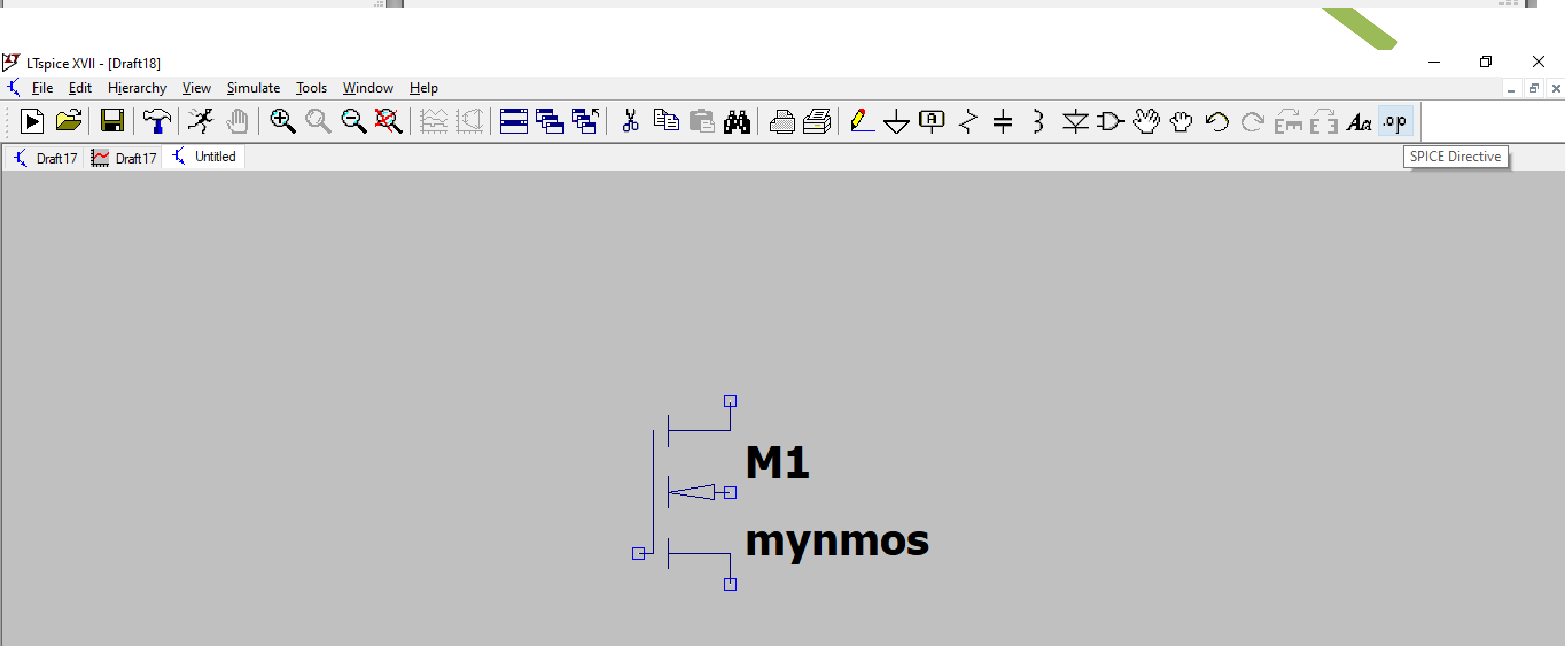
1.Selcet component from the taskbar.

2.Type nmos and select "**nmos4" type MOSFET.**

3.Right click on the MOSFET and change







5.Here KP=UnCox(Transconductance parameter) And VT0=Threshold voltage of MOSFET.

6.We can also change the channel length modulation parameter lambda

COMMON SOURCE AMPLIFIER:

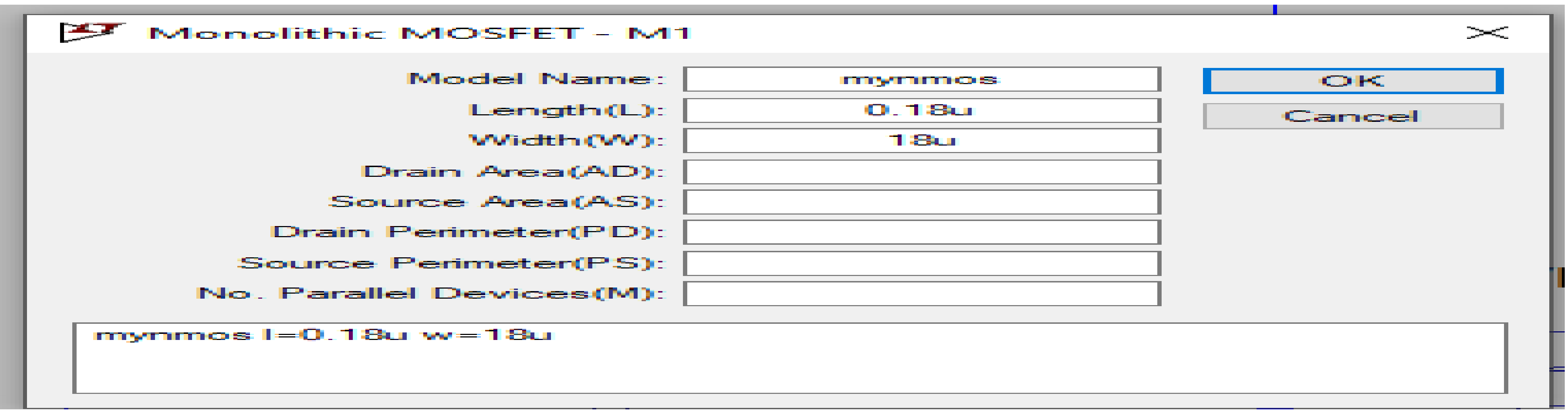
Design Specifications:

Gain=-20v/v

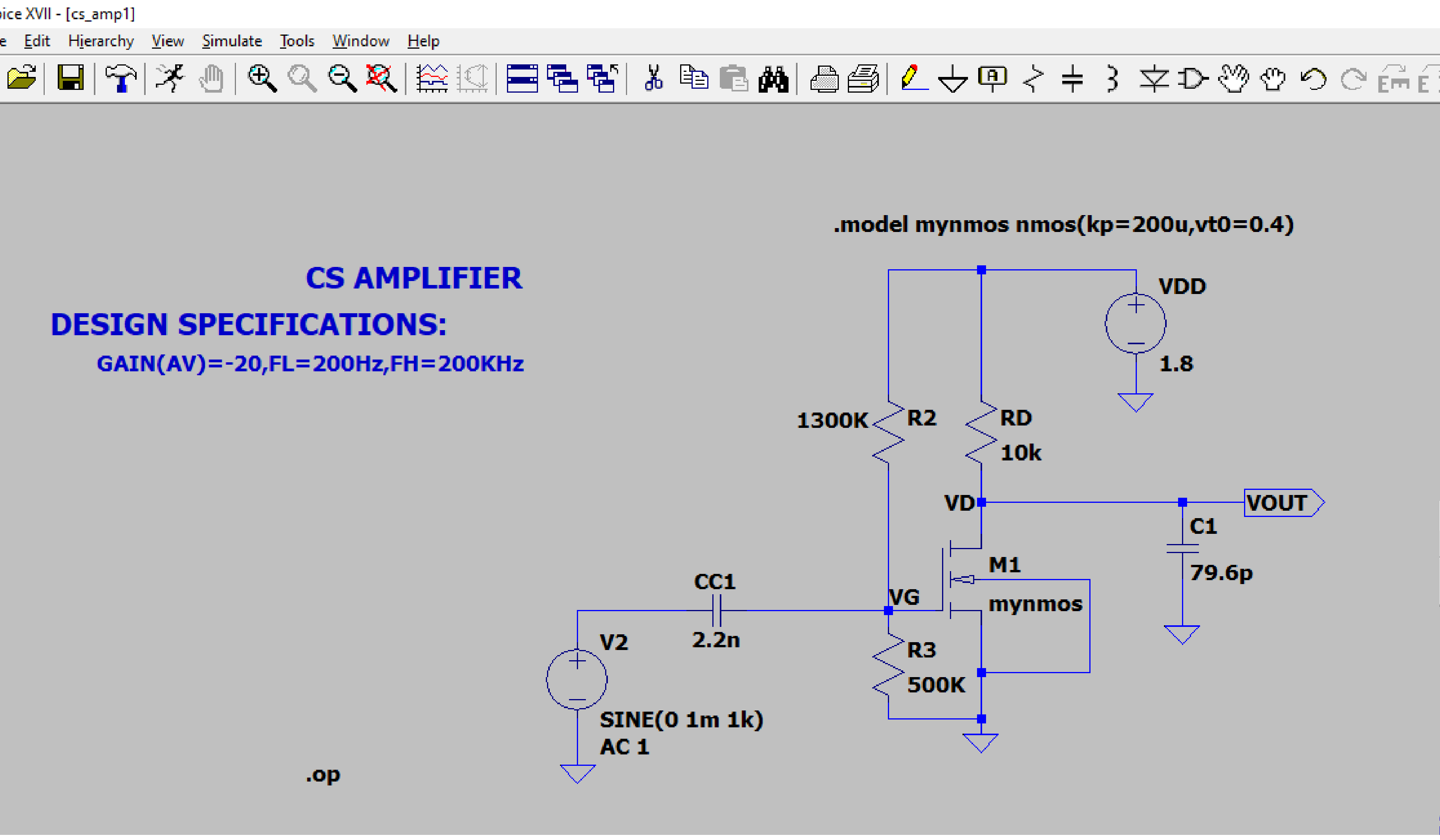
Lower cut-off frequency=200Hz

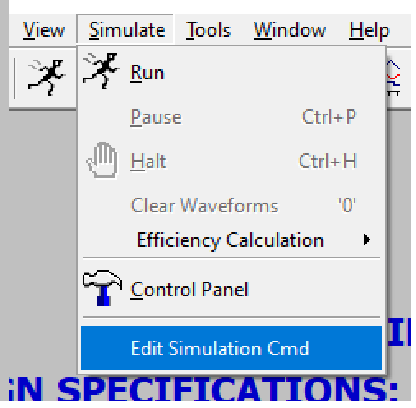
Higher cut-off frequency=200KHz

1.Right click on the MOSFET model and change the W/L value as shown in figure.



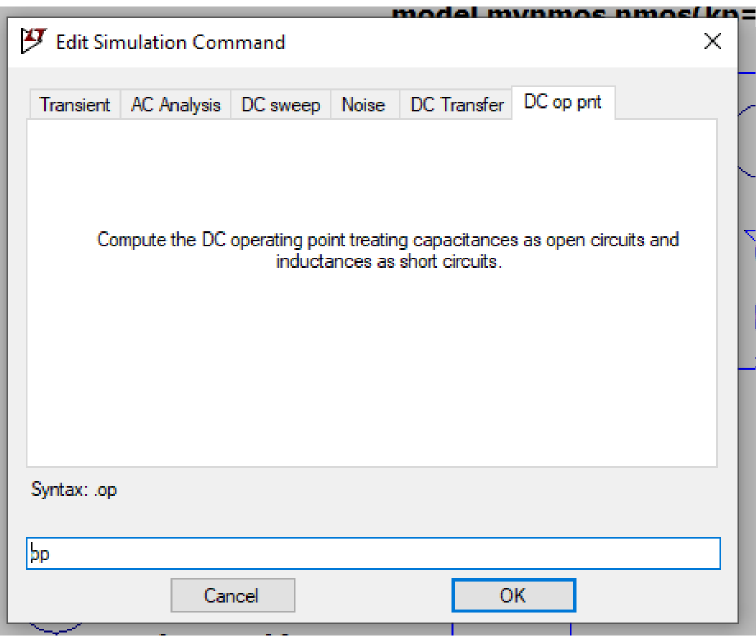
W/L=100

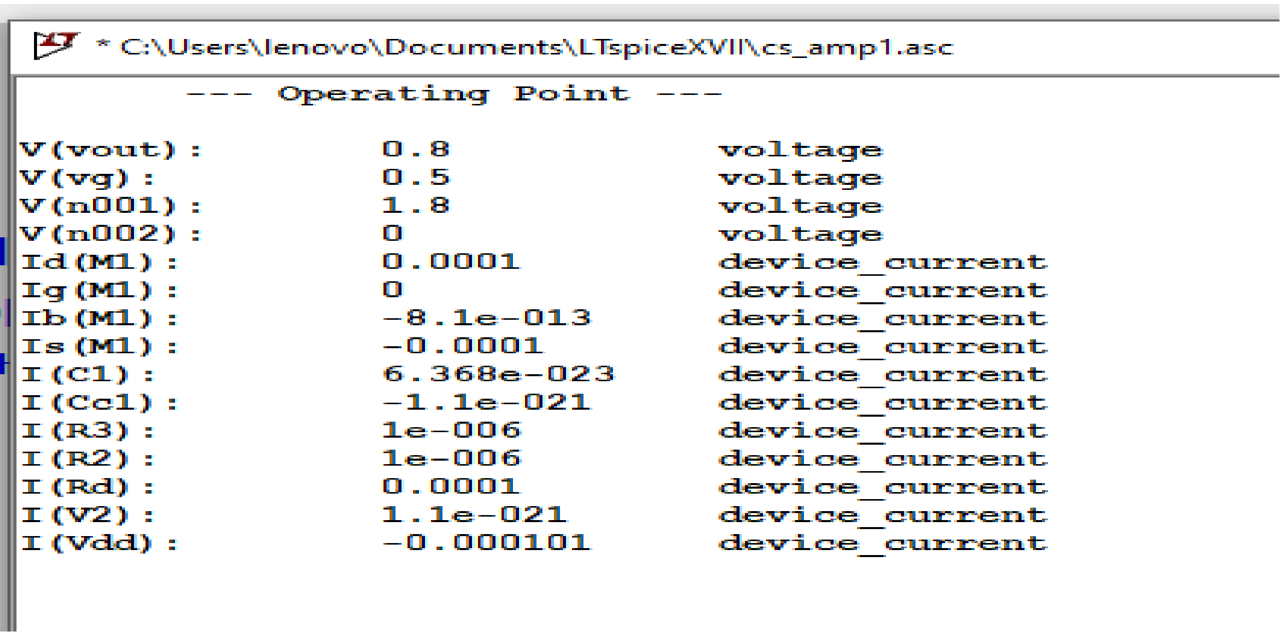




DC ANALYSIS:

Id=0.1mA ,VDS=0.8V



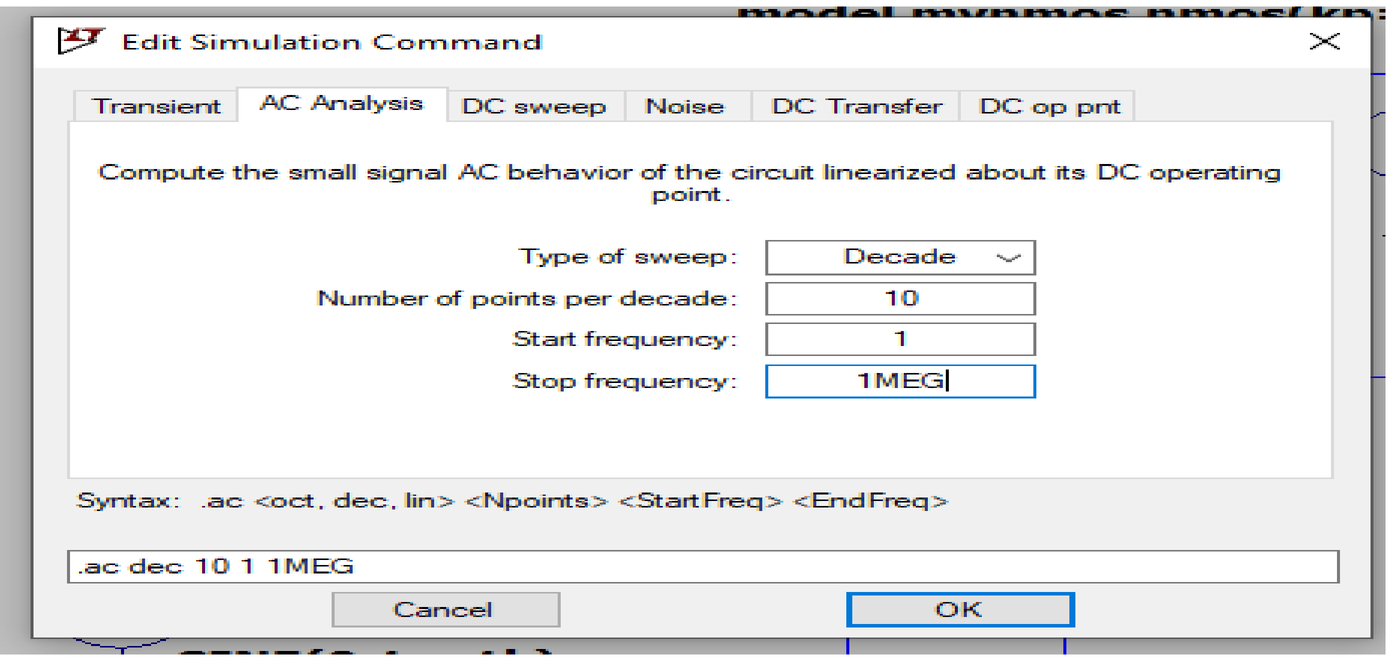


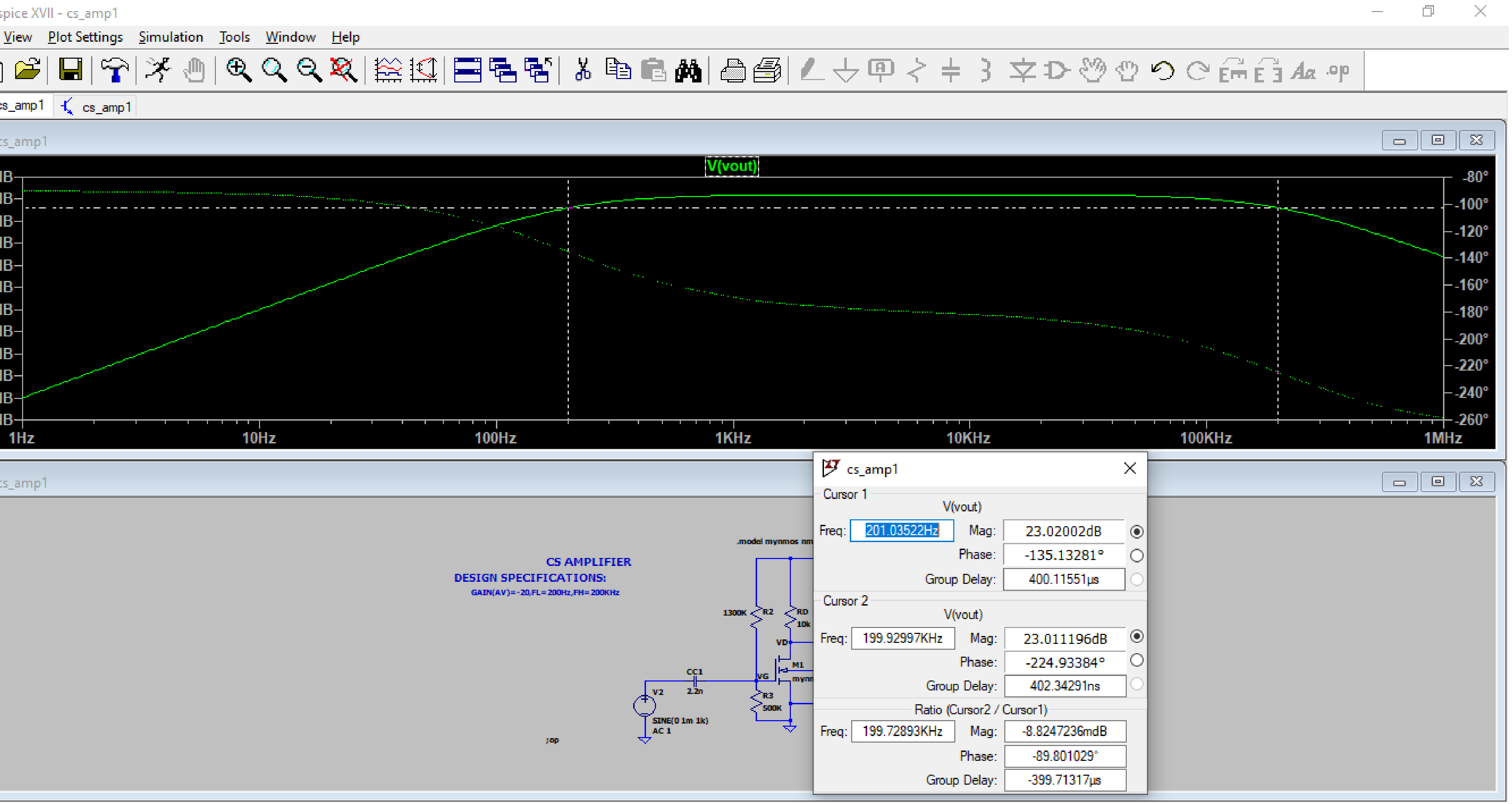
* C:\Users\lenovo\Documents\LTspiceXVII\cs_amp1.asc

--- Operating Point ---

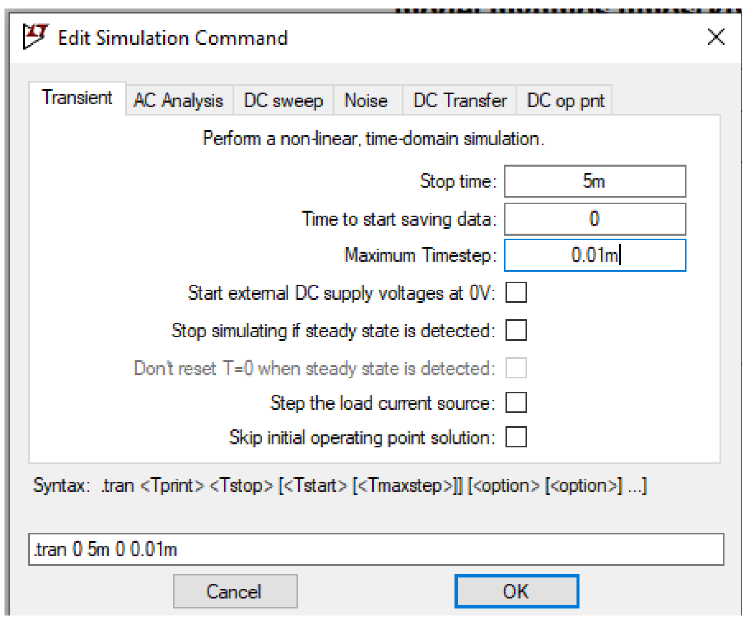
V(vout):	0.8	voltage
V(vg):	0.5	voltage
V(n001):	1.8	voltage
V(n002):	0	voltage
Id(M1):	0.0001	device_current
Ig(M1):	0	device_current
Ib(M1):	-8.1e-013	device_current
Is(M1):	-0.0001	device_current
I(C1):	6.368e-023	device_current
I(Cc1):	-1.1e-021	device_current
I(R3):	1e-006	device_current
I(R2):	1e-006	device_current
I(Rd):	0.0001	device_current
I(V2):	1.1e-021	device_current
I(Vdd):	-0.000101	device_current

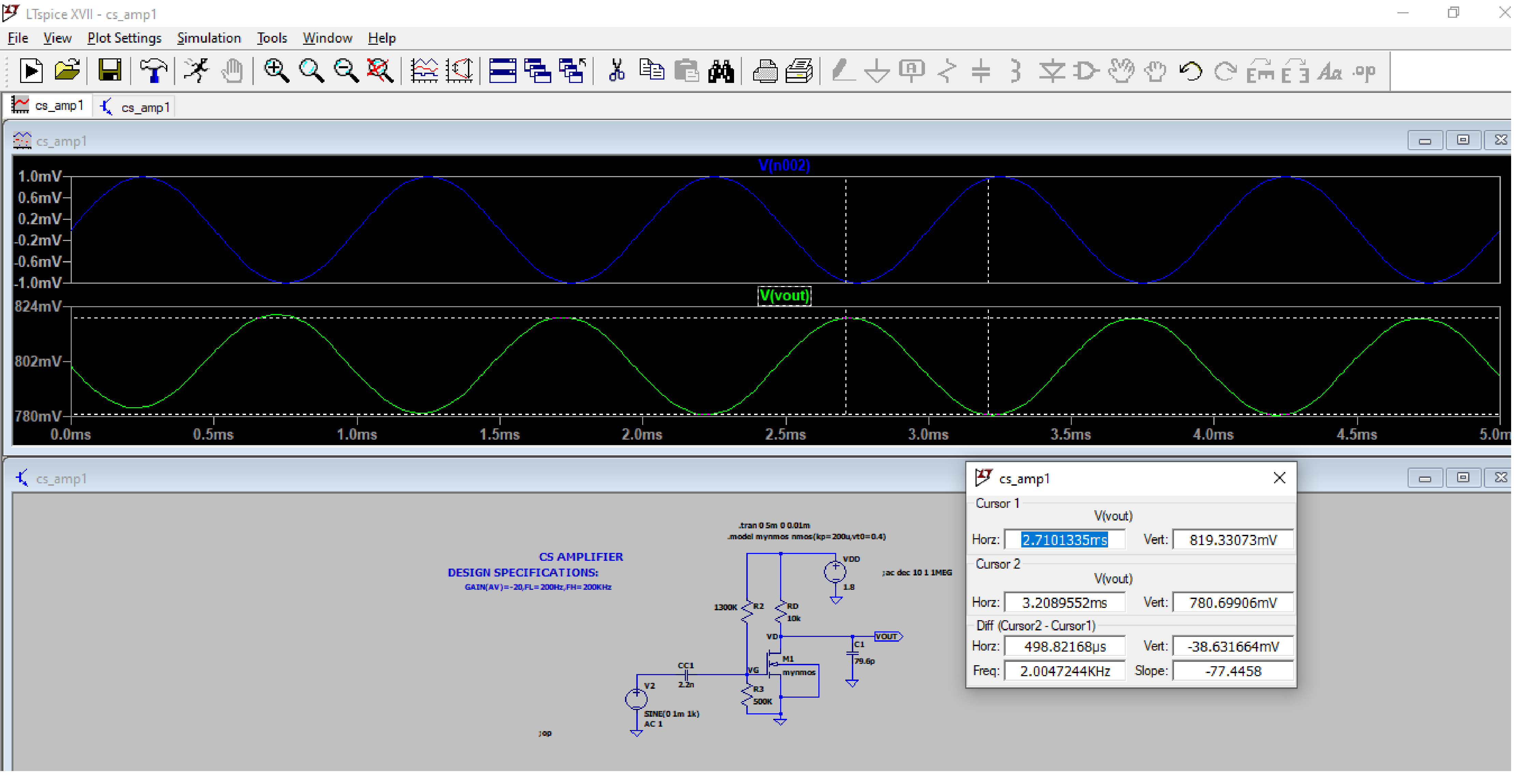
AC ANALYSIS:





TRANSIENT ANALYSIS:





COMMON GATE AMPLIFIER:

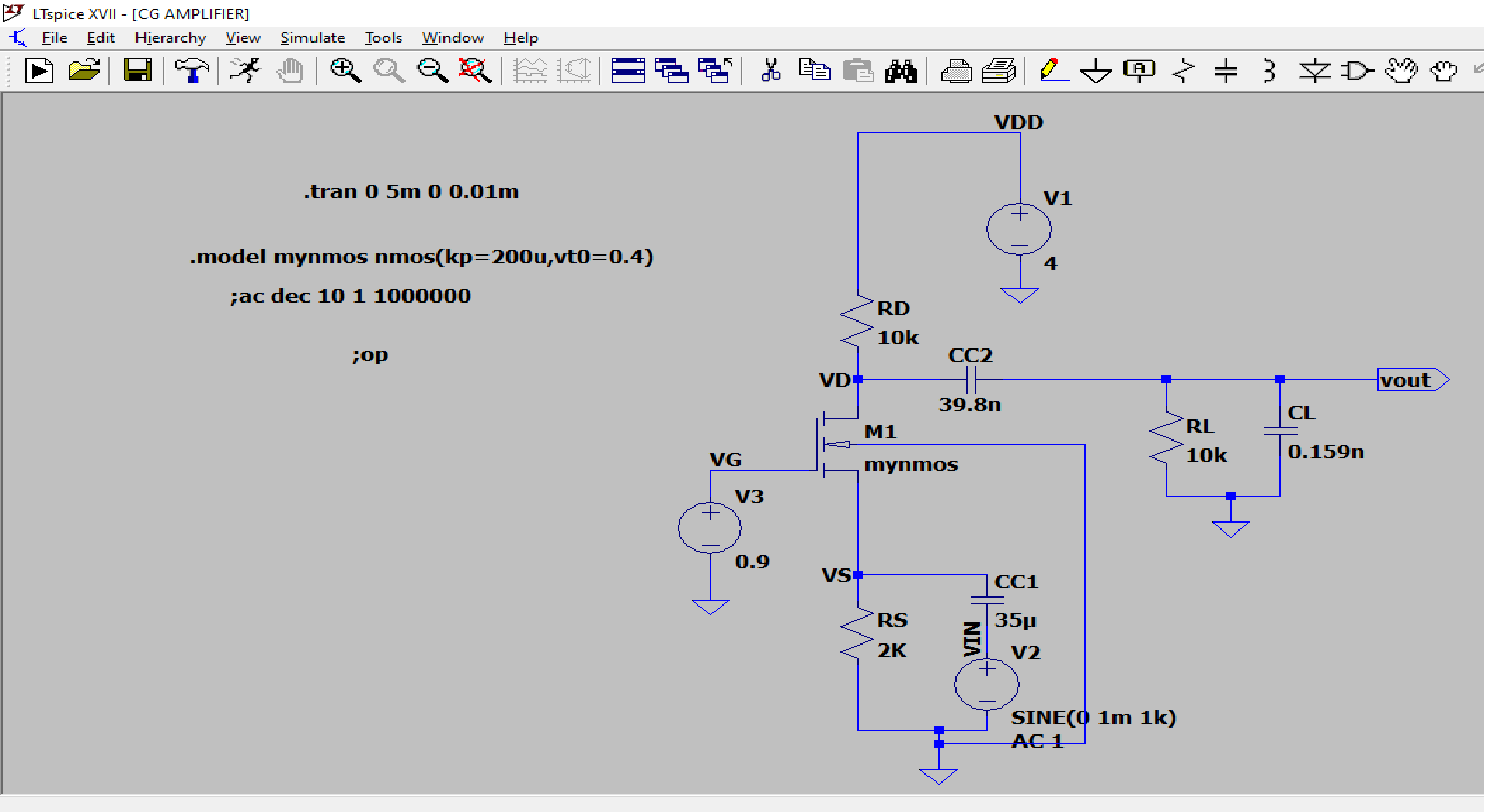
Design Specifications:

Gain=20v/v

Lower cut-off frequency=200Hz

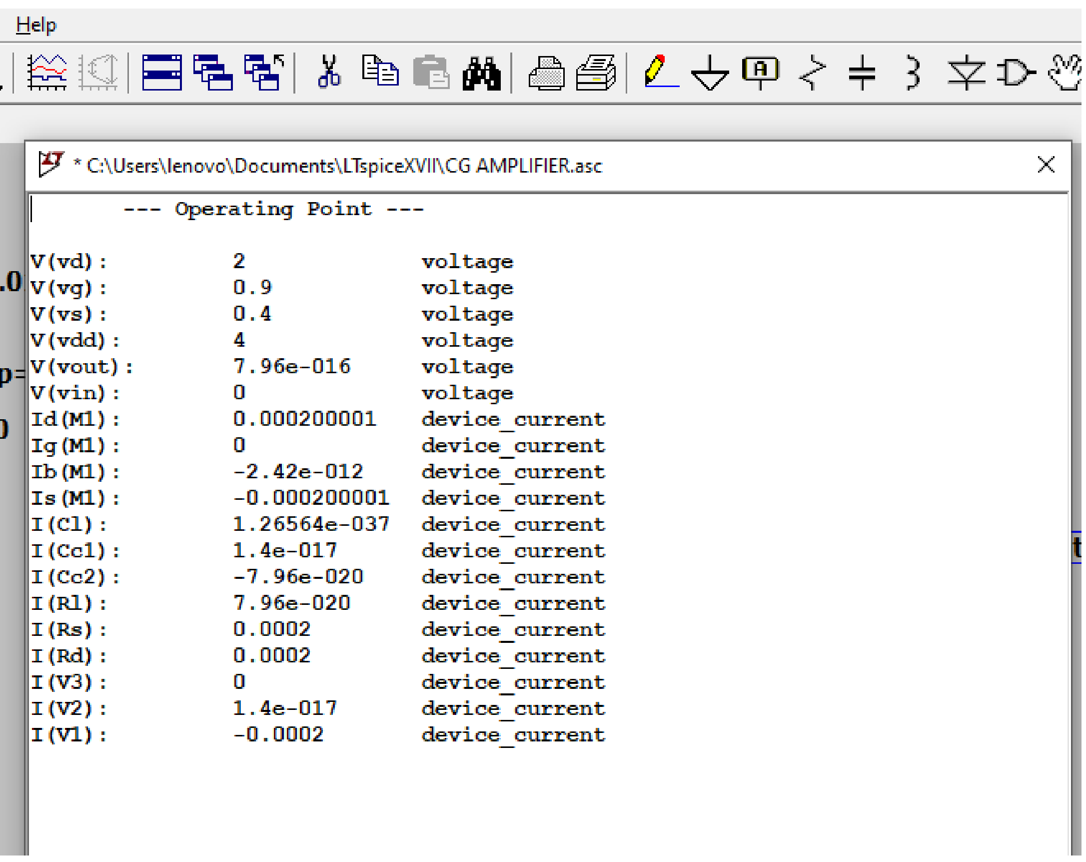
Higher cut-off frequency=200KHz

W/L=200



DC ANALYSIS:

IDQ=0.2mA,VDSQ=1.6V

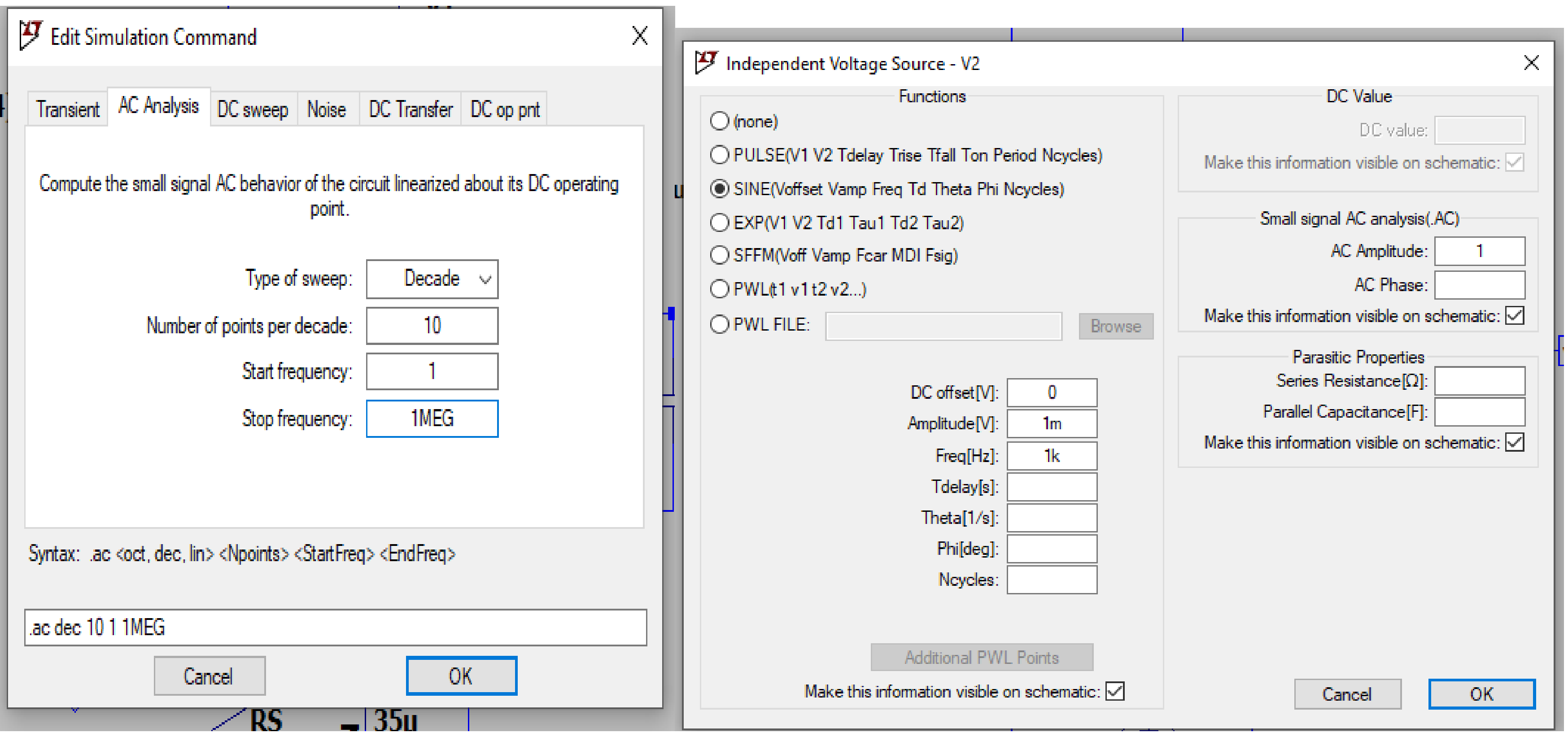


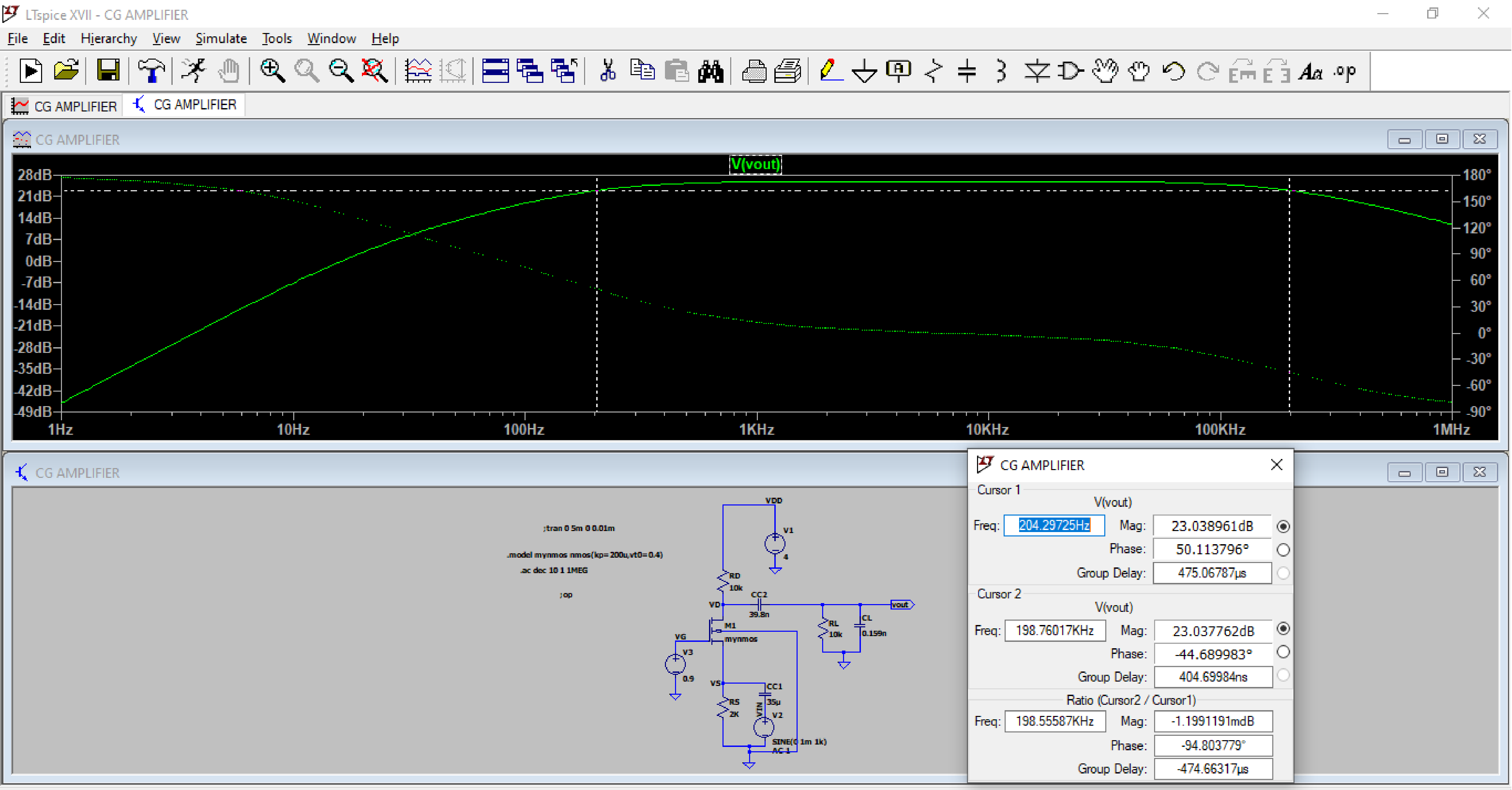
--- Operating Point ---

V(vd):	2	voltage
V(vg):	0.9	voltage
V(vs):	0.4	voltage
V(vdd):	4	voltage
V(vout):	7.96e-016	voltage
V(vin):	0	voltage
Id(M1):	0.000200001	device_current
Ig(M1):	0	device_current
Ib(M1):	-2.42e-012	device_current
Is(M1):	-0.000200001	device_current
I(Cl):	1.26564e-037	device_current
I(Cc1):	1.4e-017	device_current
I(Cc2):	-7.96e-020	device_current
I(Rl):	7.96e-020	device_current
I(Rs):	0.0002	device_current
I(Rd):	0.0002	device_current
I(V3):	0	device_current
I(V2):	1.4e-017	device_current
I(V1):	-0.0002	device_current

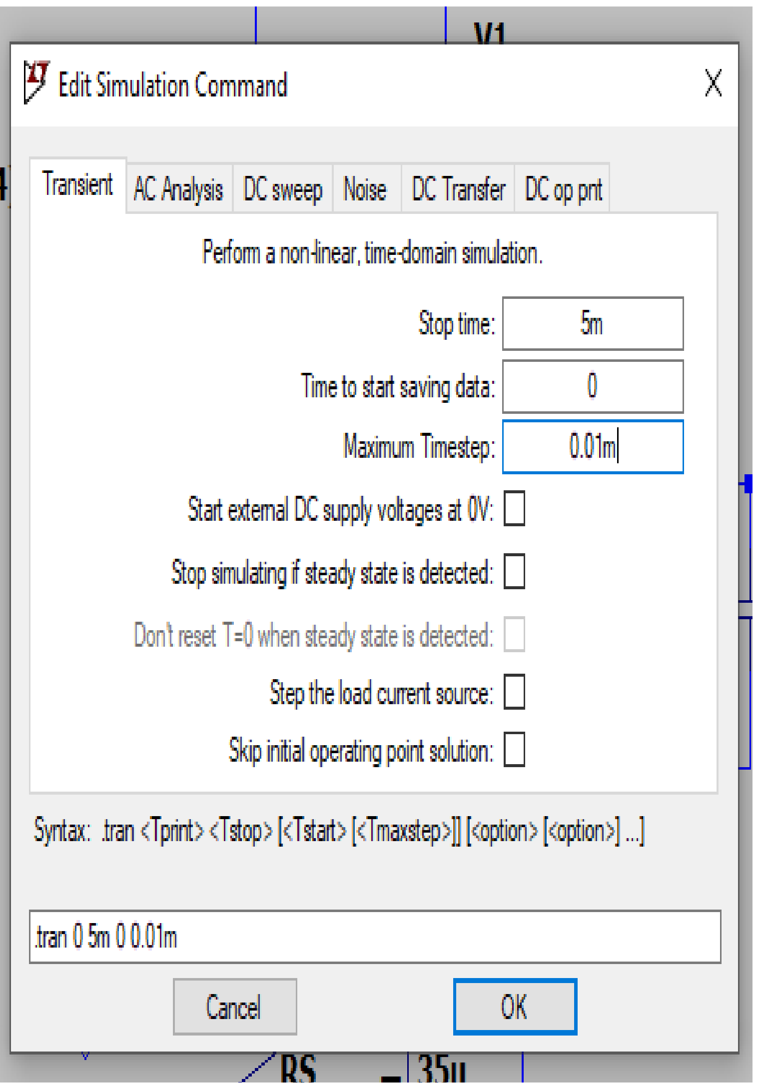
AC ANALYSIS:

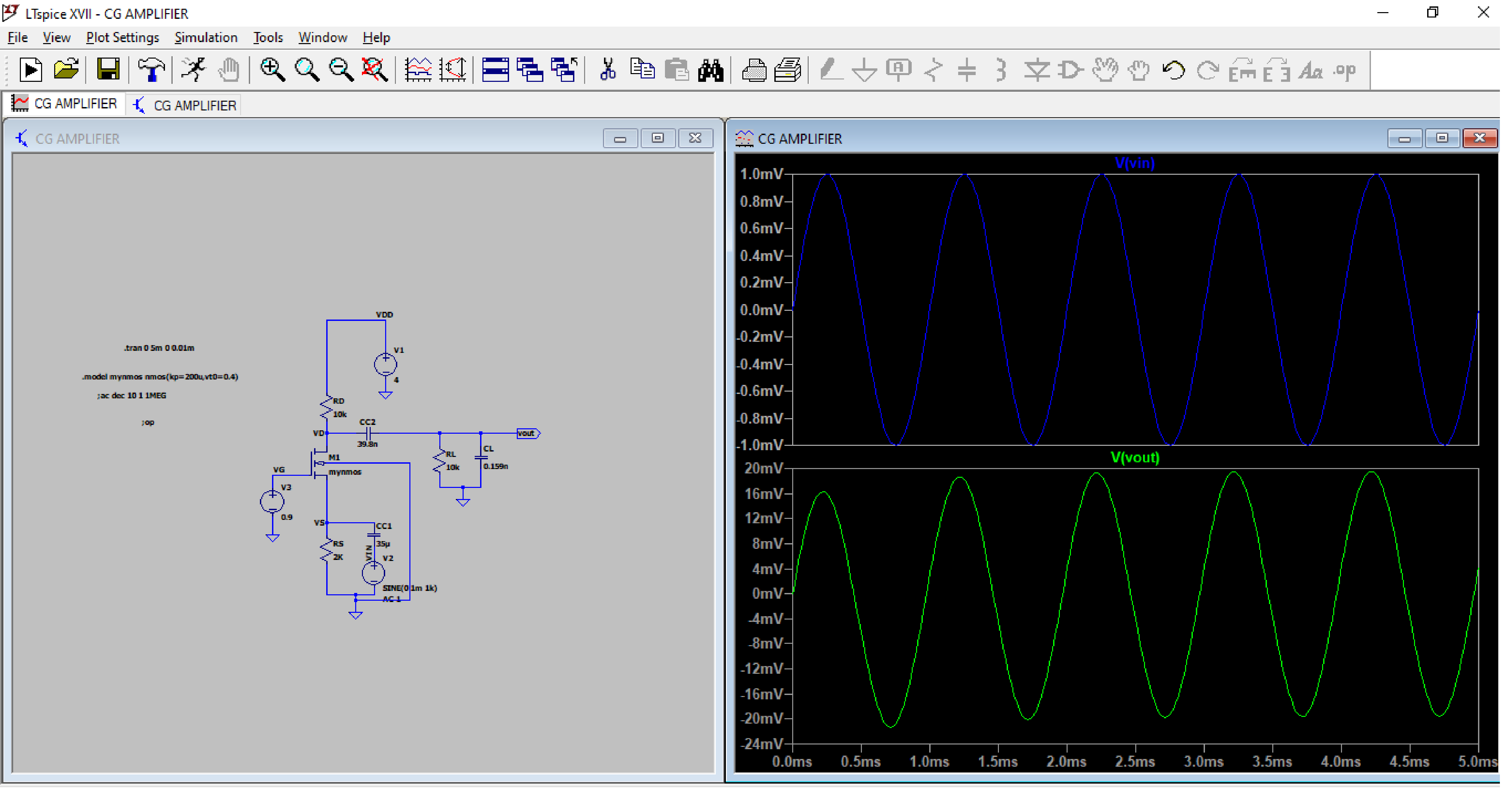
2.Right click on the voltage source and give “AC AMPLITUDE” As “1”.



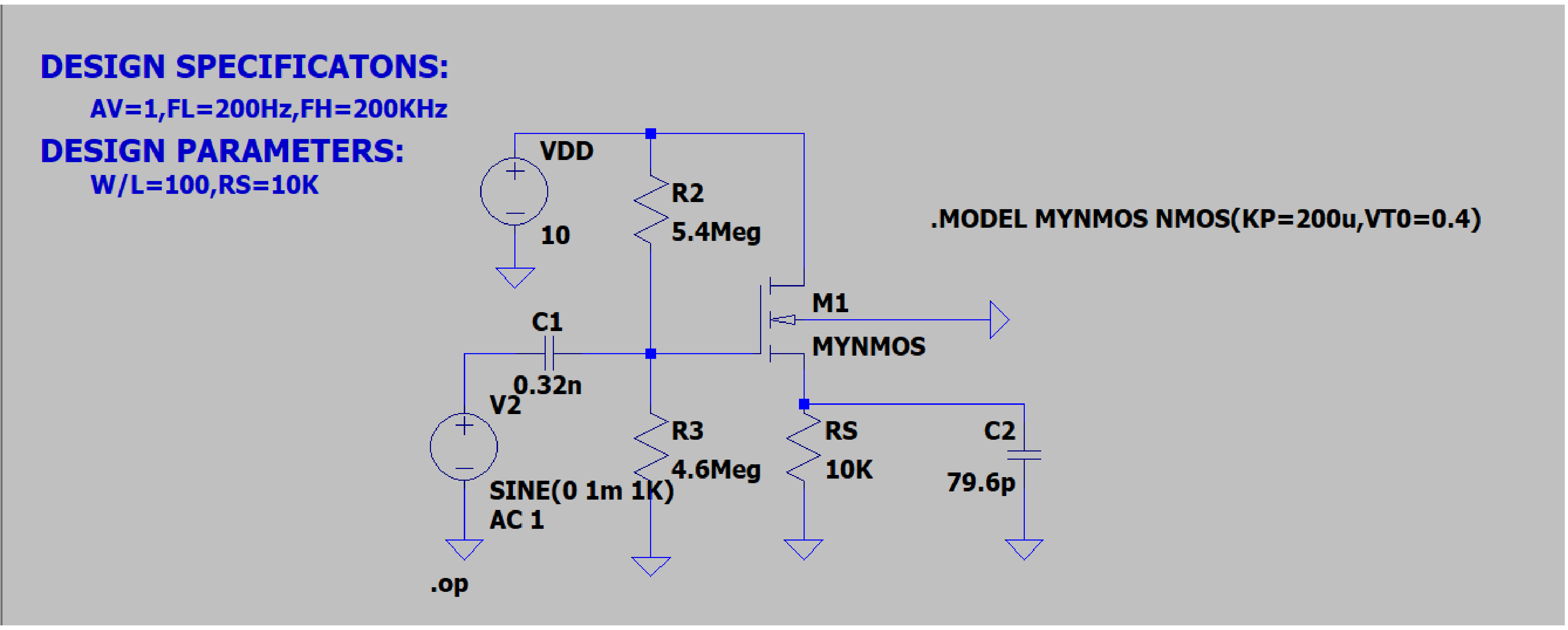


TRANSIENT ANALYSIS:

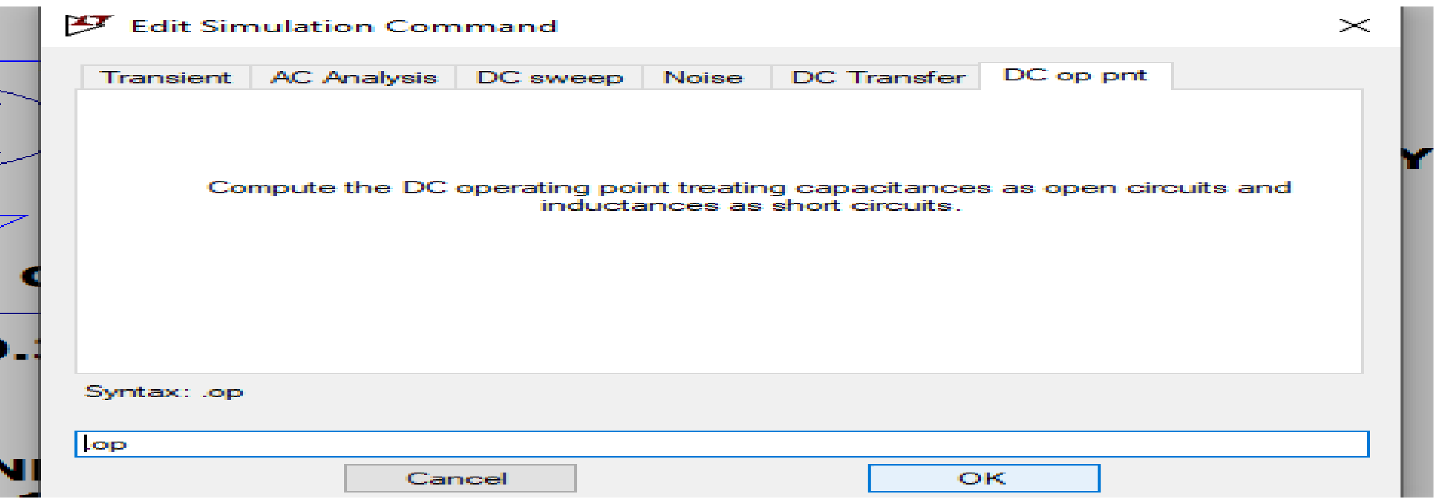




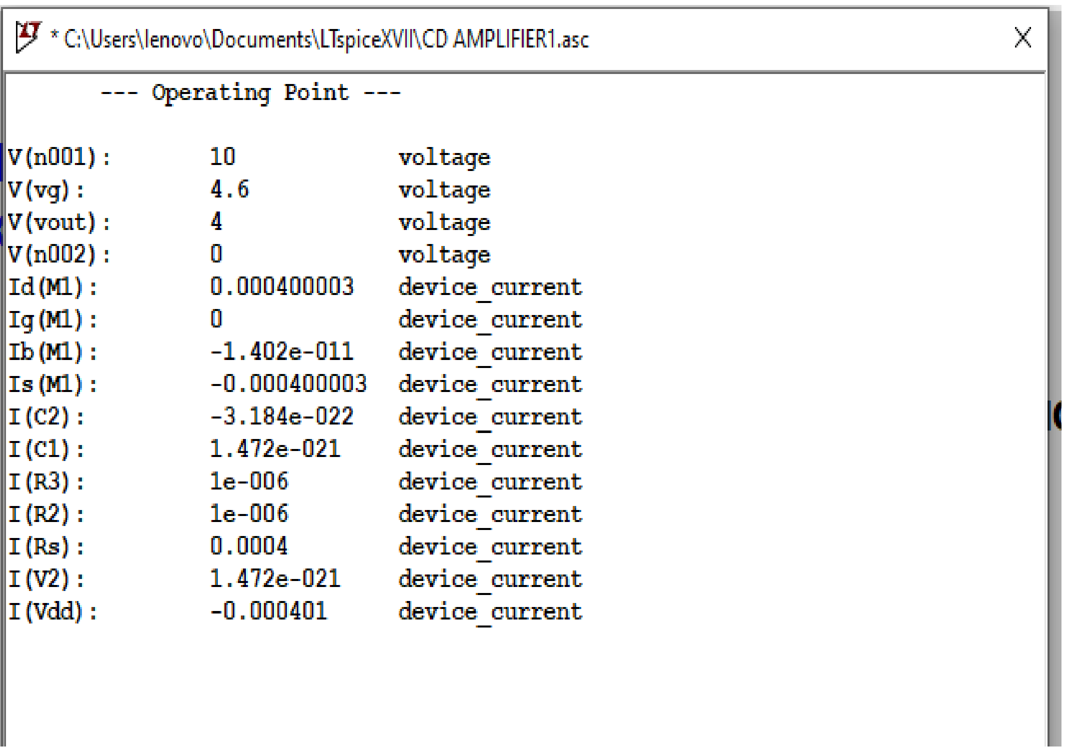
COMMON DRAIN AMPLIFIER:



DC ANALYSIS:



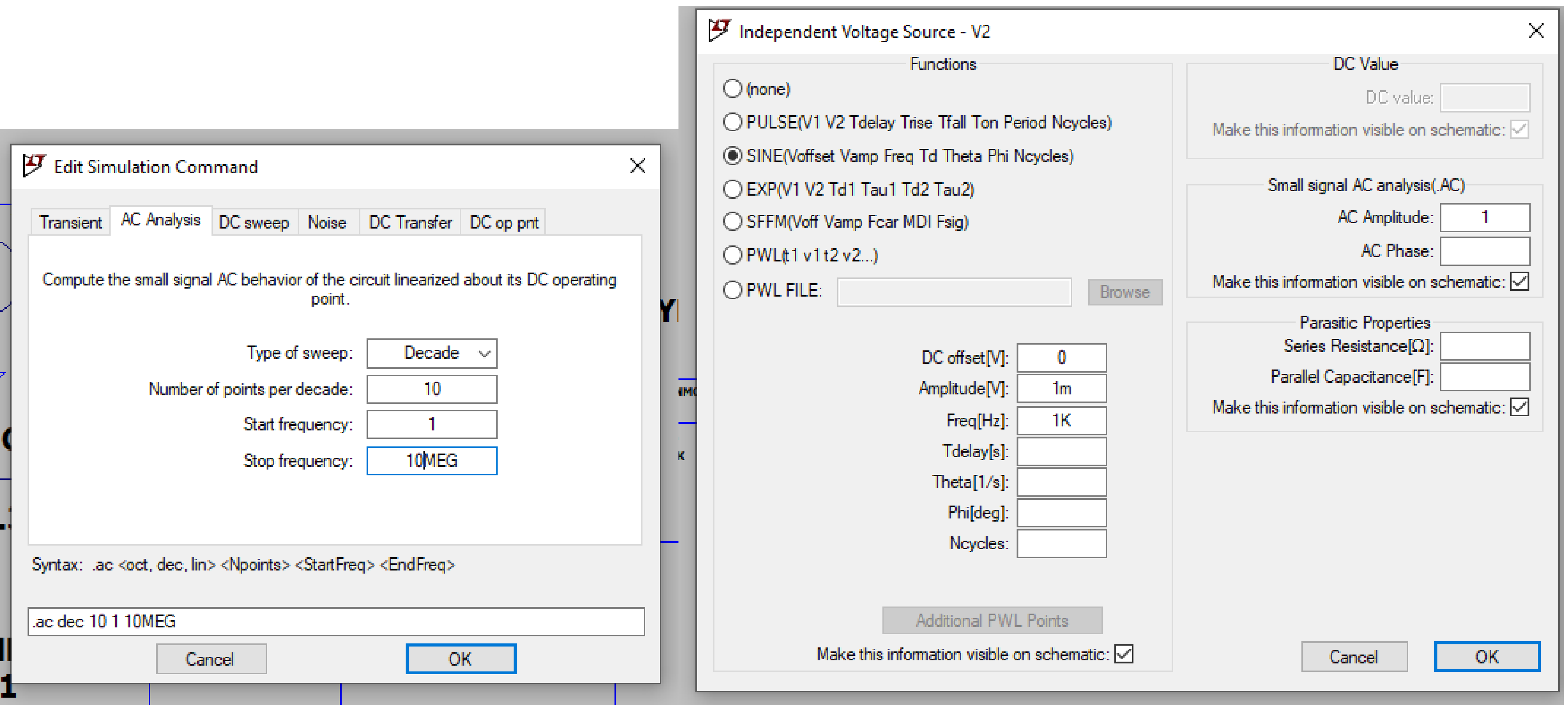
IDQ=0.4mA,VDS=6V

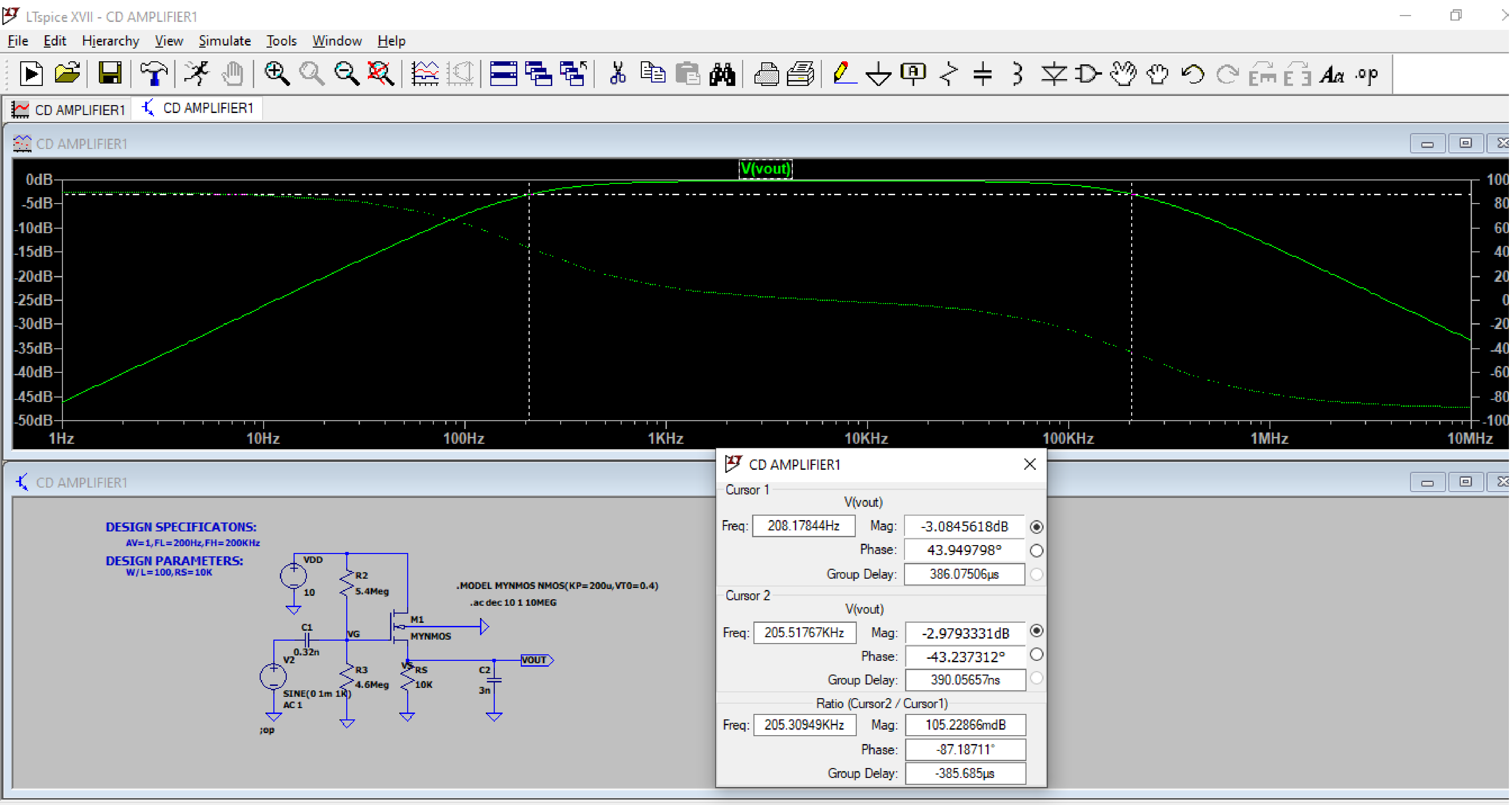


* C:\Users\lenovo\Documents\LTspiceXVII\CD AMPLIFIER1.asc

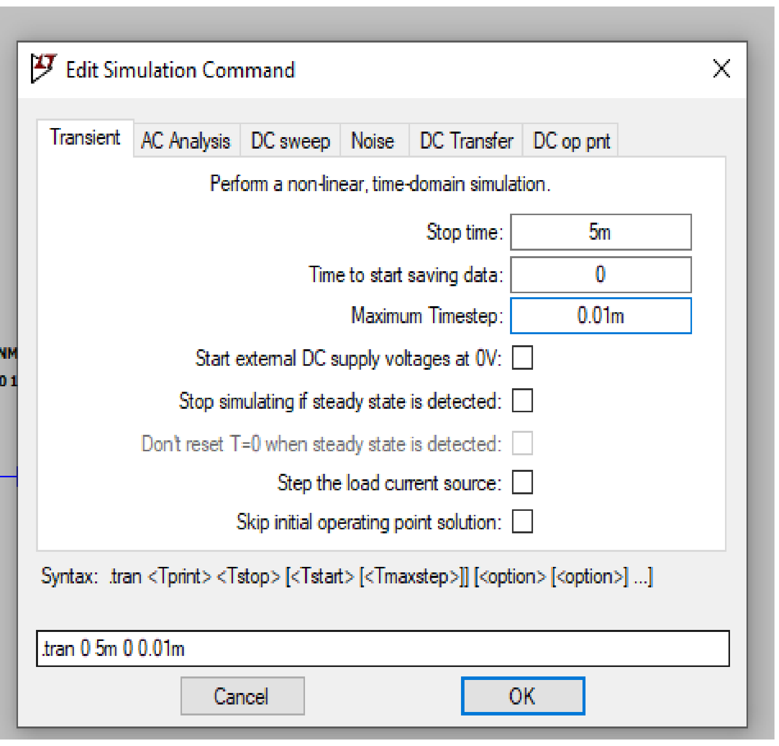
```
       --- Operating Point ---

V(n001):         10              voltage
V(vg):           4.6             voltage
V(vout):         4               voltage
V(n002):         0               voltage
Id(M1):          0.000400003     device_current
Ig(M1):          0               device_current
Ib(M1):          -1.402e-011     device_current
Is(M1):          -0.000400003    device_current
I(C2):           -3.184e-022     device_current
I(C1):           1.472e-021      device_current
I(R3):           1e-006          device_current
I(R2):           1e-006          device_current
I(Rs):           0.0004          device_current
I(V2):           1.472e-021      device_current
I(Vdd):          -0.000401       device_current
```

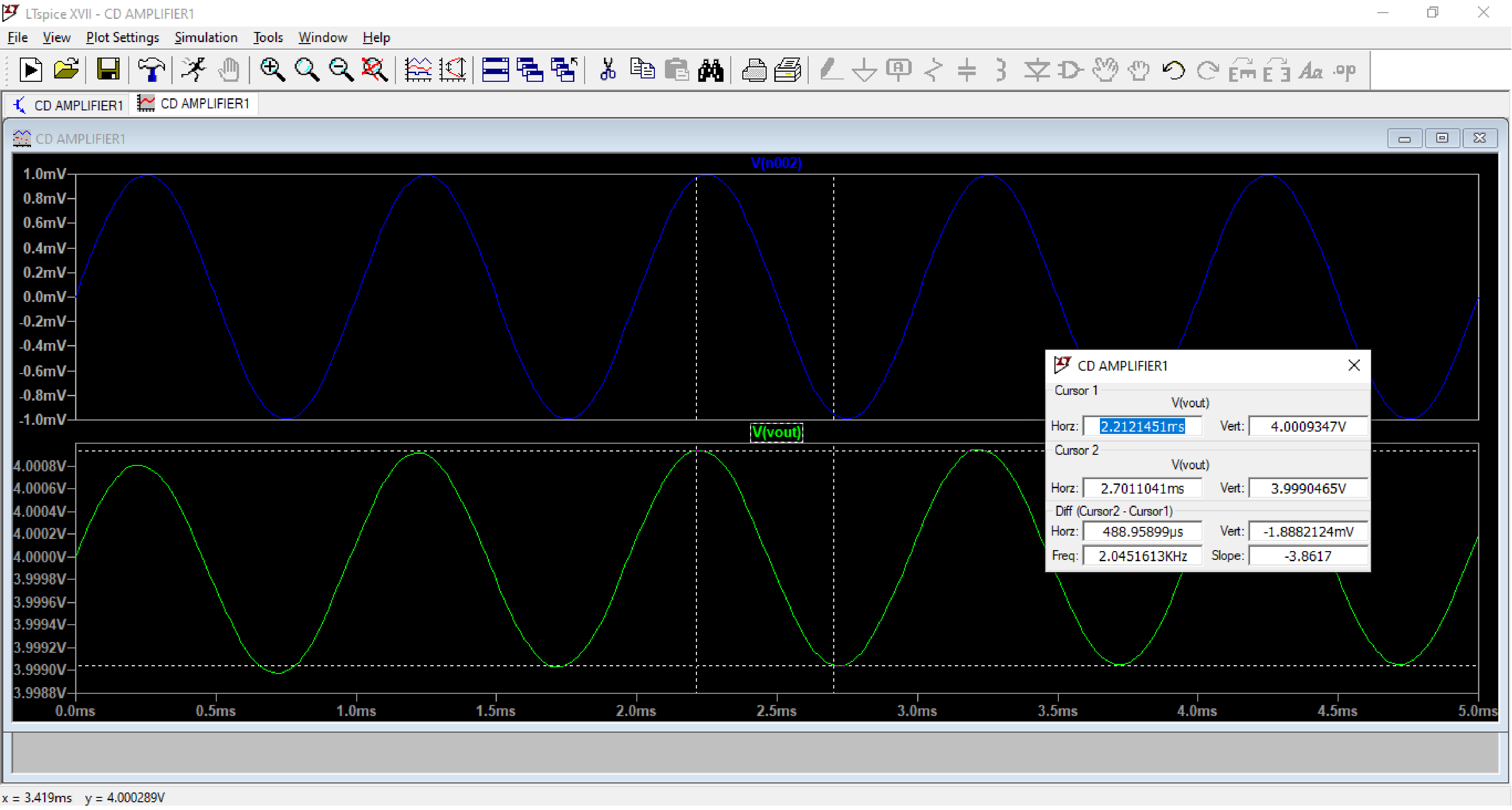
AC ANALYSIS:





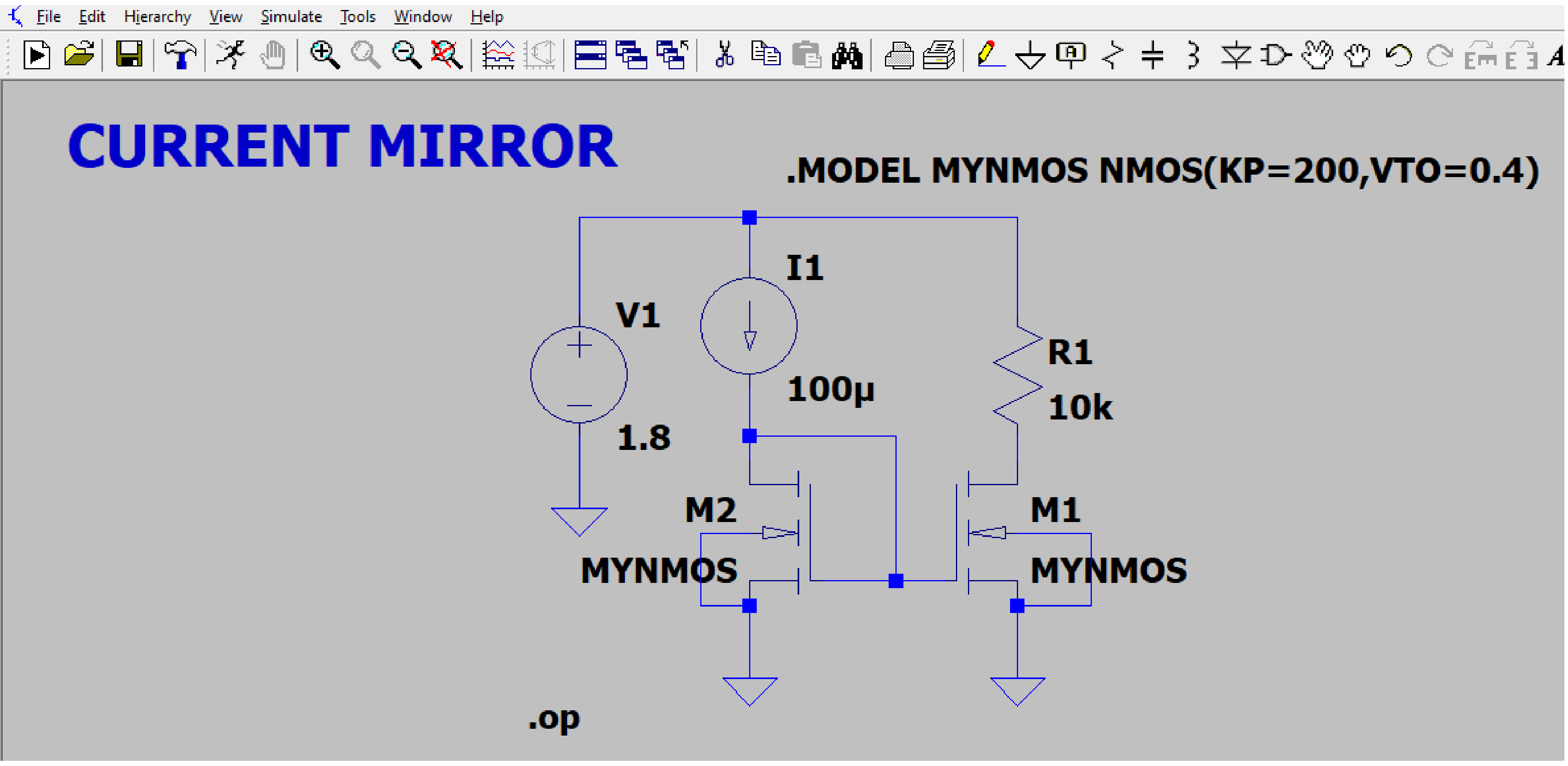
TRANSIENT ANALYSIS:



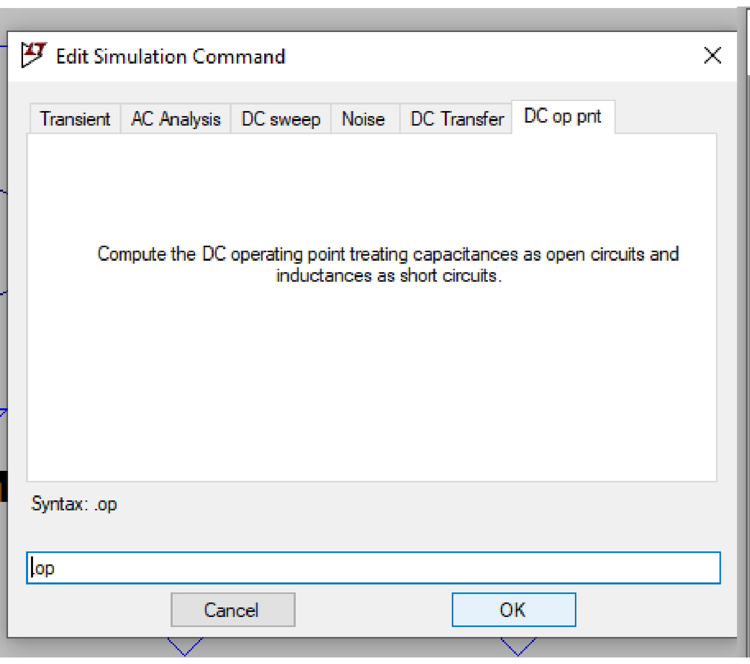


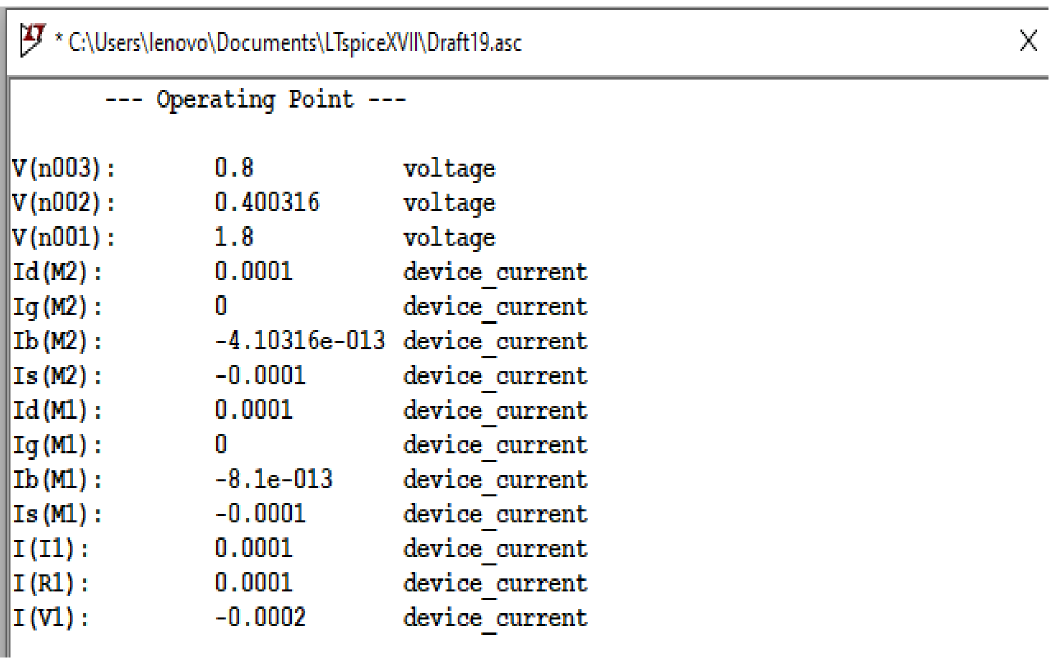
CURRENT MIRROR:

(W/L)1,2=10



DC ANLYSIS:

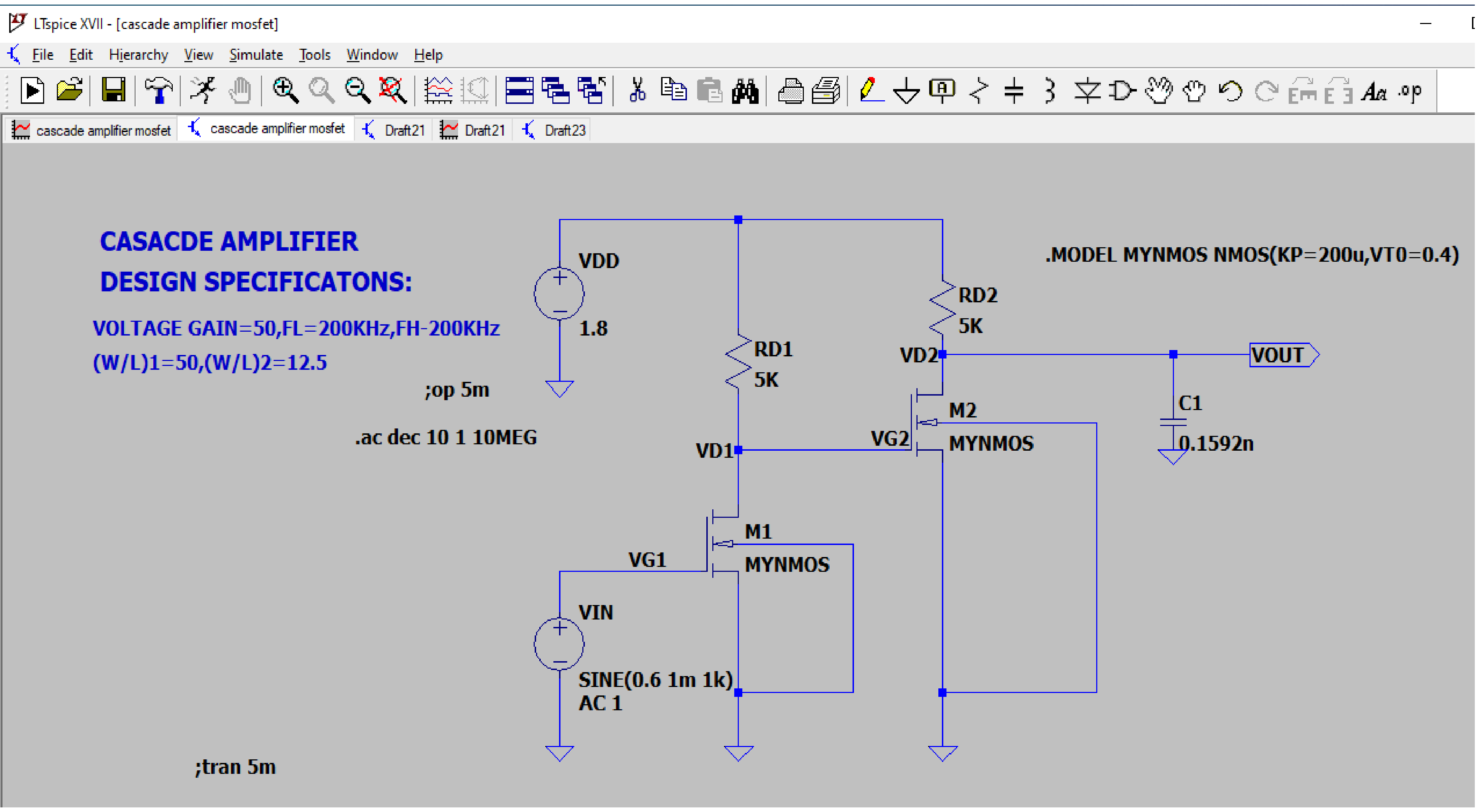




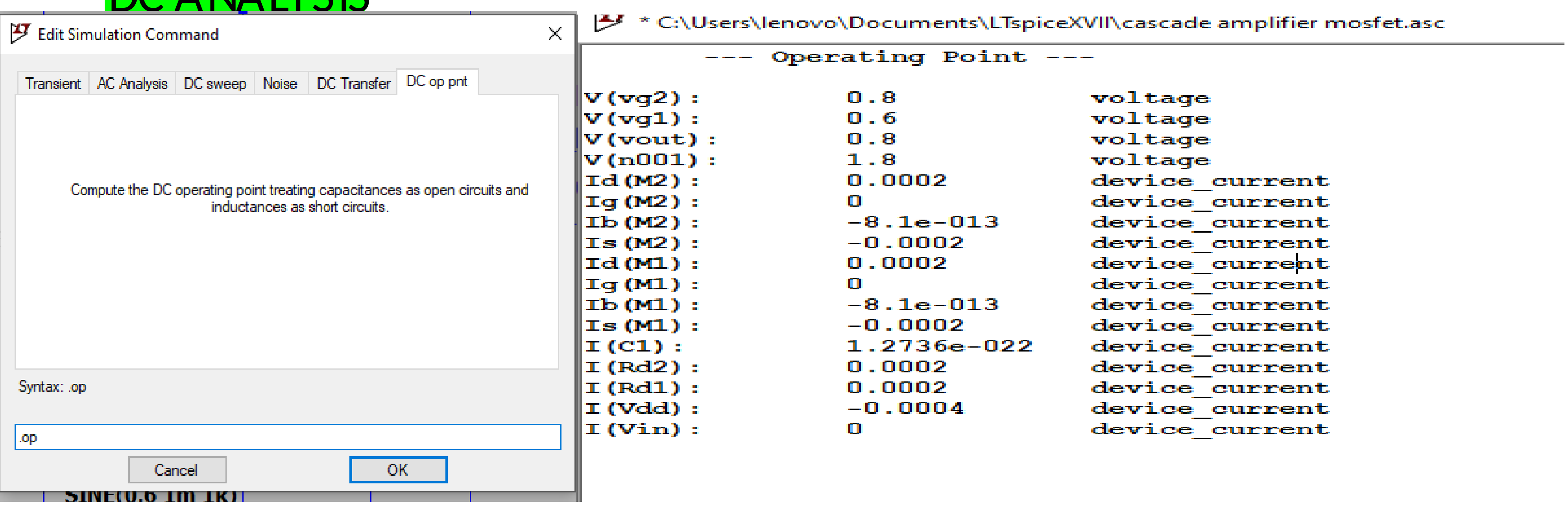
--- Operating Point ---

V(n003):	0.8	voltage
V(n002):	0.400316	voltage
V(n001):	1.8	voltage
Id(M2):	0.0001	device_current
Ig(M2):	0	device_current
Ib(M2):	-4.10316e-013	device_current
Is(M2):	-0.0001	device_current
Id(M1):	0.0001	device_current
Ig(M1):	0	device_current
Ib(M1):	-8.1e-013	device_current
Is(M1):	-0.0001	device_current
I(I1):	0.0001	device_current
I(R1):	0.0001	device_current
I(V1):	-0.0002	device_current

CASCADE AMPLIFIER:



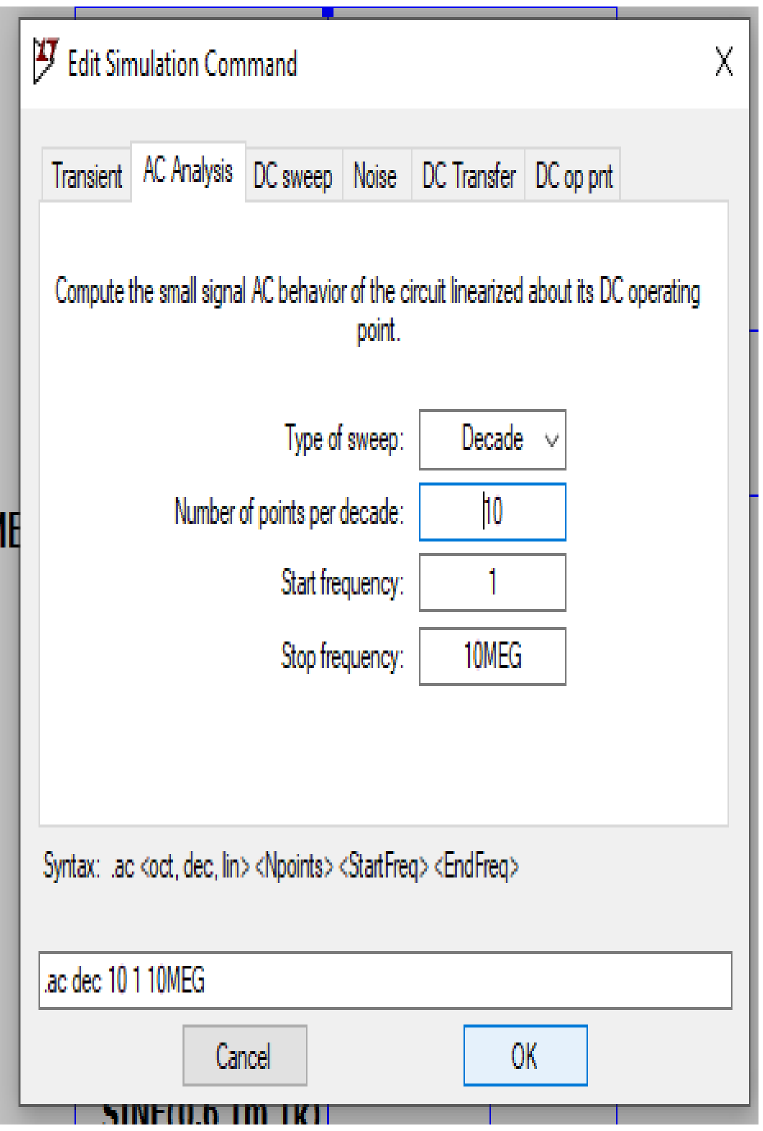
DC ANALYSIS



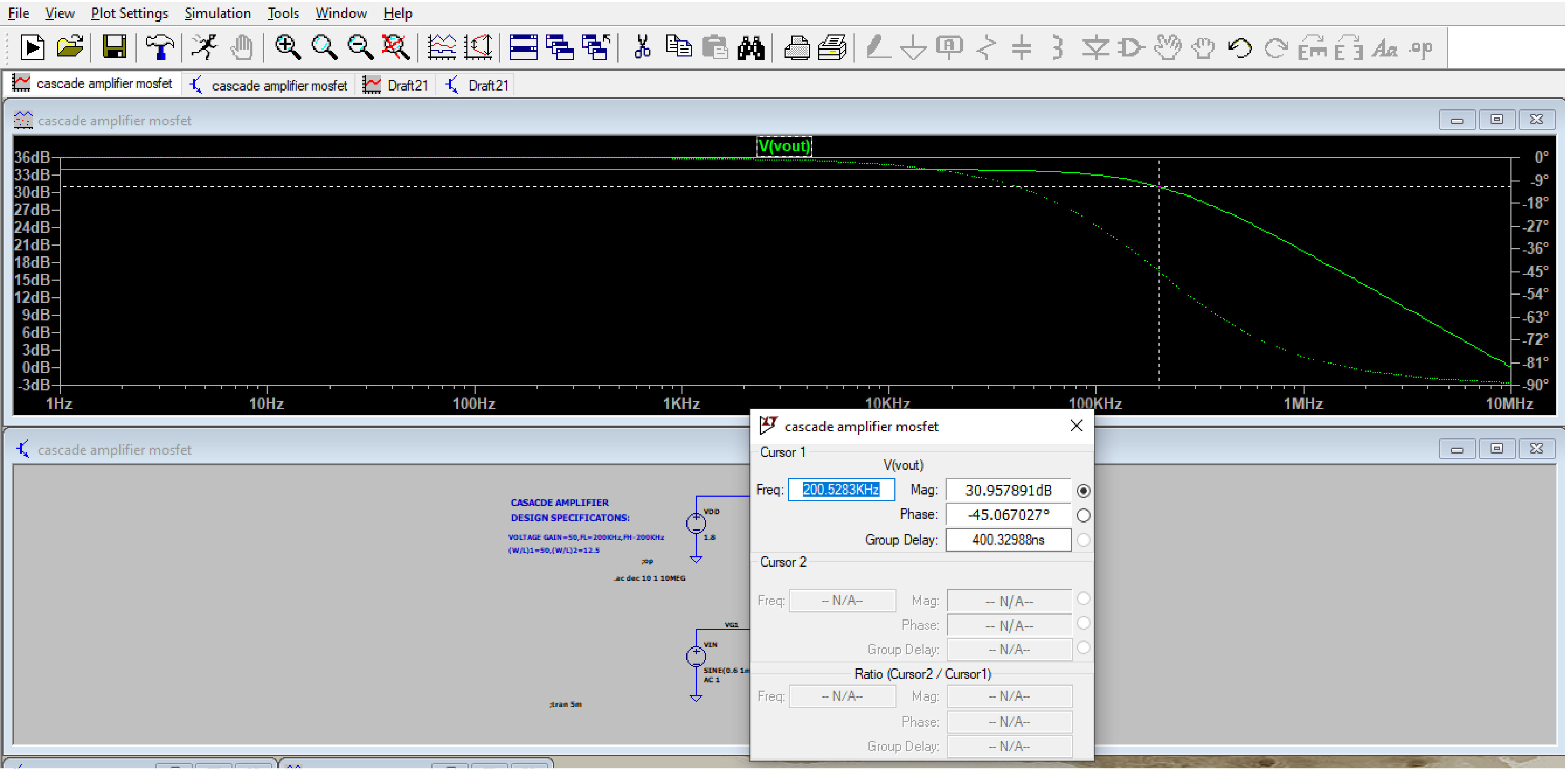
--- Operating Point ---

V(vg2):	0.8	voltage
V(vg1):	0.6	voltage
V(vout):	0.8	voltage
V(n001):	1.8	voltage
Id(M2):	0.0002	device_current
Ig(M2):	0	device_current
Ib(M2):	-8.1e-013	device_current
Is(M2):	-0.0002	device_current
Id(M1):	0.0002	device_current
Ig(M1):	0	device_current
Ib(M1):	-8.1e-013	device_current
Is(M1):	-0.0002	device_current
I(C1):	1.2736e-022	device_current
I(Rd2):	0.0002	device_current
I(Rd1):	0.0002	device_current
I(Vdd):	-0.0004	device_current
I(Vin):	0	device_current

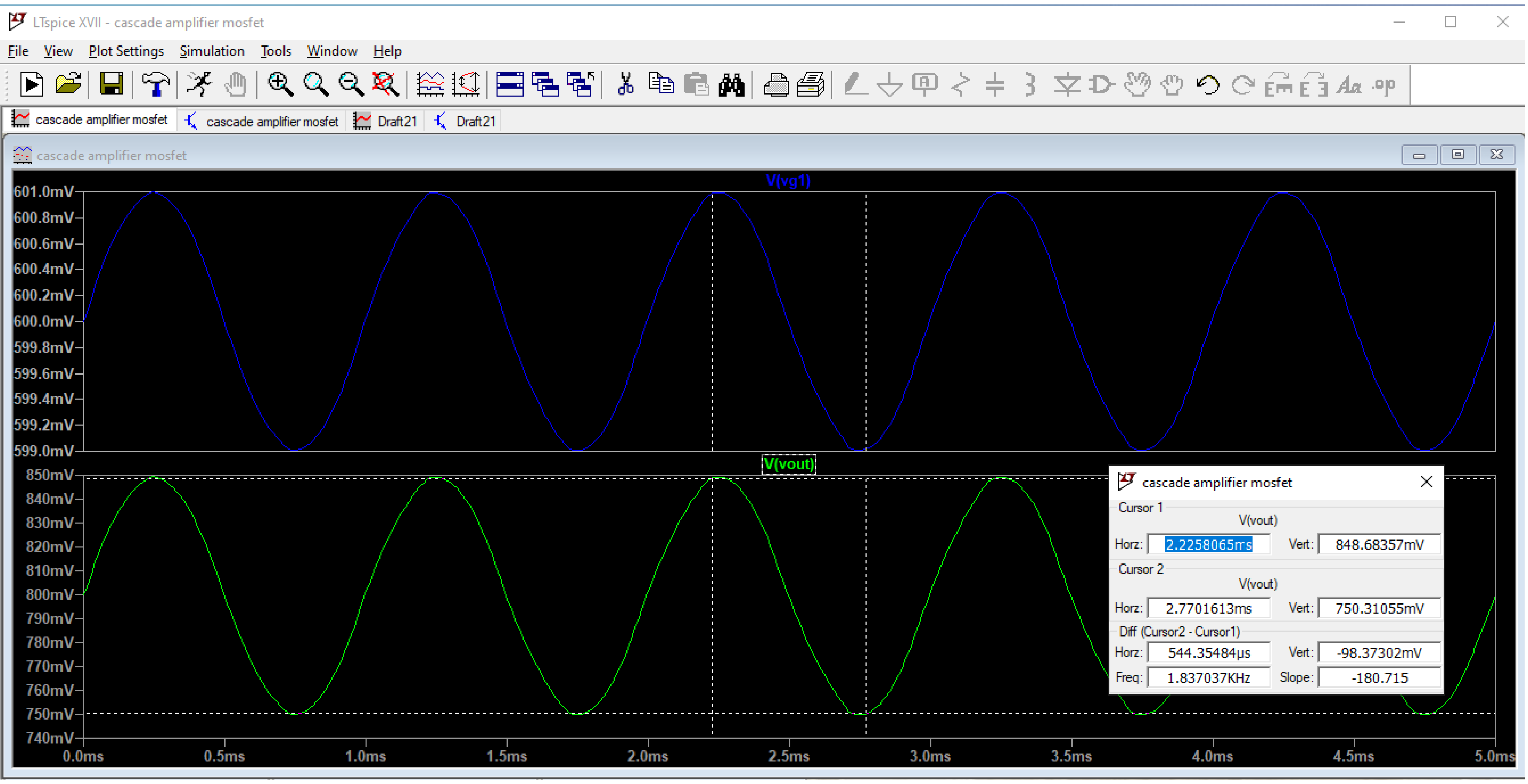
AC ANALYISIS



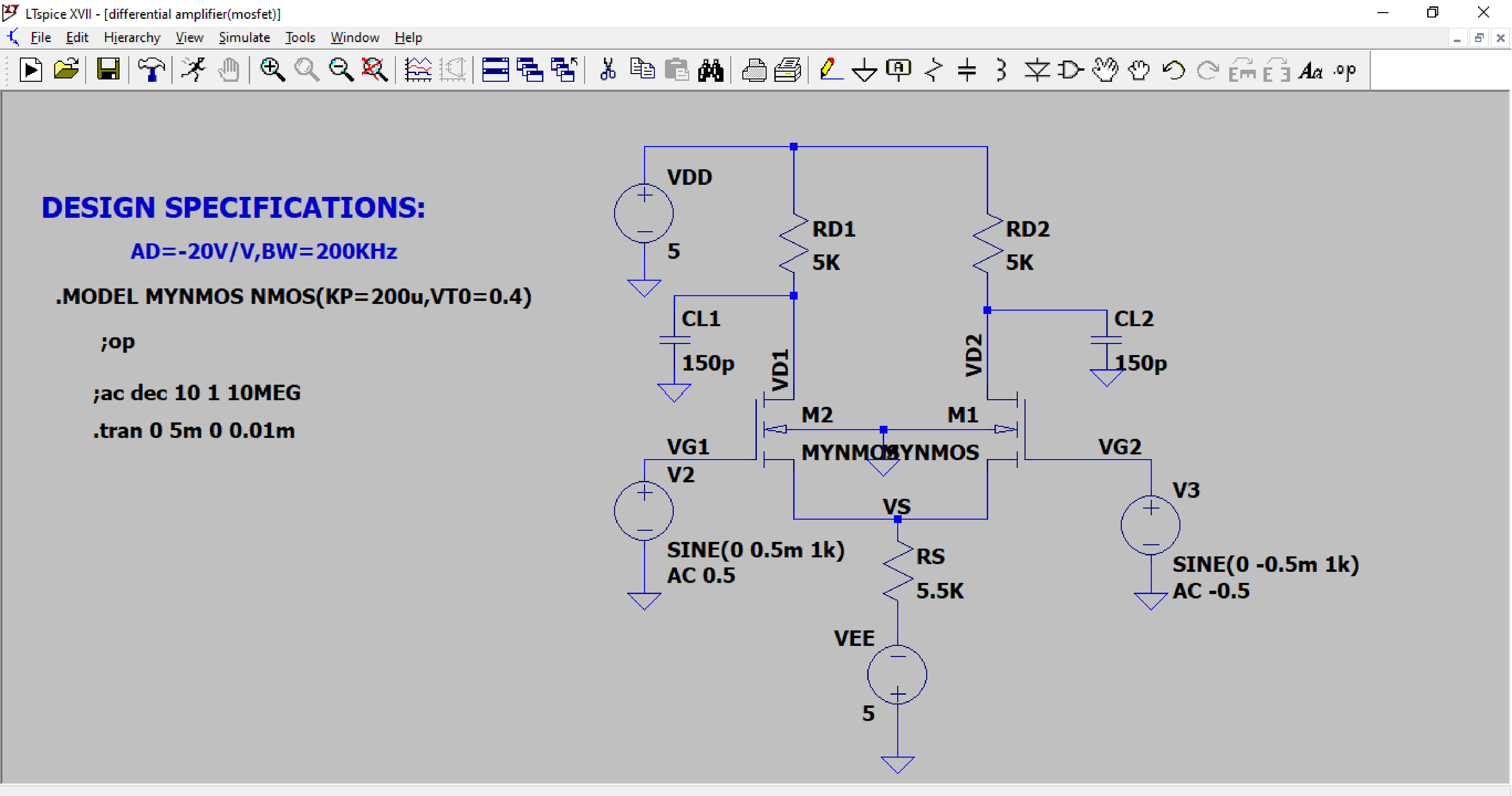
Edit Simulation Command
Transient
AC Analysis
DC sweep
Noise
DC Transfer
DC op pnt
Compute the small signal AC behavior of the circuit linearized about its DC operating point.
Type of sweep:
Decade
Number of points per decade:
10
Start frequency:
1
Stop frequency:
10MEG
Syntax: .ac <oct, dec, lin> <Npoints> <StartFreq> <EndFreq>
.ac dec 10 1 10MEG
Cancel
OK

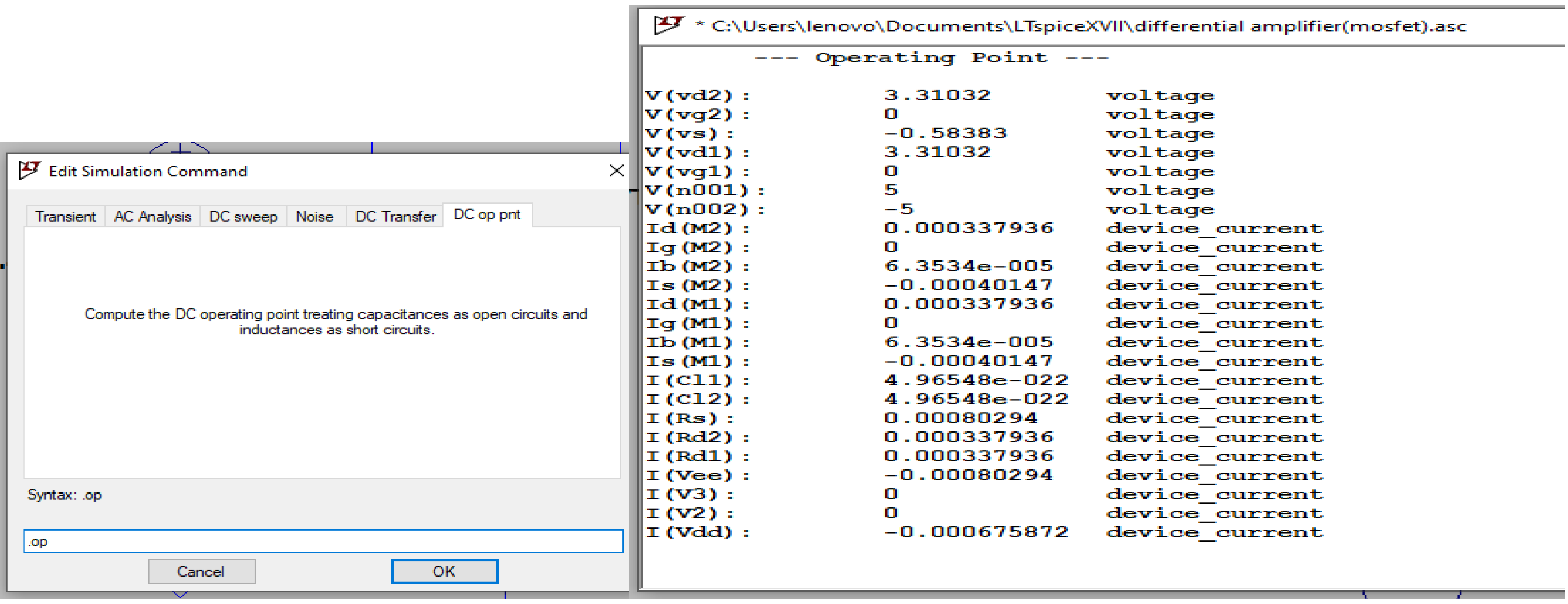


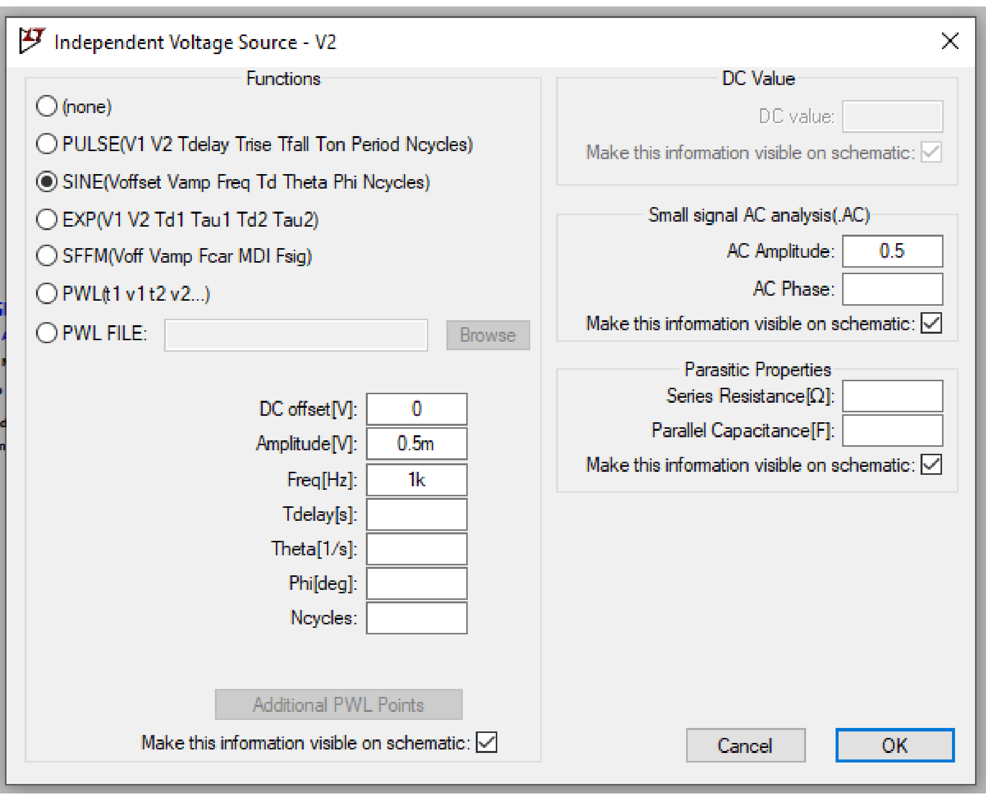
File View Plot Settings Simulation Tools Window Help
cascade amplifier mosfet
cascade amplifier mosfet
Draft21
Draft21
cascade amplifier mosfet
V(vout)
36dB
33dB
30dB
27dB
24dB
21dB
18dB
15dB
12dB
9dB
6dB
3dB
0dB
-3dB
0°
-9°
-18°
-27°
-36°
-45°
-54°
-63°
-72°
-81°
-90°
1Hz
10Hz
100Hz
1KHz
10KHz
100KHz
1MHz
10MHz
cascade amplifier mosfet
CASACDE AMPLIFIER
DESIGN SPECIFICATONS:
.ac dec 10 1 10MEG
.tran 5m
cascade amplifier mosfet
Cursor 1
V(vout)
Freq: 200.5283KHz
Mag: 30.957891dB
Phase: -45.067027°
Group Delay: 400.32988ns
Cursor 2
Freq: -- N/A--
Mag: -- N/A--
Phase: -- N/A--
Group Delay: -- N/A--
Ratio (Cursor2 / Cursor1)
Freq: -- N/A--
Mag: -- N/A--
Phase: -- N/A--
Group Delay: -- N/A--

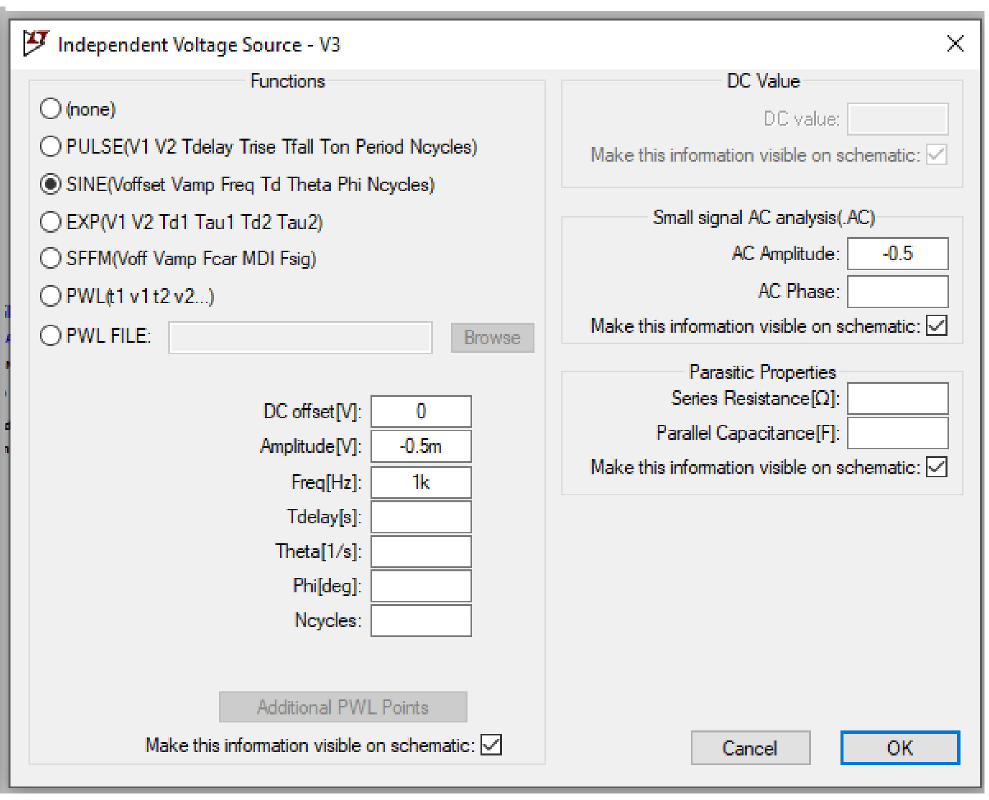


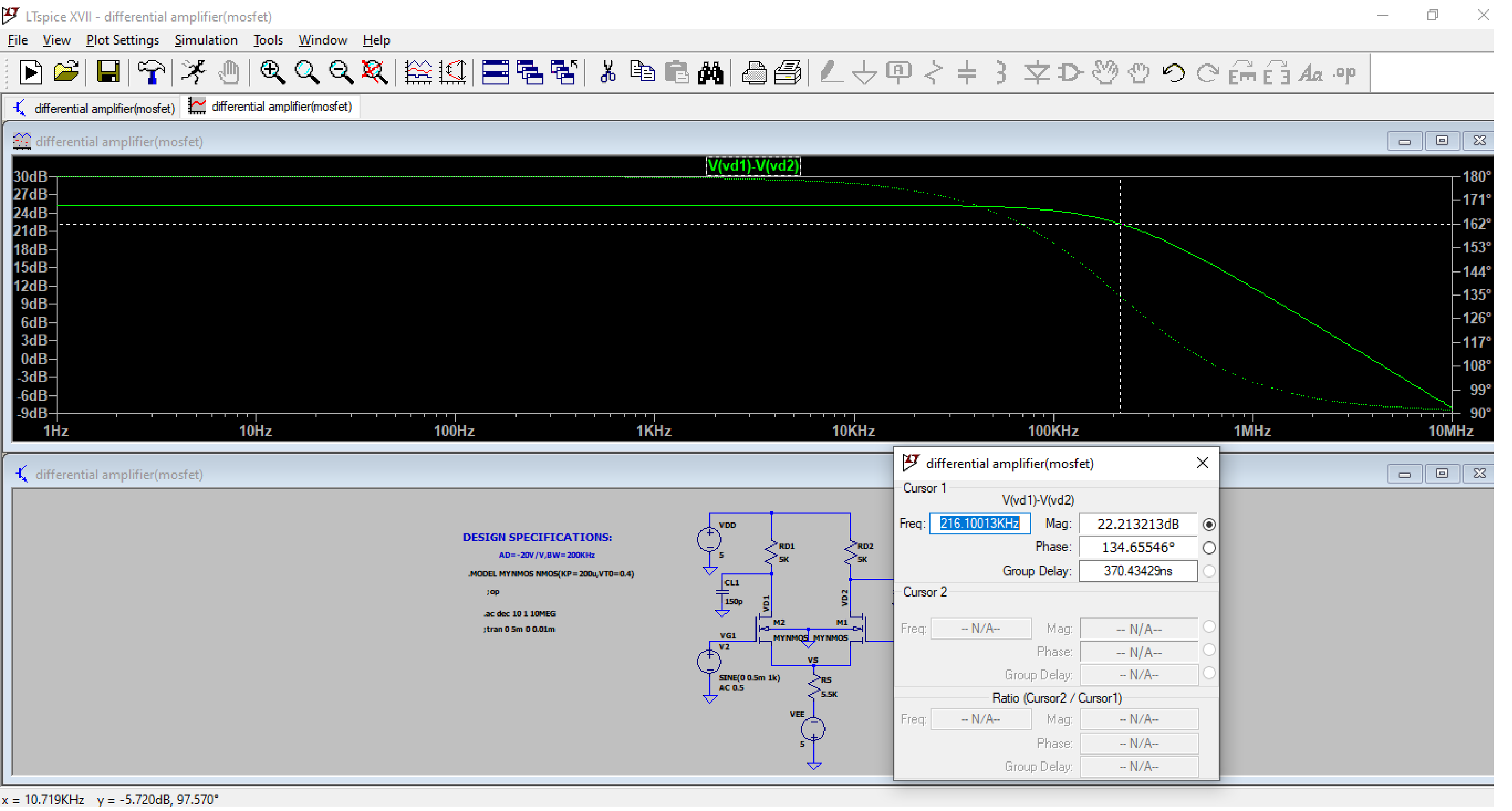
DIFFERENTIAL AMPLIFIER:

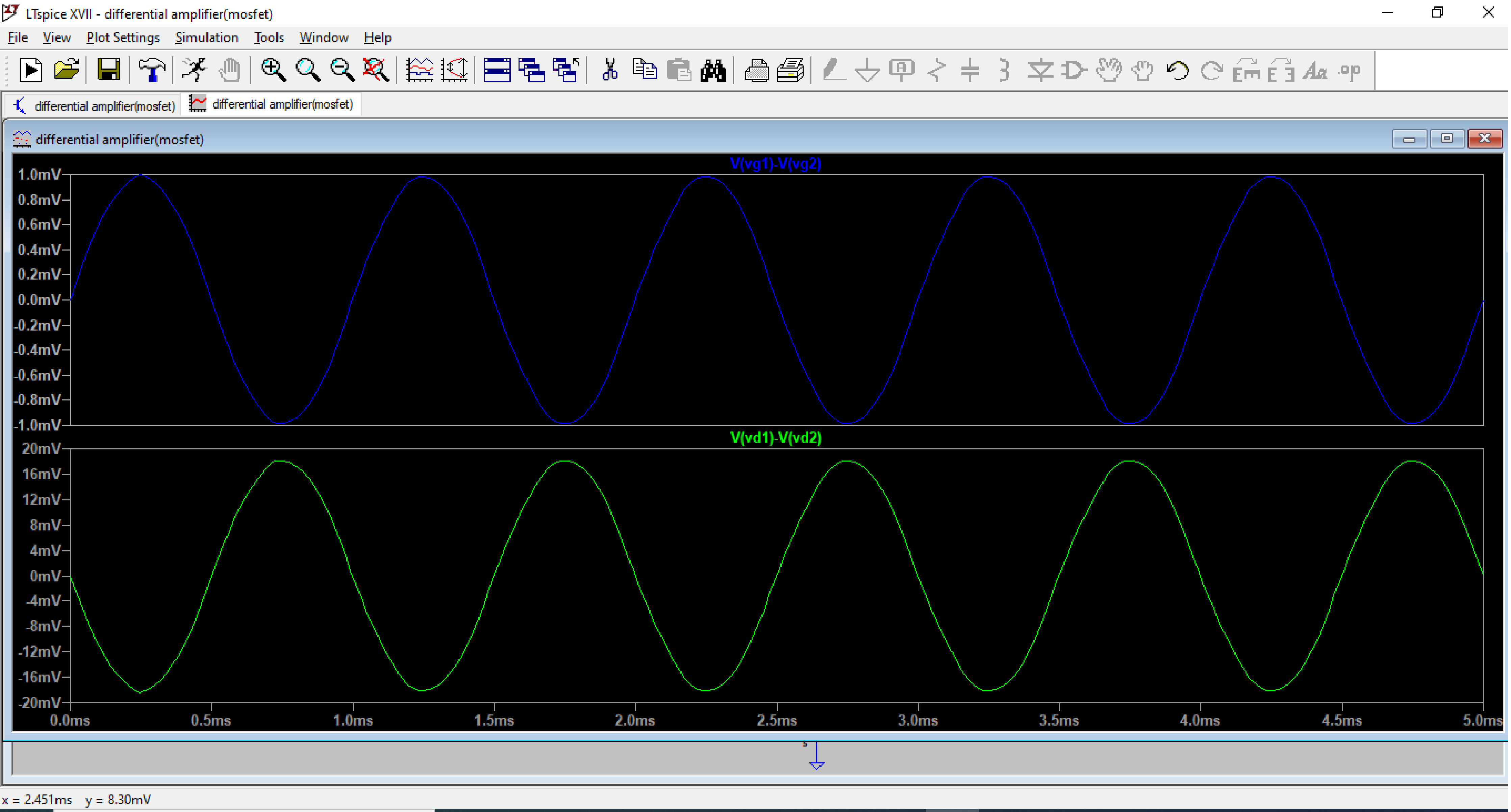

LTspice XVII - [differential amplifier(mosfet)]
File Edit Hierarchy View Simulate Tools Window Help
DESIGN SPECIFICATIONS:
AD=-20V/V,BW=200KHz
.MODEL MYNMOS NMOS(KP=200u,VT0=0.4)
;op
;ac dec 10 1 10MEG
.tran 0 5m 0 0.01m
VDD
5
RD1
5K
RD2
5K
CL1
150p
CL2
150p
VD1
VD2
M2
M1
MYNMOS
MYNMOS
VG1
V2
VG2
V3
VS
SINE(0 0.5m 1k)
AC 0.5
SINE(0 -0.5m 1k)
AC -0.5
RS
5.5K
VEE
5


Edit Simulation Command
Transient
AC Analysis
DC sweep
Noise
DC Transfer
DC op pnt
Compute the DC operating point treating capacitances as open circuits and inductances as short circuits.
Syntax: .op
.op
Cancel
OK
* C:\Users\lenovo\Documents\LTspiceXVII\differential amplifier(mosfet).asc
--- Operating Point ---
V(vd2): 3.31032 voltage
V(vg2): 0 voltage
V(vs): -0.58383 voltage
V(vd1): 3.31032 voltage
V(vg1): 0 voltage
V(n001): 5 voltage
V(n002): -5 voltage
Id(M2): 0.000337936 device_current
Ig(M2): 0 device_current
Ib(M2): 6.3534e-005 device_current
Is(M2): -0.00040147 device_current
Id(M1): 0.000337936 device_current
Ig(M1): 0 device_current
Ib(M1): 6.3534e-005 device_current
Is(M1): -0.00040147 device_current
I(Cl1): 4.96548e-022 device_current
I(Cl2): 4.96548e-022 device_current
I(Rs): 0.00080294 device_current
I(Rd2): 0.000337936 device_current
I(Rd1): 0.000337936 device_current
I(Vee): -0.00080294 device_current
I(V3): 0 device_current
I(V2): 0 device_current
I(Vdd): -0.000675872 device_current

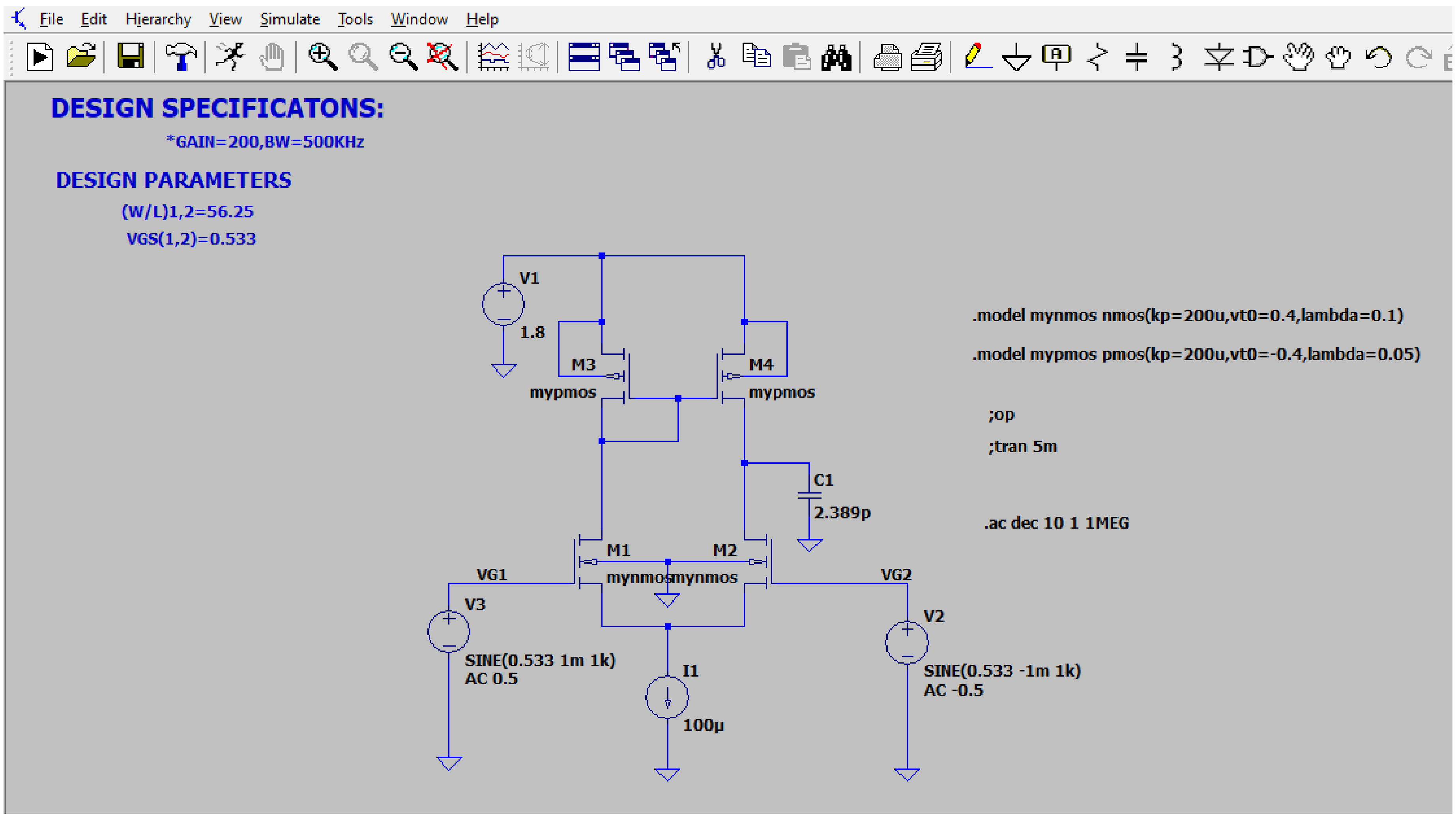

Independent Voltage Source - V2
Functions
(none)
PULSE(V1 V2 Tdelay Trise Tfall Ton Period Ncycles)
SINE(Voffset Vamp Freq Td Theta Phi Ncycles)
EXP(V1 V2 Td1 Tau1 Td2 Tau2)
SFFM(Voff Vamp Fcar MDI Fsig)
PWL(t1 v1 t2 v2...)
PWL FILE:
Browse
DC offset[V]: 0
Amplitude[V]: 0.5m
Freq[Hz]: 1k
Tdelay[s]:
Theta[1/s]:
Phi[deg]:
Ncycles:
Additional PWL Points
Make this information visible on schematic:
DC Value
DC value:
Make this information visible on schematic:
Small signal AC analysis(.AC)
AC Amplitude: 0.5
AC Phase:
Make this information visible on schematic:
Parasitic Properties
Series Resistance[Ω]:
Parallel Capacitance[F]:
Make this information visible on schematic:
Cancel
OK

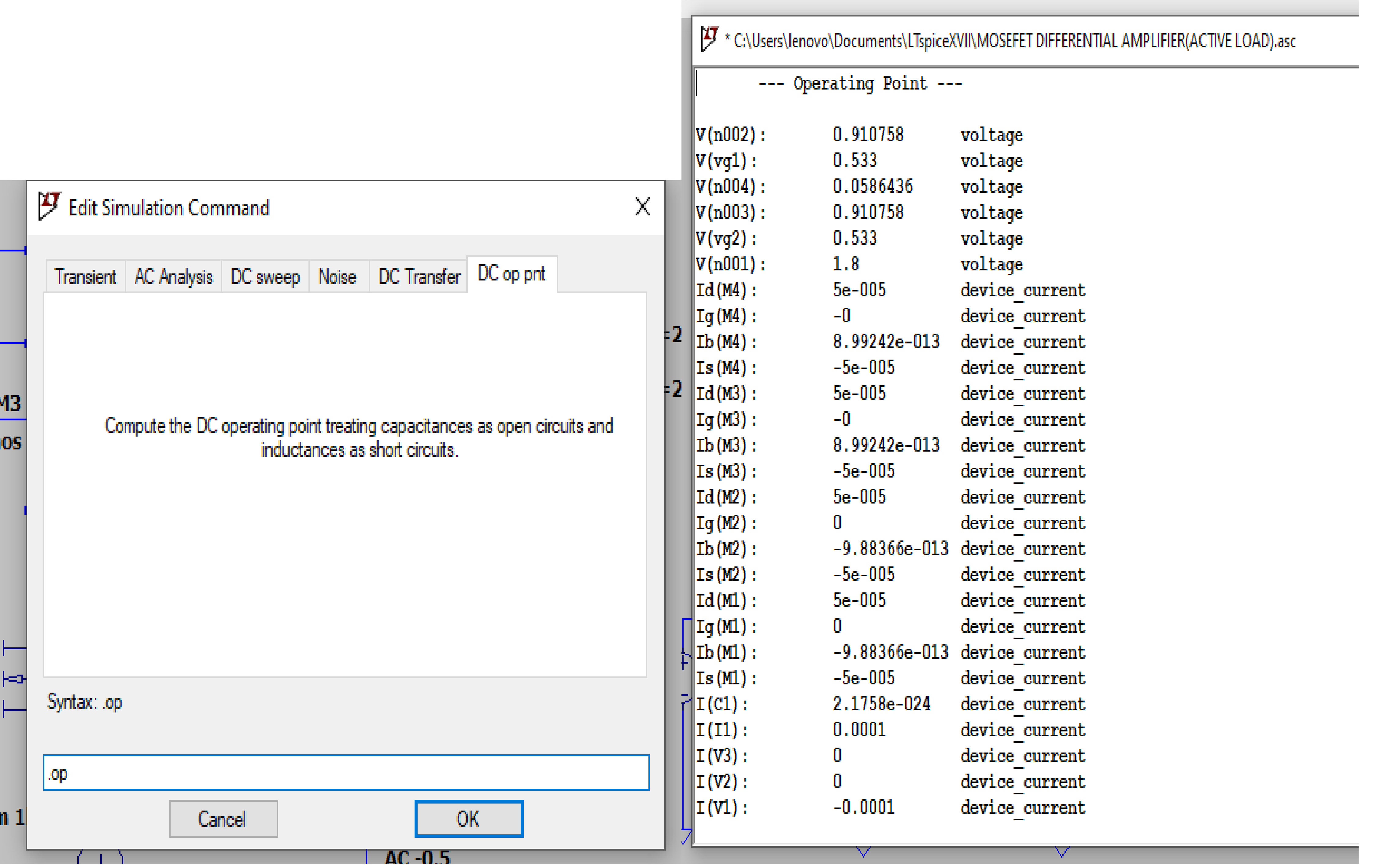

Independent Voltage Source - V3
Functions
(none)
PULSE(V1 V2 Tdelay Trise Tfall Ton Period Ncycles)
SINE(Voffset Vamp Freq Td Theta Phi Ncycles)
EXP(V1 V2 Td1 Tau1 Td2 Tau2)
SFFM(Voff Vamp Fcar MDI Fsig)
PWL(t1 v1 t2 v2...)
PWL FILE:
Browse
DC offset[V]: 0
Amplitude[V]: -0.5m
Freq[Hz]: 1k
Tdelay[s]:
Theta[1/s]:
Phi[deg]:
Ncycles:
Additional PWL Points
Make this information visible on schematic:
DC Value
DC value:
Make this information visible on schematic:
Small signal AC analysis(.AC)
AC Amplitude: -0.5
AC Phase:
Make this information visible on schematic:
Parasitic Properties
Series Resistance[Ω]:
Parallel Capacitance[F]:
Make this information visible on schematic:
Cancel
OK

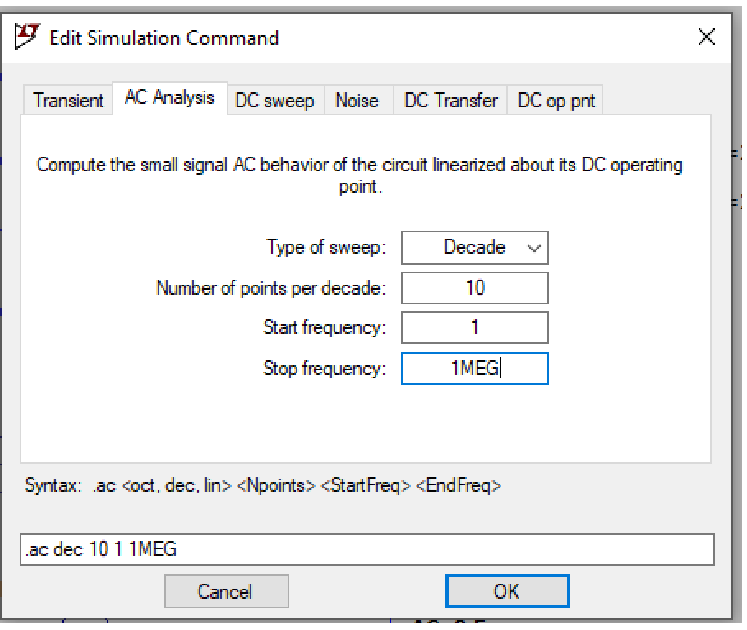

LTspice XVII - differential amplifier(mosfet)
File View Plot Settings Simulation Tools Window Help
differential amplifier(mosfet)
V(vd1)-V(vd2)
30dB 27dB 24dB 21dB 18dB 15dB 12dB 9dB 6dB 3dB 0dB -3dB -6dB -9dB
180° 171° 162° 153° 144° 135° 126° 117° 108° 99° 90°
1Hz 10Hz 100Hz 1KHz 10KHz 100KHz 1MHz 10MHz
DESIGN SPECIFICATIONS:
AD=-20V/V,BW=200KHz
.MODEL MYNMOS NMOS(KP=200u,VT0=0.4)
;op
.ac dec 10 1 10MEG
;tran 0.5m 0 0.01m
VDD RD1 5K RD2 5K CL1 150p VD1 VD2 M2 M1 MYNMOS MYNMOS VG1 V2 VS RS 5.5K VEE
SINE(0 0.5m 1k) AC 0.5
Cursor 1
V(vd1)-V(vd2)
Freq: 216.10013KHz
Mag: 22.213213dB
Phase: 134.65546°
Group Delay: 370.43429ns
Cursor 2
Freq: --N/A--
Mag: --N/A--
Phase: --N/A--
Group Delay: --N/A--
Ratio (Cursor2 / Cursor1)
Freq: --N/A--
Mag: --N/A--
Phase: --N/A--
Group Delay: --N/A--
x = 10.719KHz y = -5.720dB, 97.570°

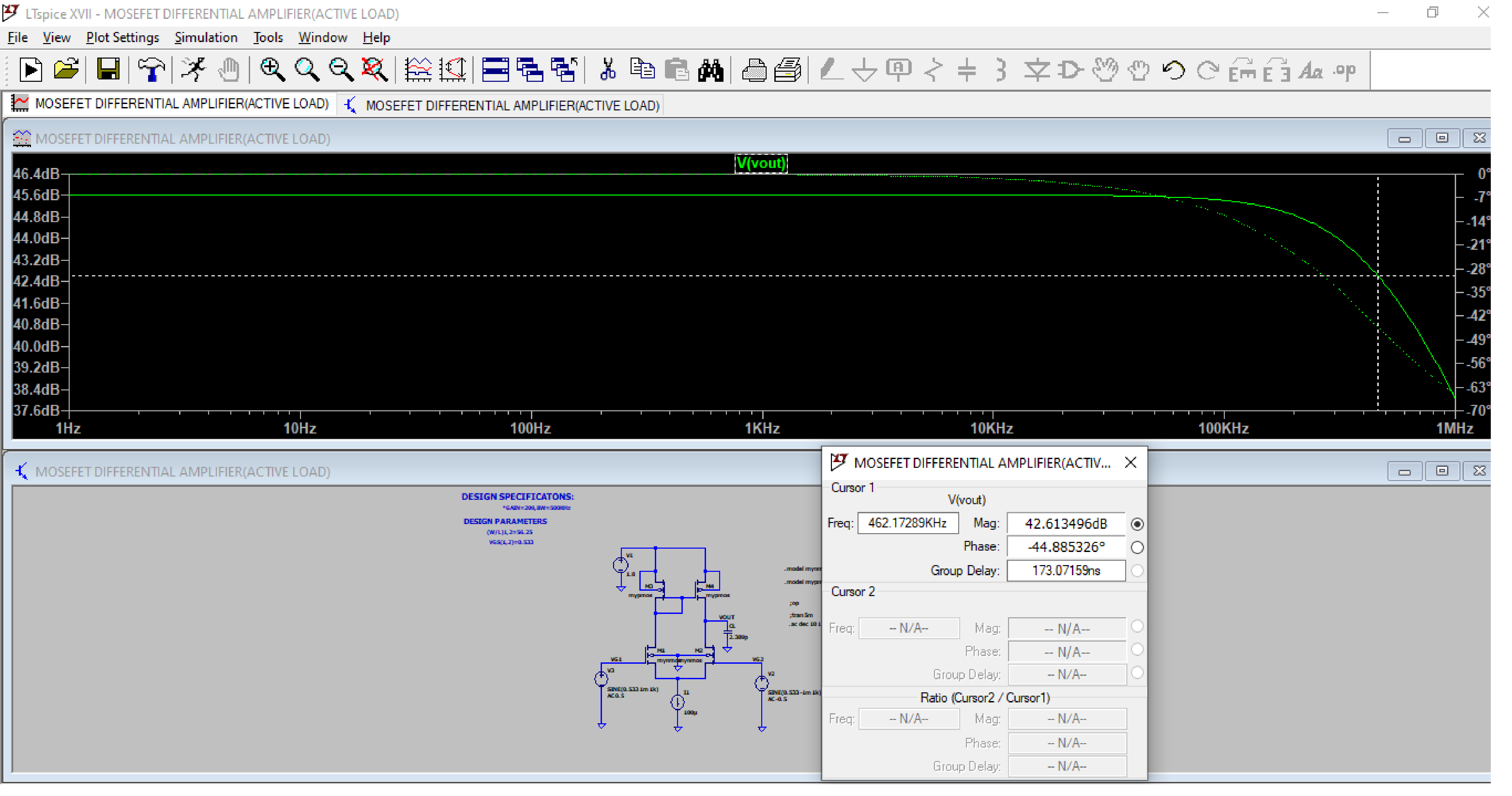


DIFFERENTIAL AMPLIFIER ACTIVE LOAD:

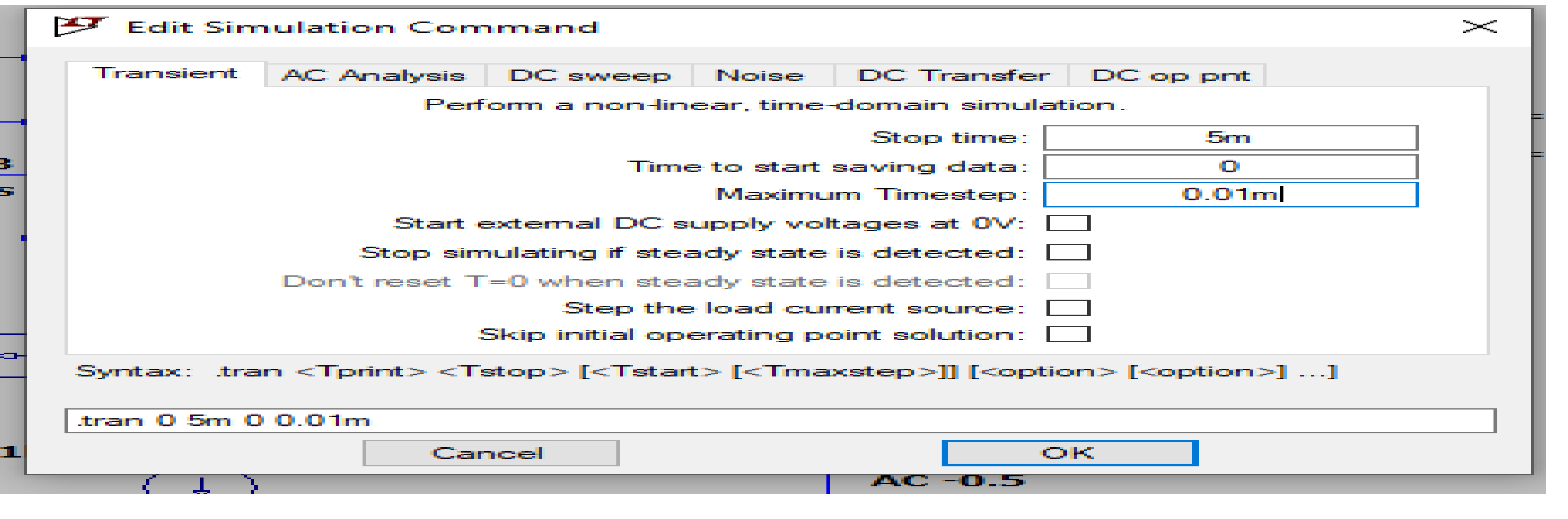


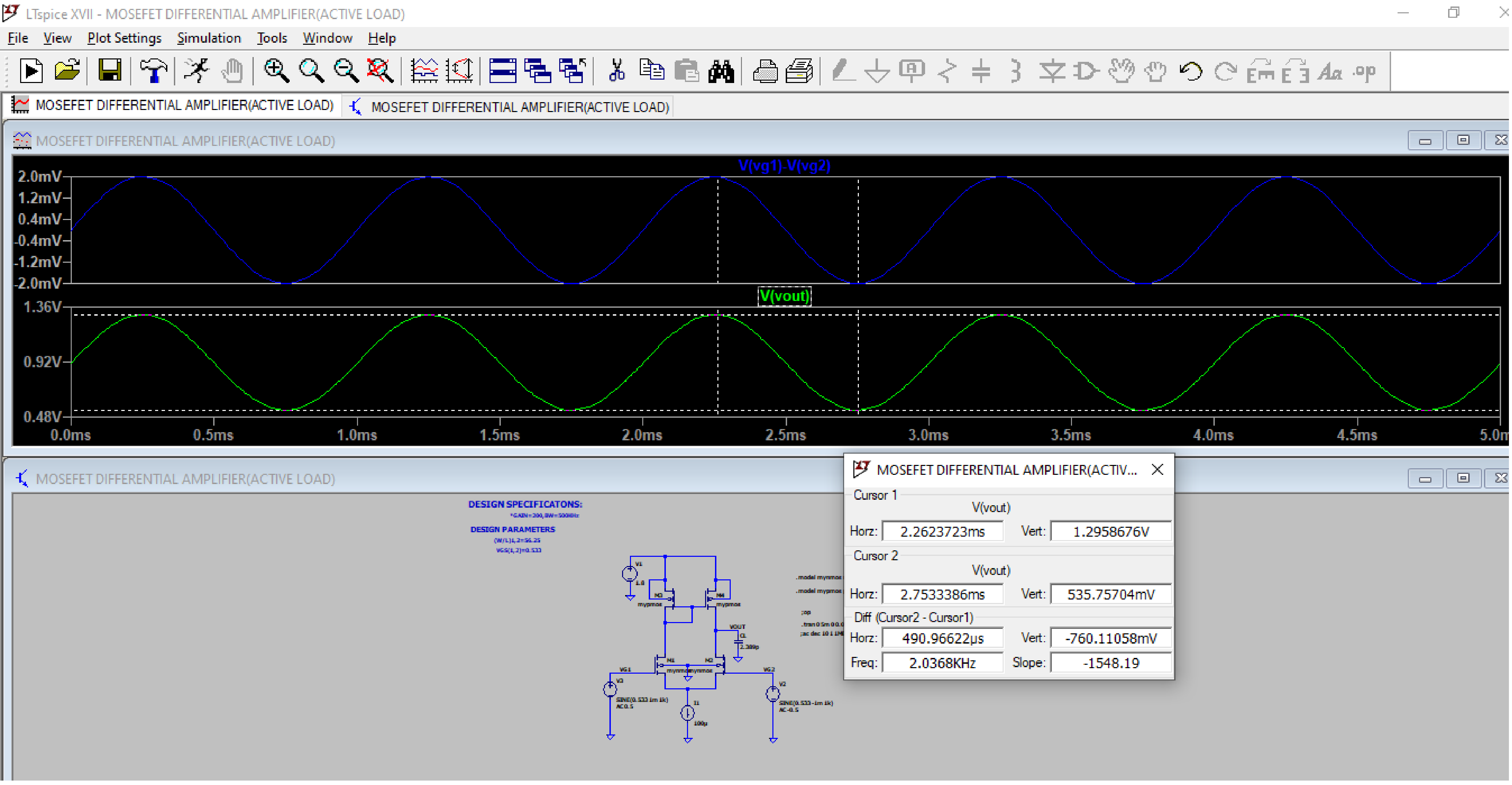

Edit Simulation Command
Transient
AC Analysis
DC sweep
Noise
DC Transfer
DC op pnt
Compute the DC operating point treating capacitances as open circuits and inductances as short circuits.
Syntax: .op
.op
Cancel
OK
* C:\Users\lenovo\Documents\LTspiceXVII\MOSEFET DIFFERENTIAL AMPLIFIER(ACTIVE LOAD).asc
--- Operating Point ---
V(n002): 0.910758 voltage
V(vg1): 0.533 voltage
V(n004): 0.0586436 voltage
V(n003): 0.910758 voltage
V(vg2): 0.533 voltage
V(n001): 1.8 voltage
Id(M4): 5e-005 device_current
Ig(M4): -0 device_current
Ib(M4): 8.99242e-013 device_current
Is(M4): -5e-005 device_current
Id(M3): 5e-005 device_current
Ig(M3): -0 device_current
Ib(M3): 8.99242e-013 device_current
Is(M3): -5e-005 device_current
Id(M2): 5e-005 device_current
Ig(M2): 0 device_current
Ib(M2): -9.88366e-013 device_current
Is(M2): -5e-005 device_current
Id(M1): 5e-005 device_current
Ig(M1): 0 device_current
Ib(M1): -9.88366e-013 device_current
Is(M1): -5e-005 device_current
I(C1): 2.1758e-024 device_current
I(I1): 0.0001 device_current
I(V3): 0 device_current
I(V2): 0 device_current
I(V1): -0.0001 device_current
AC -0.5


Edit Simulation Command
Transient
AC Analysis
DC sweep
Noise
DC Transfer
DC op pnt
Compute the small signal AC behavior of the circuit linearized about its DC operating point.
Type of sweep: Decade
Number of points per decade: 10
Start frequency: 1
Stop frequency: 1MEG
Syntax: .ac <oct, dec, lin> <Npoints> <StartFreq> <EndFreq>
.ac dec 10 1 1MEG
Cancel
OK

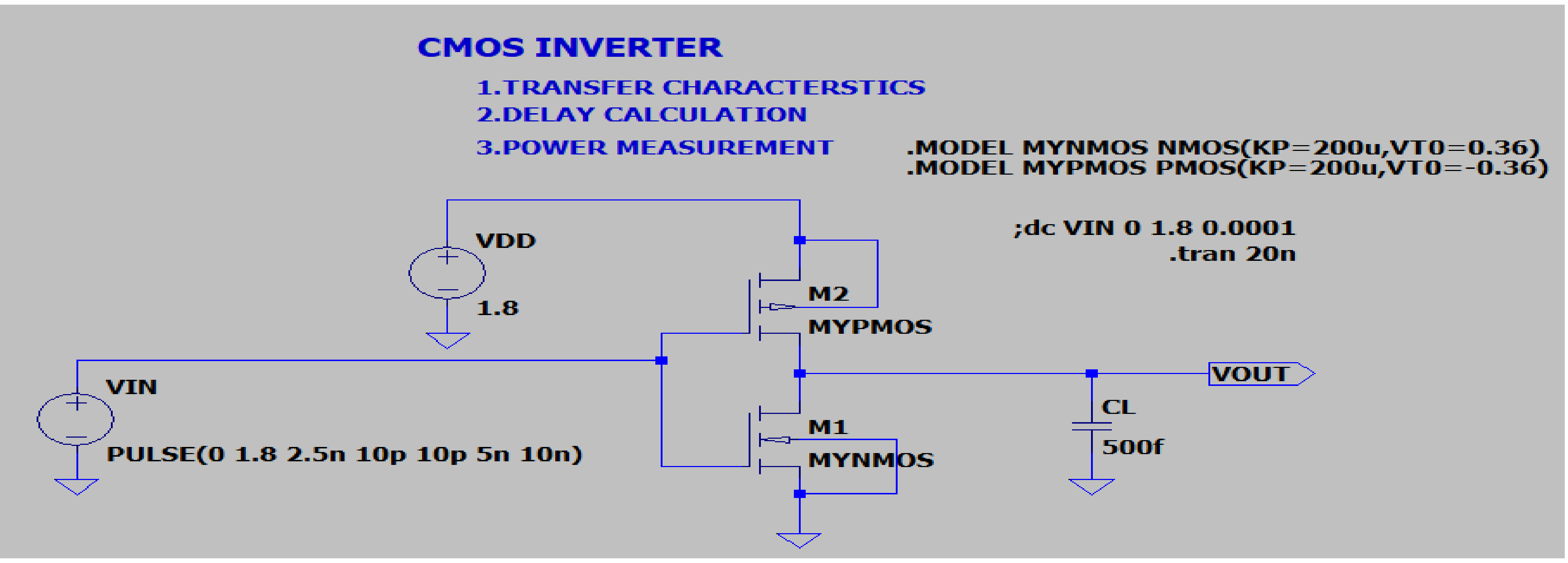


TRANSIENT ANALYSIS:





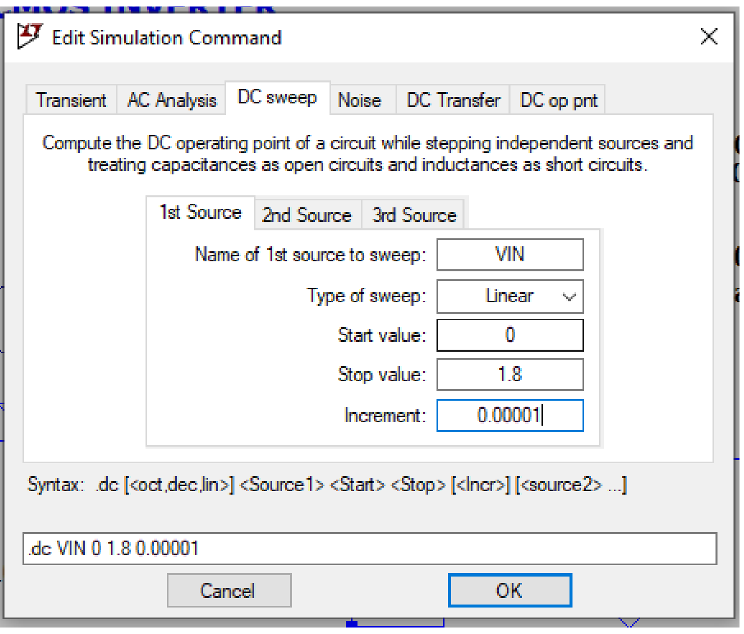
CMOS NOT GATE:

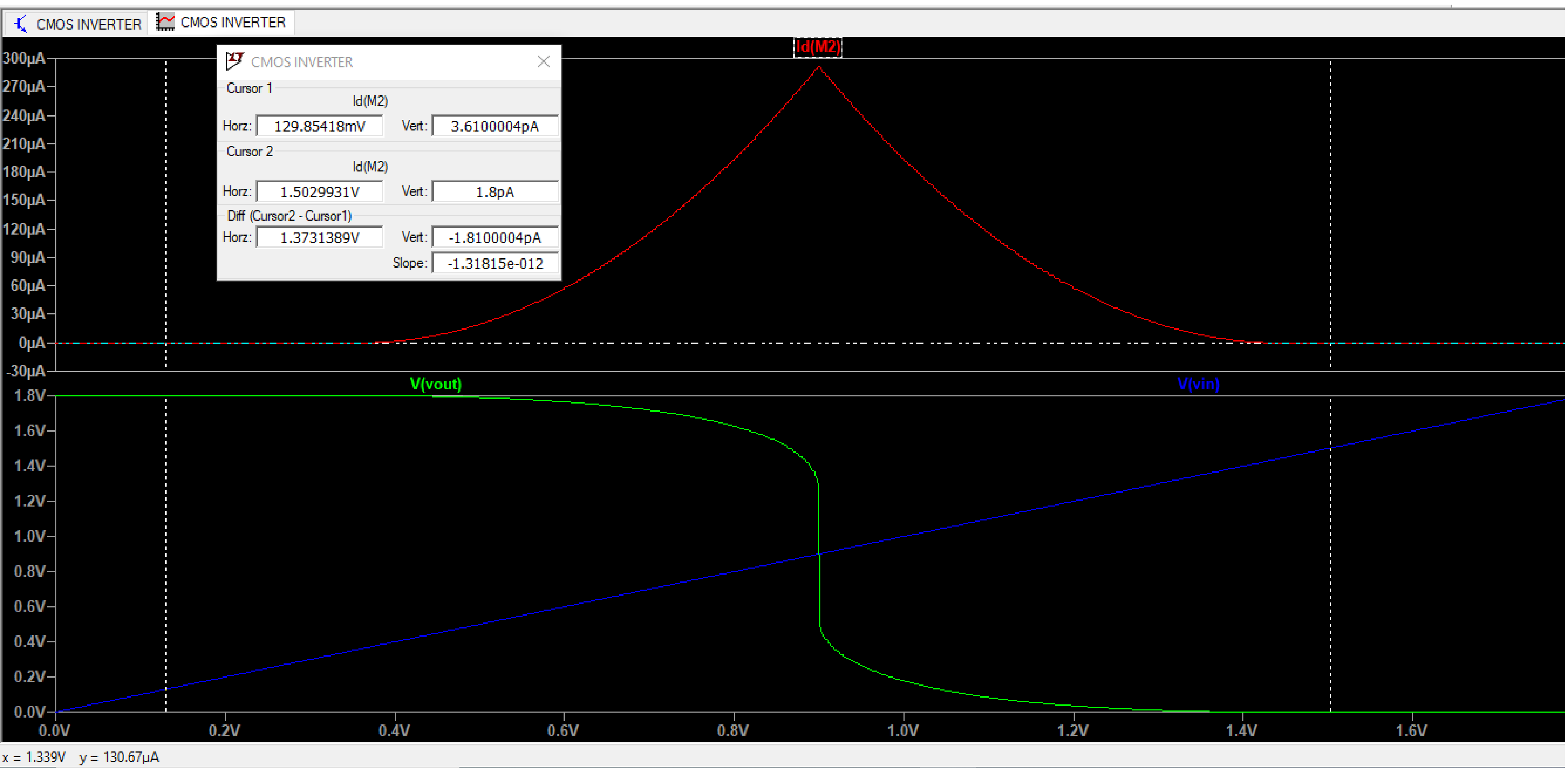


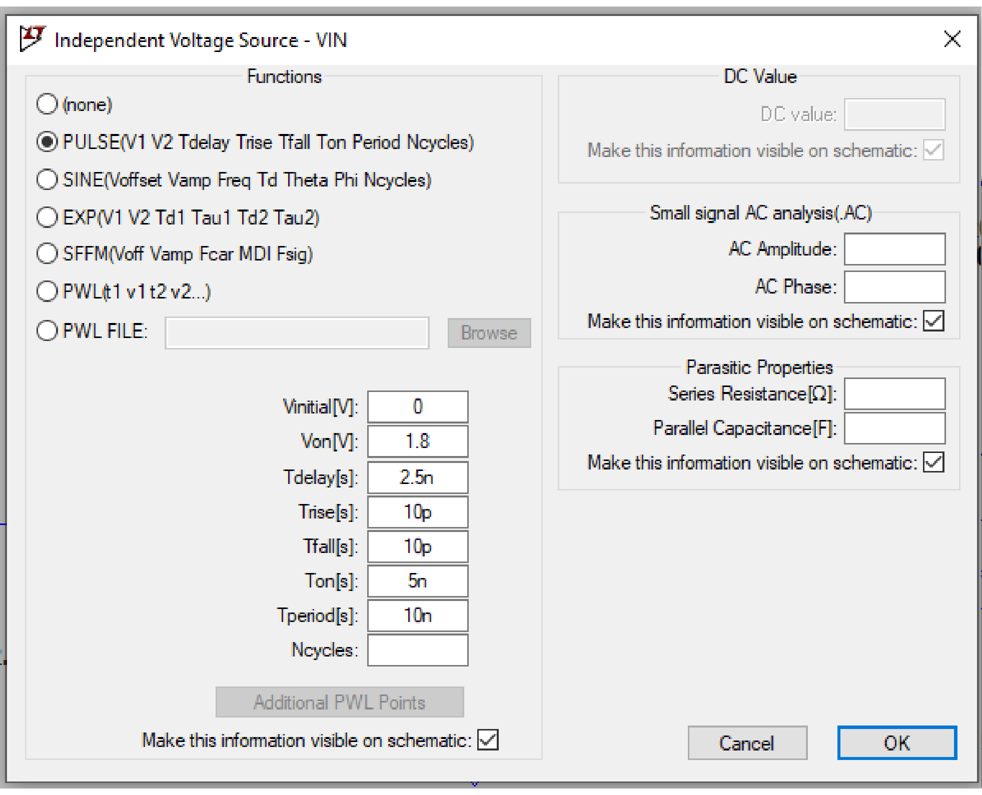
TRANSFER CHARACTERSTICS:

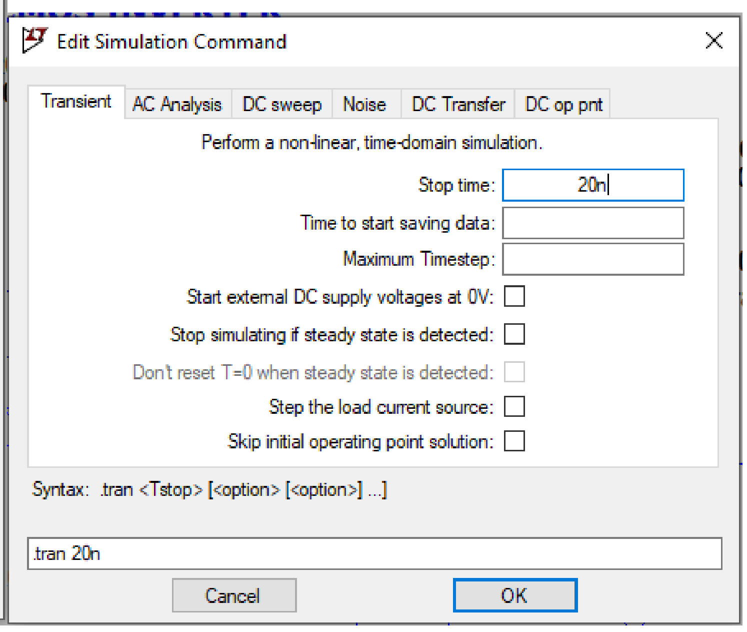
- For finding the transfer function go to DC SWEEP and give the source name and other parameters as shown in figure.
- Here the 3.61pA And 1.8pA current Are static leakage currents of NMOS and PMOS Respectively.

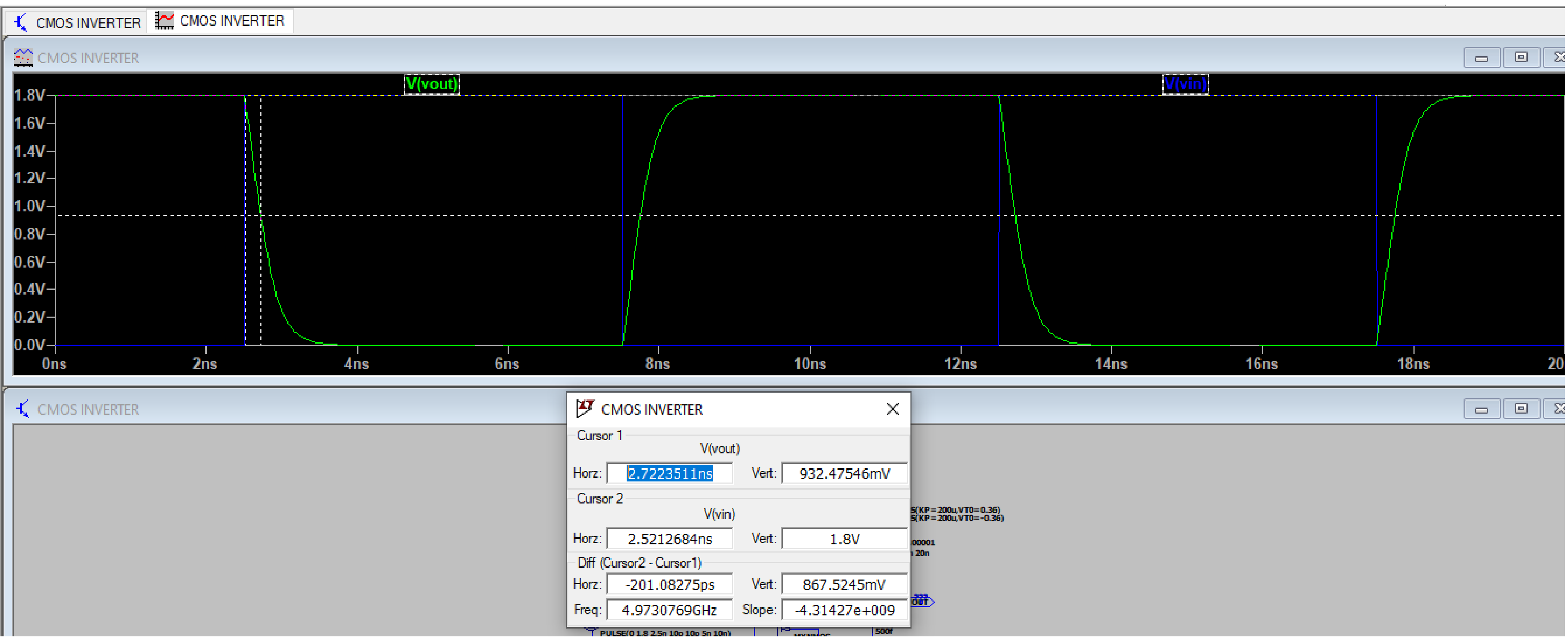
t(phl)=201pS

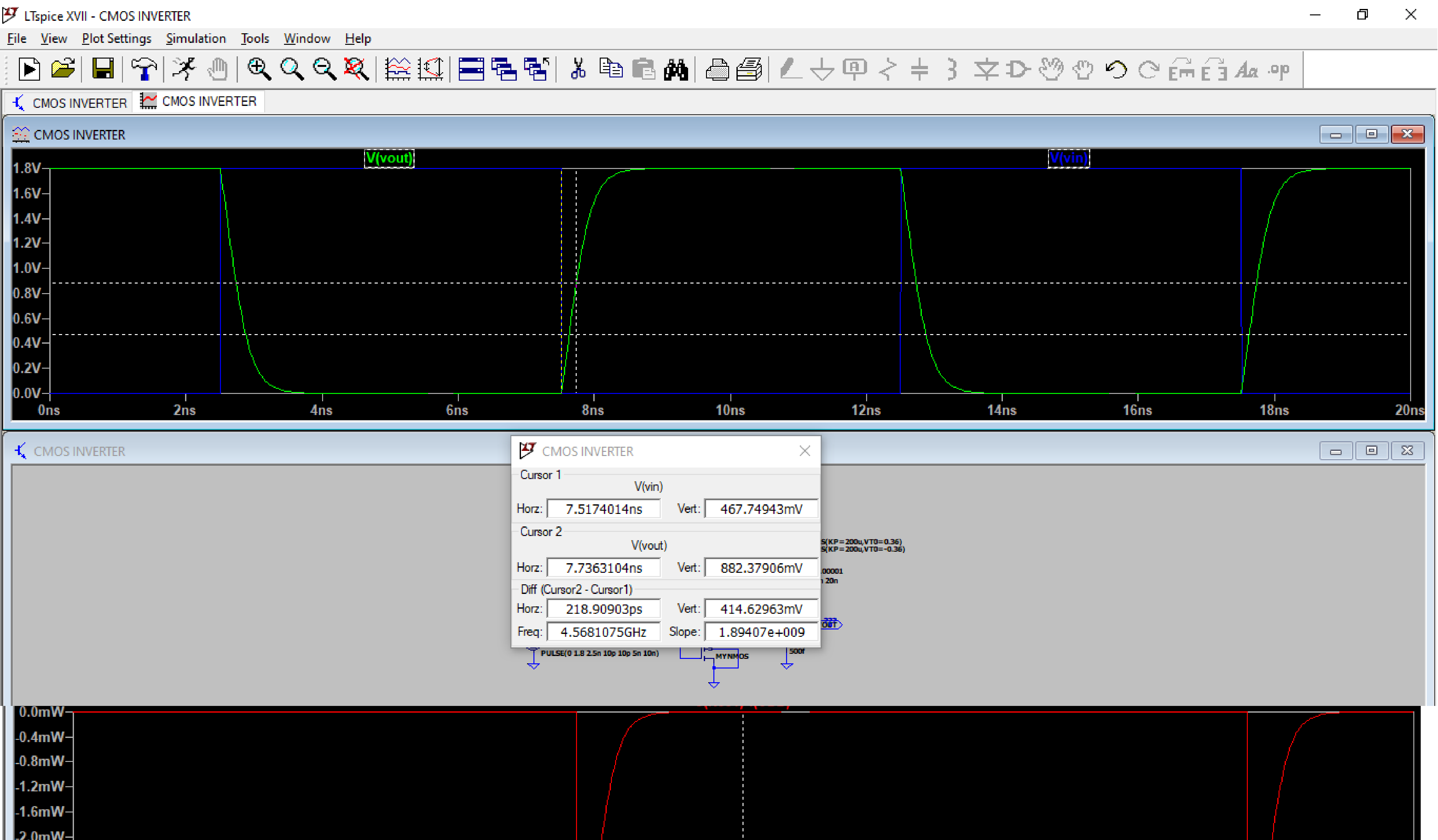

Edit Simulation Command
Transient AC Analysis DC sweep Noise DC Transfer DC op pnt
Compute the DC operating point of a circuit while stepping independent sources and treating capacitances as open circuits and inductances as short circuits.
1st Source 2nd Source 3rd Source
Name of 1st source to sweep: VIN
Type of sweep: Linear
Start value: 0
Stop value: 1.8
Increment: 0.00001
Syntax: .dc [<oct,dec,lin>] <Source1> <Start> <Stop> [<Incr>] [<source2> ...]
.dc VIN 0 1.8 0.00001
Cancel
OK


CMOS INVERTER
CMOS INVERTER
Id(M2)
CMOS INVERTER
Cursor 1
Id(M2)
Horz: 129.85418mV Vert: 3.6100004pA
Cursor 2
Id(M2)
Horz: 1.5029931V Vert: 1.8pA
Diff (Cursor2 - Cursor1)
Horz: 1.3731389V Vert: -1.8100004pA
Slope: -1.31815e-012
300µA
270µA
240µA
210µA
180µA
150µA
120µA
90µA
60µA
30µA
0µA
-30µA
V(vout)
V(vin)
1.8V
1.6V
1.4V
1.2V
1.0V
0.8V
0.6V
0.4V
0.2V
0.0V
0.0V 0.2V 0.4V 0.6V 0.8V 1.0V 1.2V 1.4V 1.6V
x = 1.339V y = 130.67µA


Independent Voltage Source - VIN
Functions
(none)
PULSE(V1 V2 Tdelay Trise Tfall Ton Period Ncycles)
SINE(Voffset Vamp Freq Td Theta Phi Ncycles)
EXP(V1 V2 Td1 Tau1 Td2 Tau2)
SFFM(Voff Vamp Fcar MDI Fsig)
PWL(t1 v1 t2 v2...)
PWL FILE:
Browse
Vinitial[V]: 0
Von[V]: 1.8
Tdelay[s]: 2.5n
Trise[s]: 10p
Tfall[s]: 10p
Ton[s]: 5n
Tperiod[s]: 10n
Ncycles:
Additional PWL Points
Make this information visible on schematic:
DC Value
DC value:
Make this information visible on schematic:
Small signal AC analysis(.AC)
AC Amplitude:
AC Phase:
Make this information visible on schematic:
Parasitic Properties
Series Resistance[Ω]:
Parallel Capacitance[F]:
Make this information visible on schematic:
Cancel
OK


Edit Simulation Command
Transient AC Analysis DC sweep Noise DC Transfer DC op pnt
Perform a non-linear, time-domain simulation.
Stop time: 20n
Time to start saving data:
Maximum Timestep:
Start external DC supply voltages at 0V:
Stop simulating if steady state is detected:
Don't reset T=0 when steady state is detected:
Step the load current source:
Skip initial operating point solution:
Syntax: .tran <Tstop> [<option> [<option>] ...]
.tran 20n
Cancel
OK





Tpd=(t(phl)+t(plh))/2

=(201+218)/2

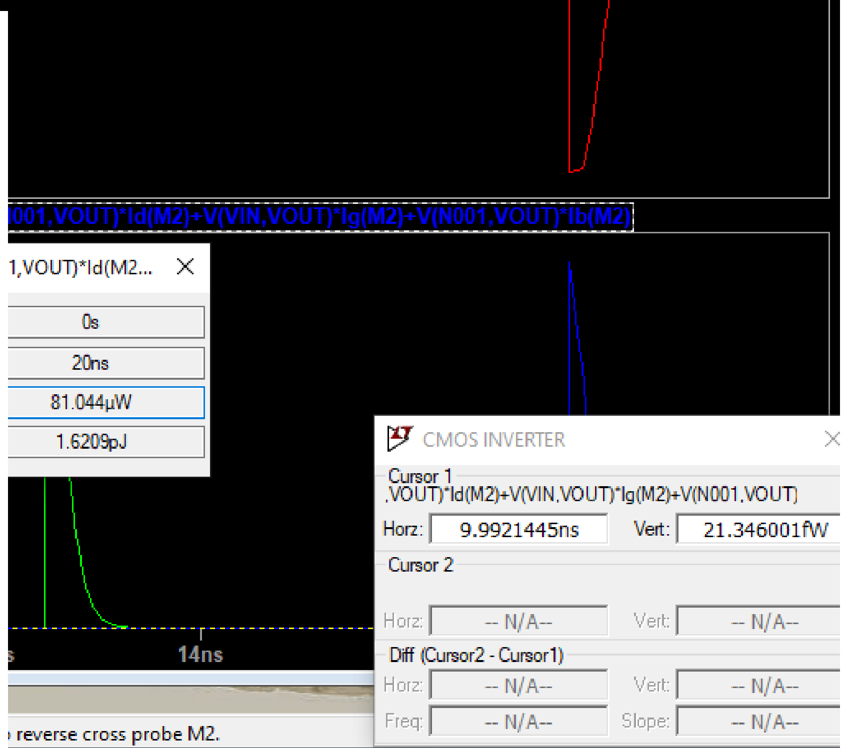
=209.5Ps

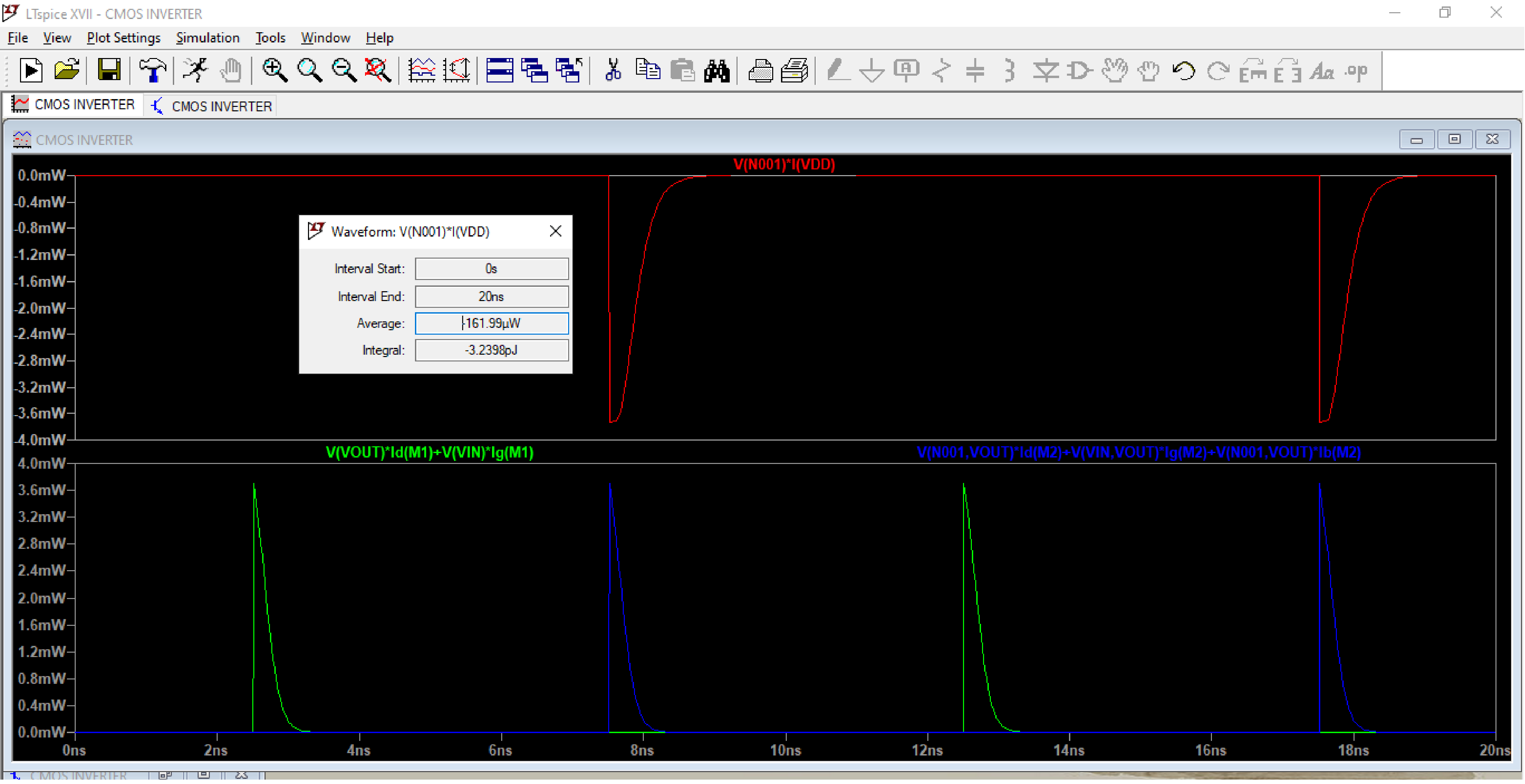
DYNAMIC POWER DISSIPATION CALCULATION:

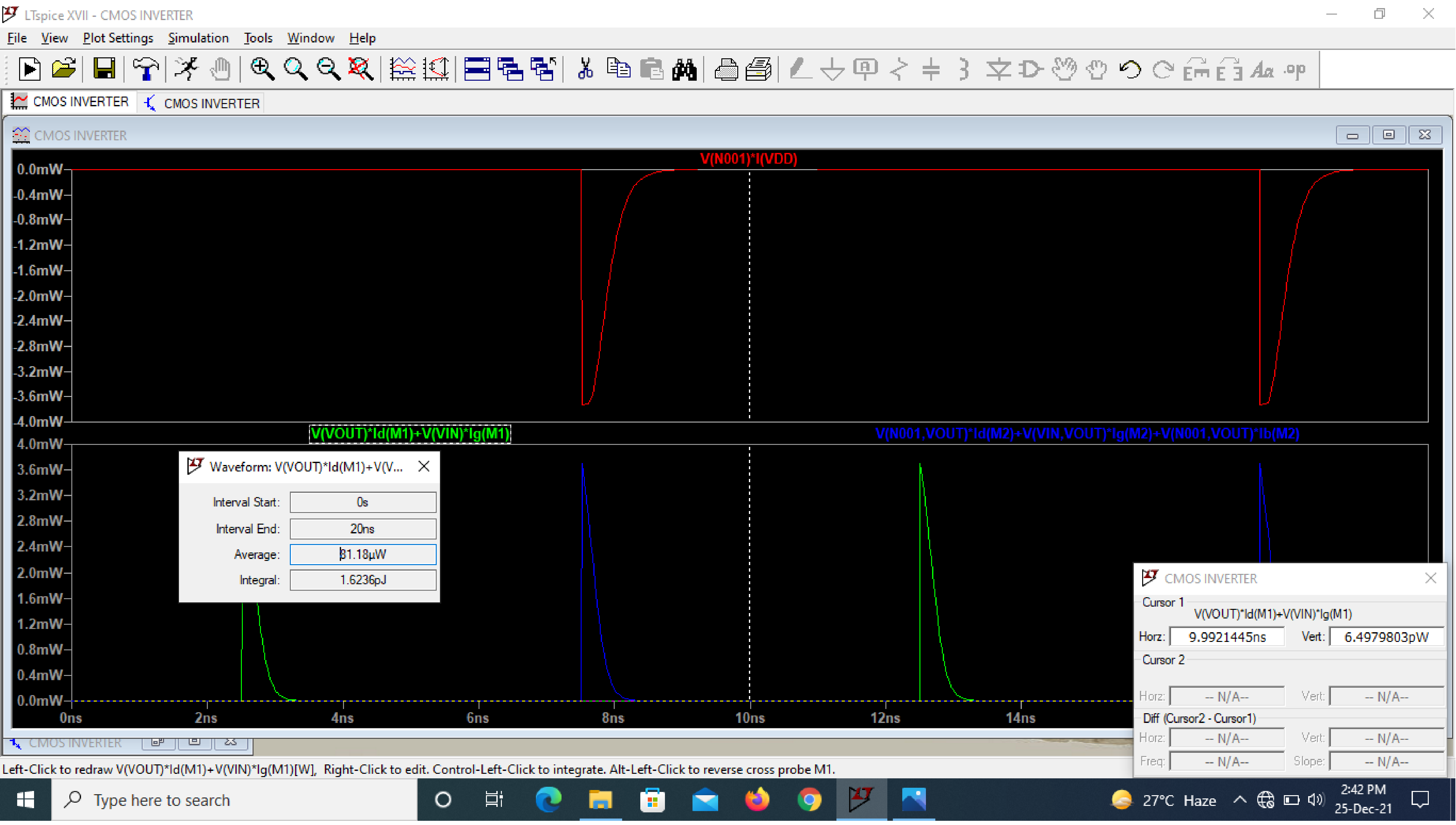
TOTAL PWER DISSIPATED=fCL(VDD)^2

POWER DISSIPATED BY NMOS=(f(CL)(VDD)^2)/2

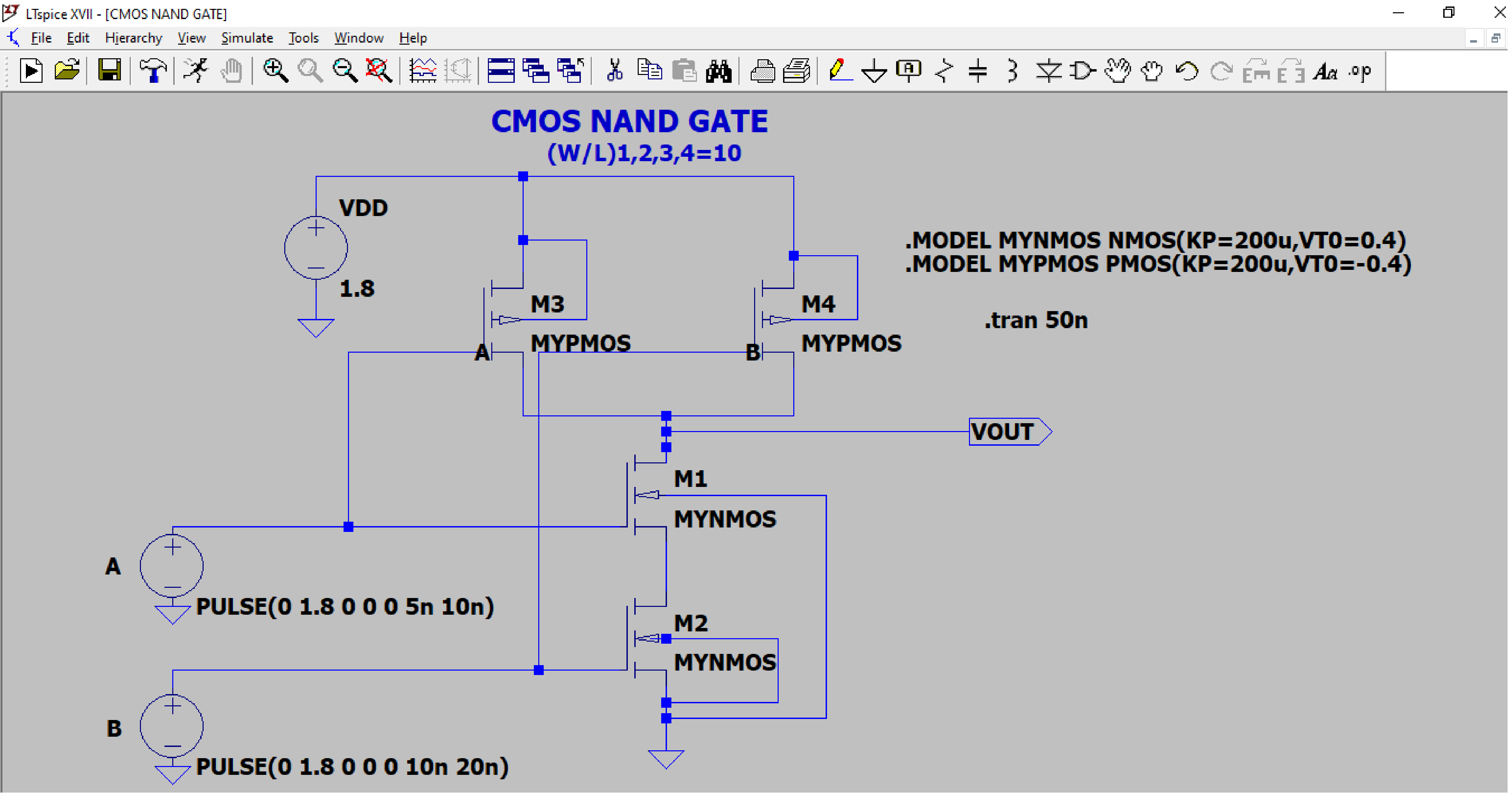
POWER DISSIPATED BY PMOS=(f(CL)(VDD)^2)/2



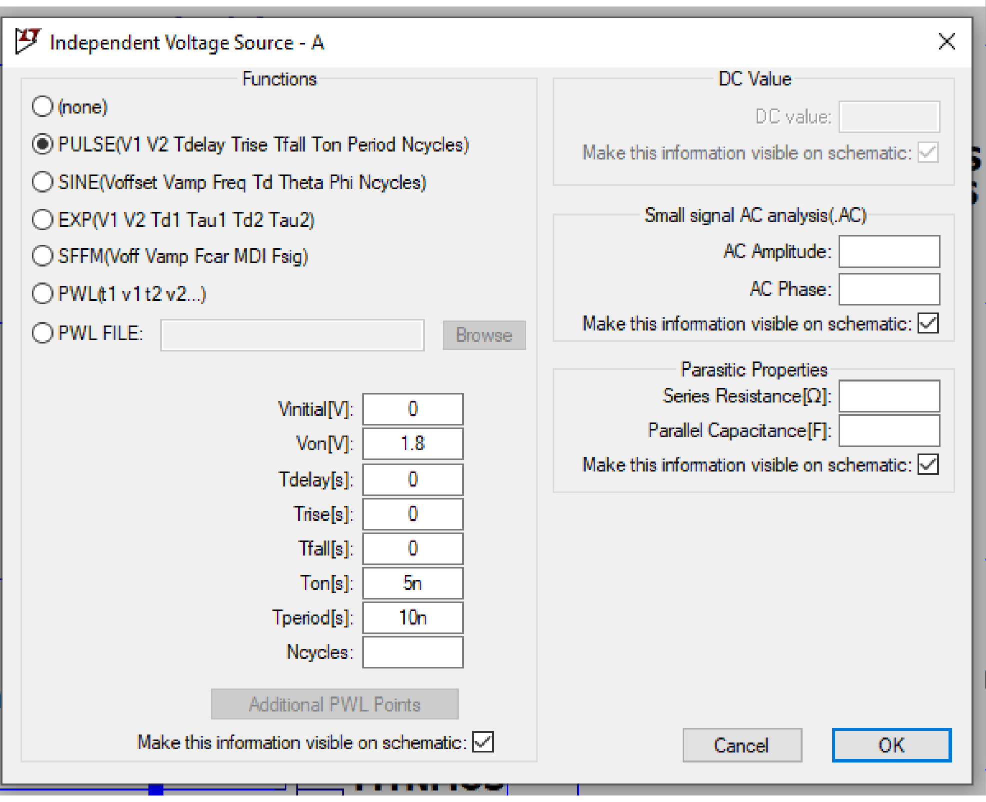




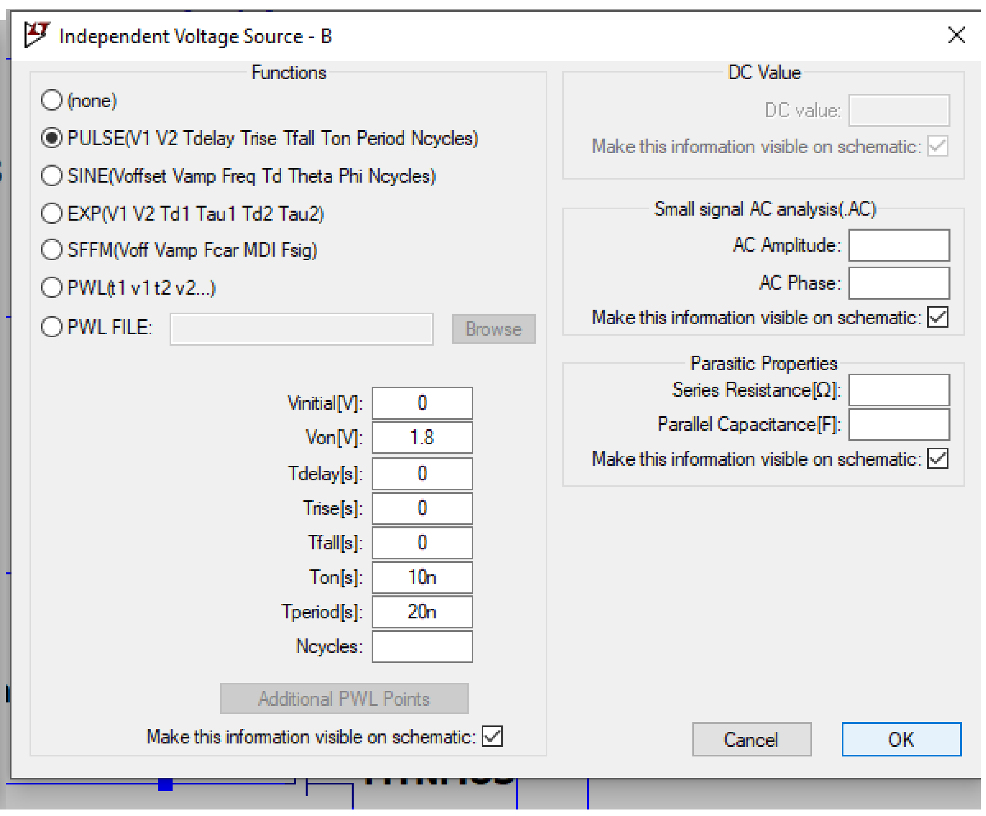
CMOS NAND GATE:



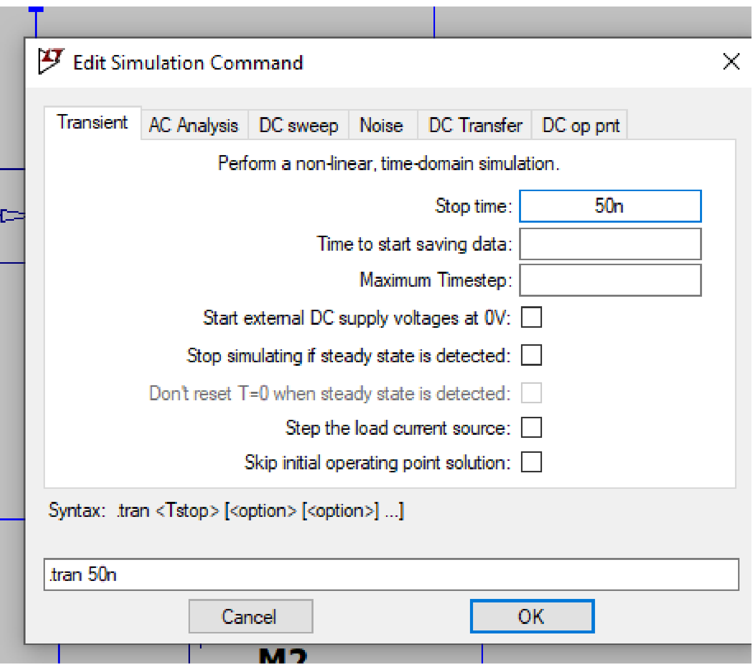
LTspice XVII - [CMOS NAND GATE]
File Edit Hierarchy View Simulate Tools Window Help
CMOS NAND GATE
(W/L)1,2,3,4=10
VDD
1.8
M3
MYPMOS
M4
MYPMOS
A
B
.MODEL MYNMOS NMOS(KP=200u,VT0=0.4)
.MODEL MYPMOS PMOS(KP=200u,VT0=-0.4)
.tran 50n
VOUT
M1
MYNMOS
M2
MYNMOS
A
PULSE(0 1.8 0 0 0 5n 10n)
B
PULSE(0 1.8 0 0 0 10n 20n)



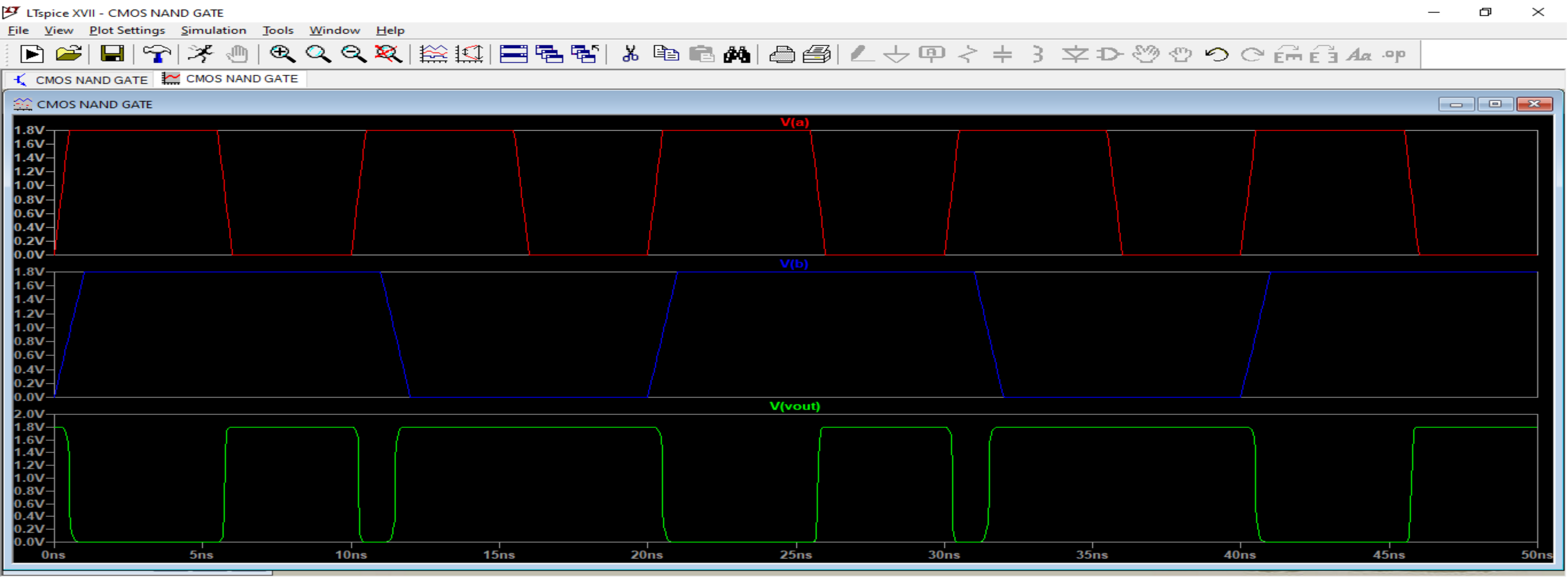
Independent Voltage Source - A
Functions
(none)
PULSE(V1 V2 Tdelay Trise Tfall Ton Period Ncycles)
SINE(Voffset Vamp Freq Td Theta Phi Ncycles)
EXP(V1 V2 Td1 Tau1 Td2 Tau2)
SFFM(Voff Vamp Fcar MDI Fsig)
PWL(t1 v1 t2 v2...)
PWL FILE:
Browse
Vinitial[V]: 0
Von[V]: 1.8
Tdelay[s]: 0
Trise[s]: 0
Tfall[s]: 0
Ton[s]: 5n
Tperiod[s]: 10n
Ncycles:
Additional PWL Points
Make this information visible on schematic:
DC Value
DC value:
Make this information visible on schematic:
Small signal AC analysis(.AC)
AC Amplitude:
AC Phase:
Make this information visible on schematic:
Parasitic Properties
Series Resistance[Ω]:
Parallel Capacitance[F]:
Make this information visible on schematic:
Cancel
OK



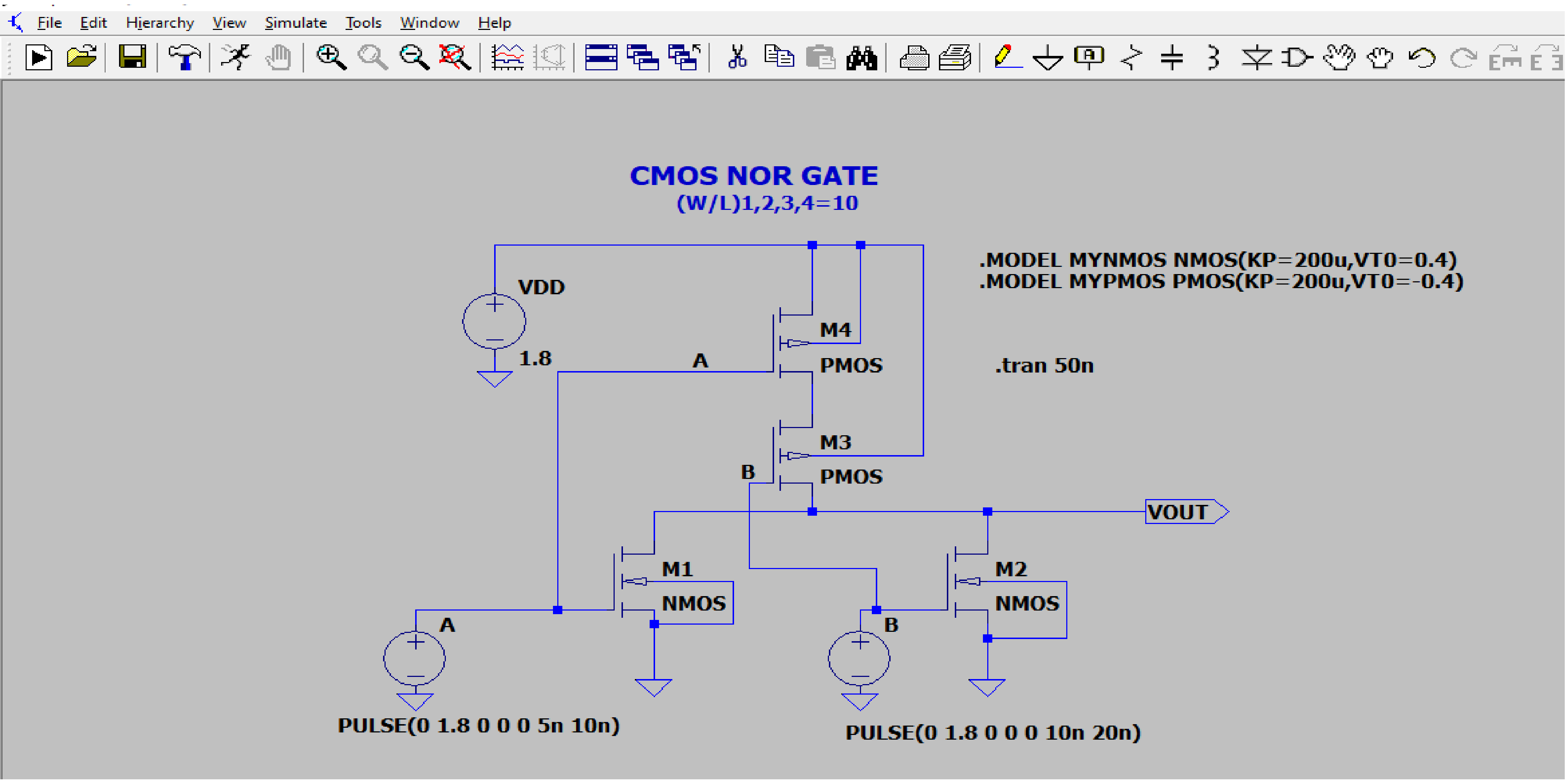
Independent Voltage Source - B
Functions
(none)
PULSE(V1 V2 Tdelay Trise Tfall Ton Period Ncycles)
SINE(Voffset Vamp Freq Td Theta Phi Ncycles)
EXP(V1 V2 Td1 Tau1 Td2 Tau2)
SFFM(Voff Vamp Fcar MDI Fsig)
PWL(t1 v1 t2 v2...)
PWL FILE:
Browse
Vinitial[V]: 0
Von[V]: 1.8
Tdelay[s]: 0
Trise[s]: 0
Tfall[s]: 0
Ton[s]: 10n
Tperiod[s]: 20n
Ncycles:
Additional PWL Points
Make this information visible on schematic:
DC Value
DC value:
Make this information visible on schematic:
Small signal AC analysis(.AC)
AC Amplitude:
AC Phase:
Make this information visible on schematic:
Parasitic Properties
Series Resistance[Ω]:
Parallel Capacitance[F]:
Make this information visible on schematic:
Cancel
OK

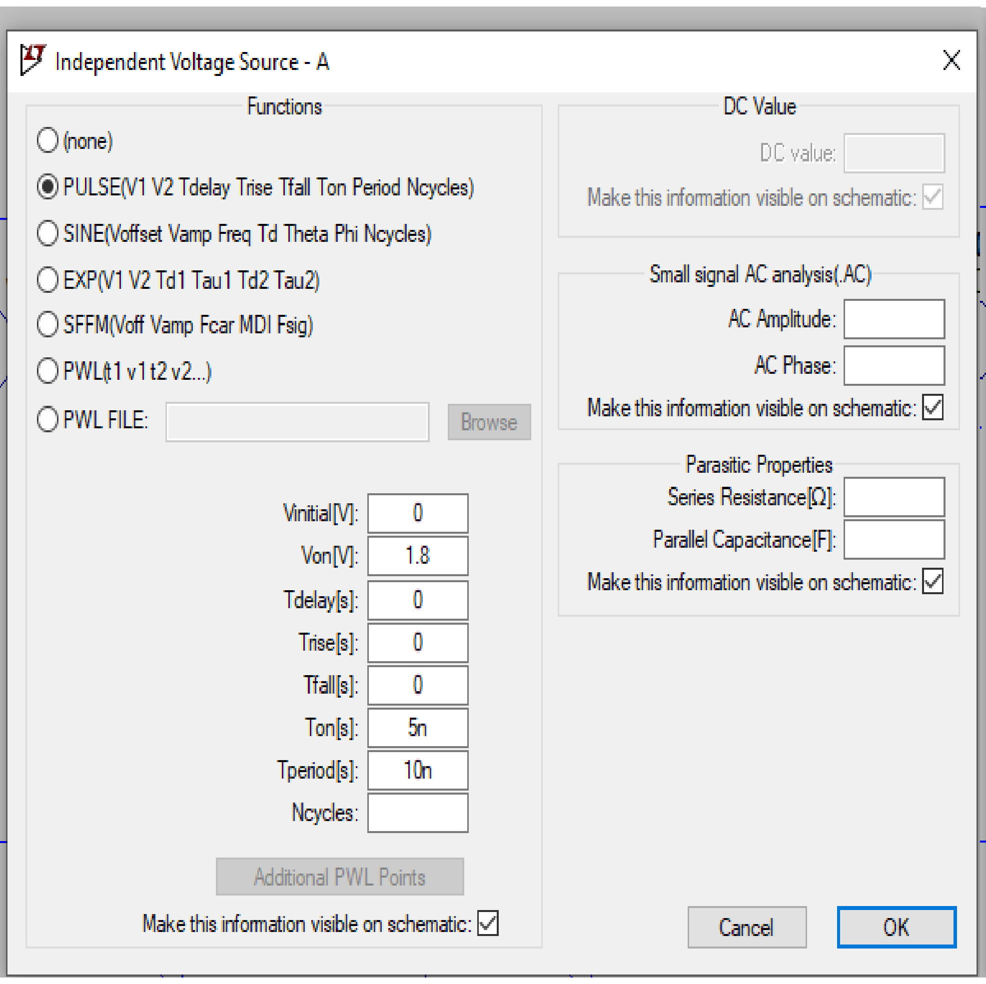


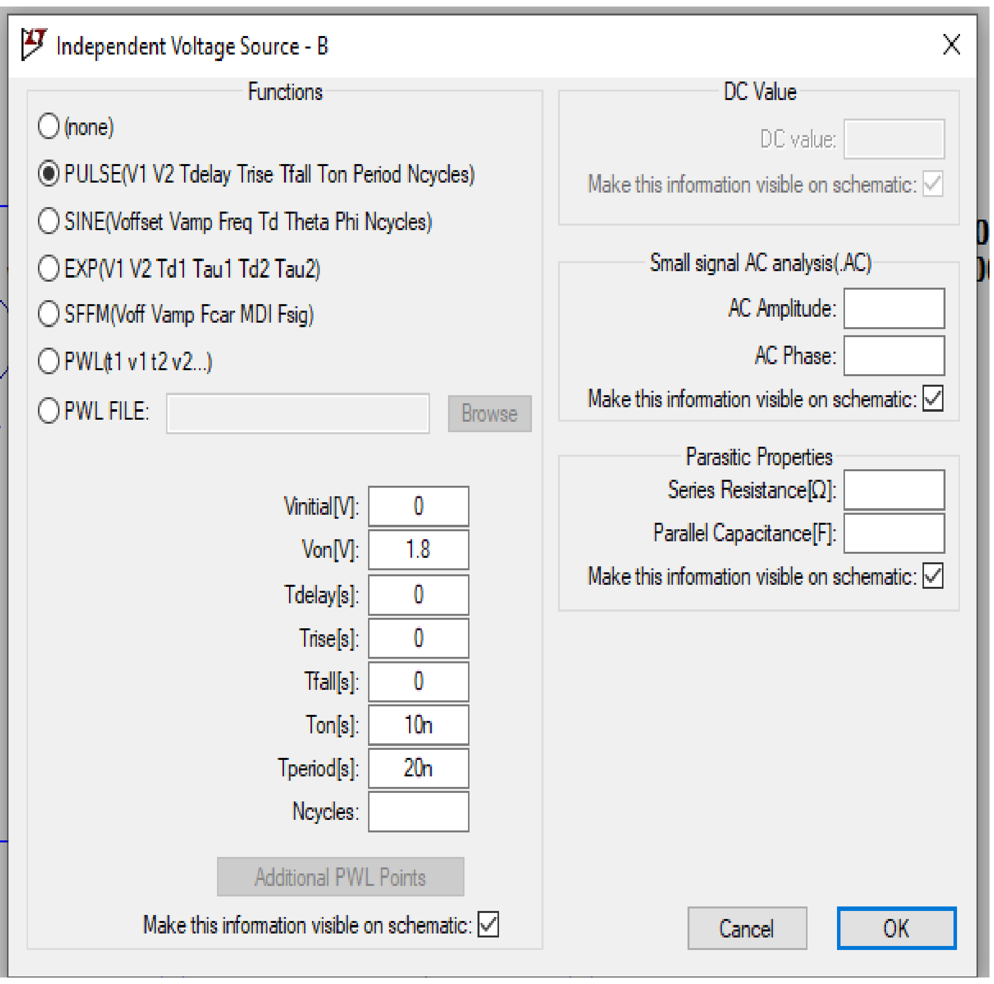
TRANSIENT ANALYSIS:



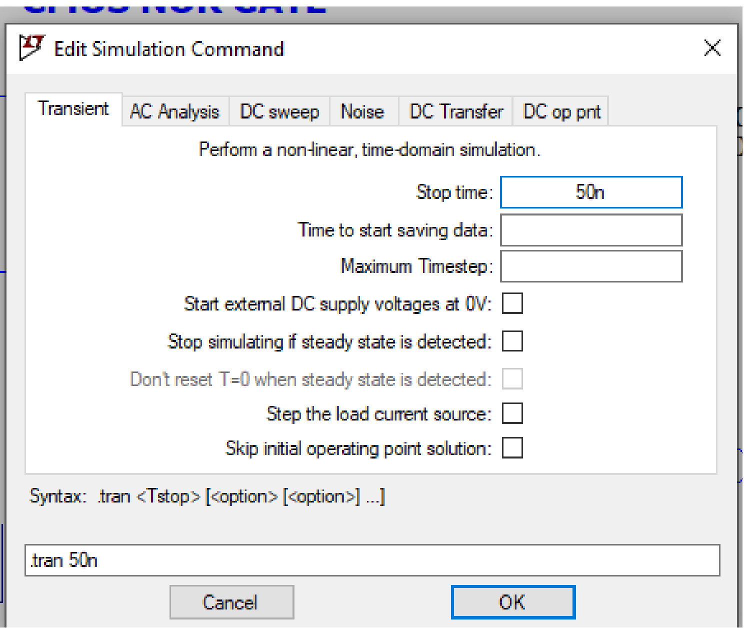
CMOS NOR GATE:

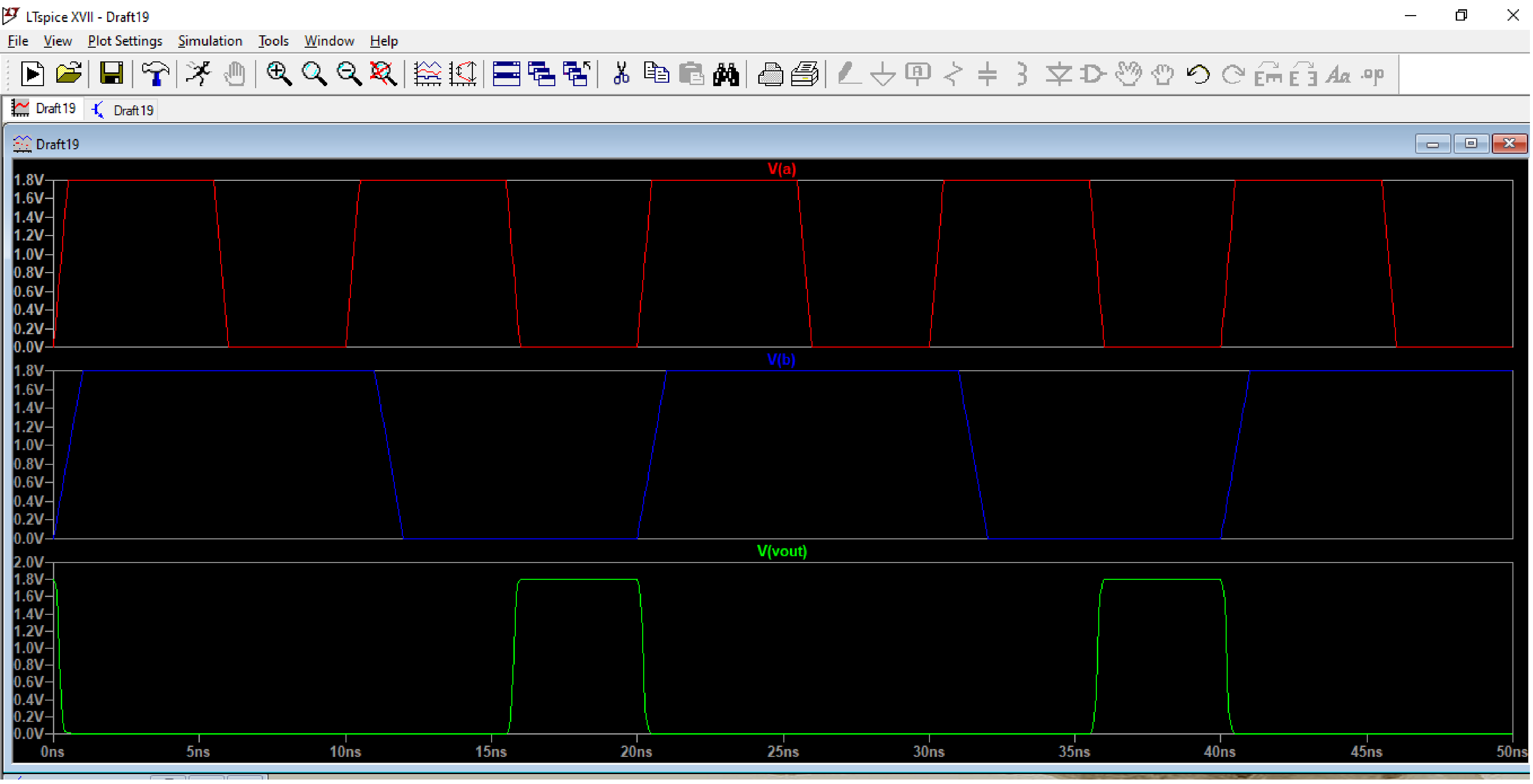






TRANSIENT ANALYIS:


Edit Simulation Command
Transient
AC Analysis
DC sweep
Noise
DC Transfer
DC op pnt
Perform a non-linear, time-domain simulation.
Stop time:
50n
Time to start saving data:
Maximum Timestep:
Start external DC supply voltages at 0V:
Stop simulating if steady state is detected:
Don't reset T=0 when steady state is detected:
Step the load current source:
Skip initial operating point solution:
Syntax: .tran <Tstop> [<option> [<option>] ...]
.tran 50n
Cancel
OK


LTspice XVII - Draft19
File
View
Plot Settings
Simulation
Tools
Window
Help
Draft19
Draft19
Draft19
V(a)
V(b)
V(vout)
1.8V
1.6V
1.4V
1.2V
1.0V
0.8V
0.6V
0.4V
0.2V
0.0V
2.0V
0ns
5ns
10ns
15ns
20ns
25ns
30ns
35ns
40ns
45ns
50ns