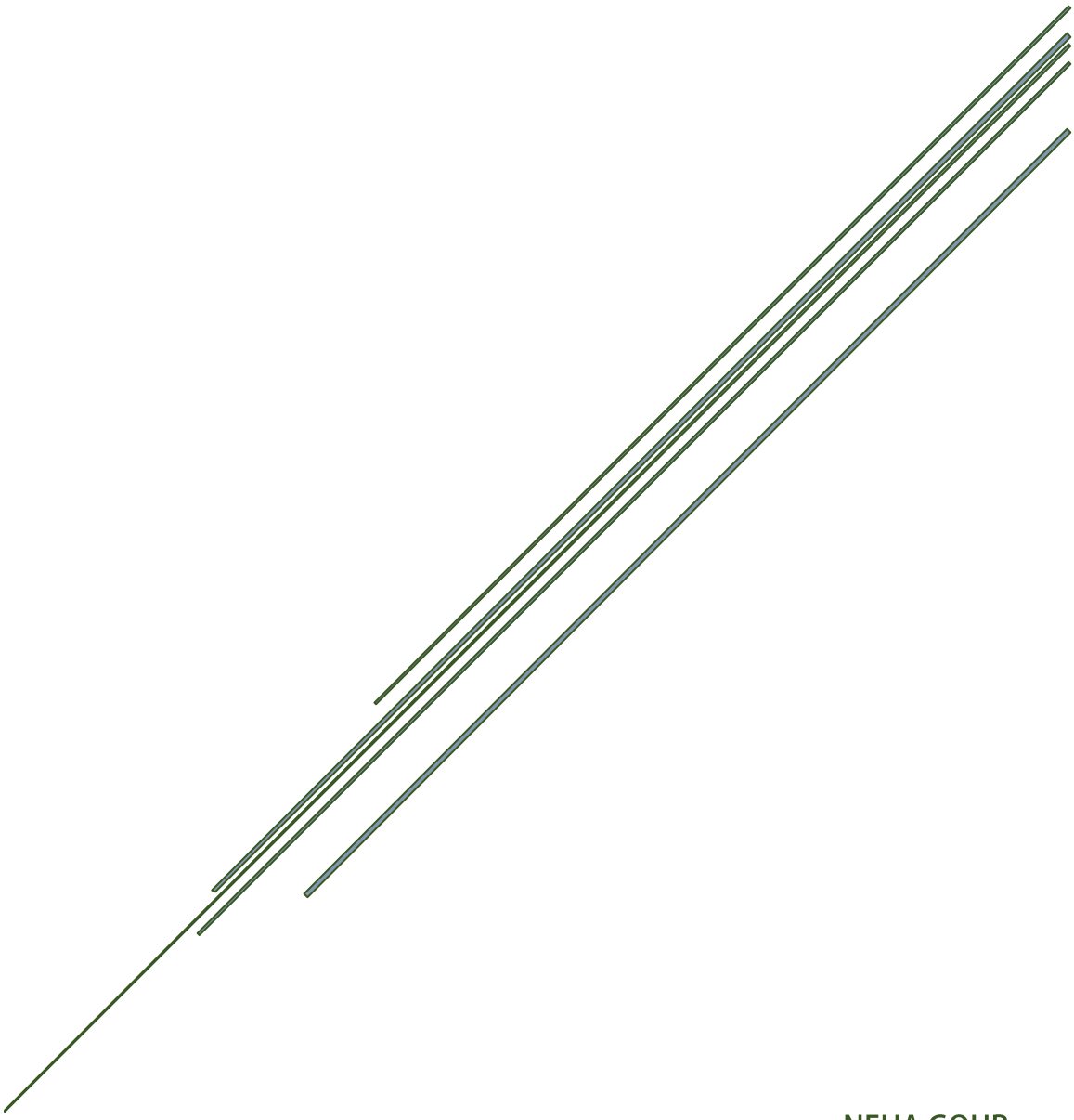
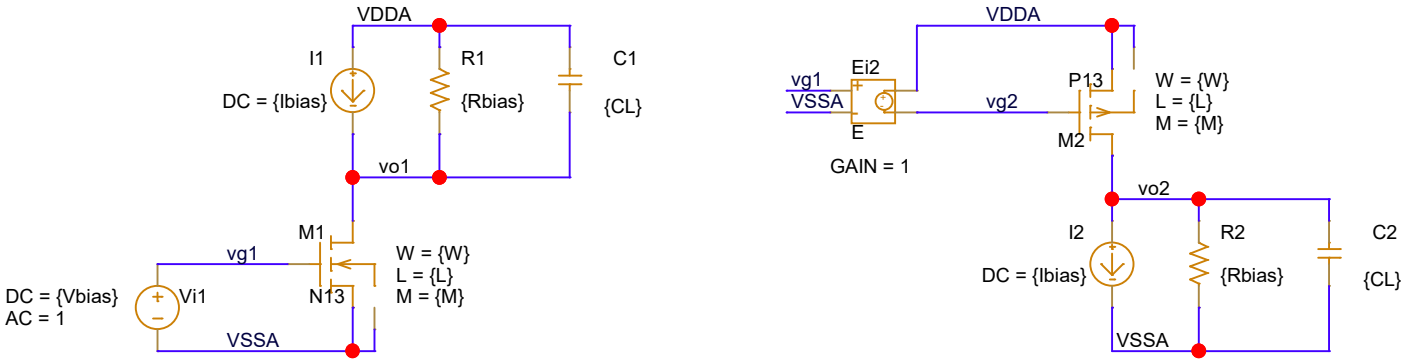
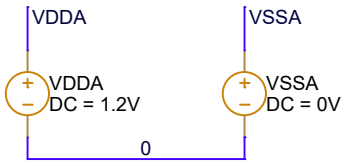
EEE 230 PROJECT-1 REPORT

Design and Simulation of Common Source Amplifier



NEHA GOUR
303261751





PARAMETERS:

W = 2.6u
L = .13u
M = 2

Vbias = 385.960mV

Rbias = 10k
Ibias = 0

CL = 100fF

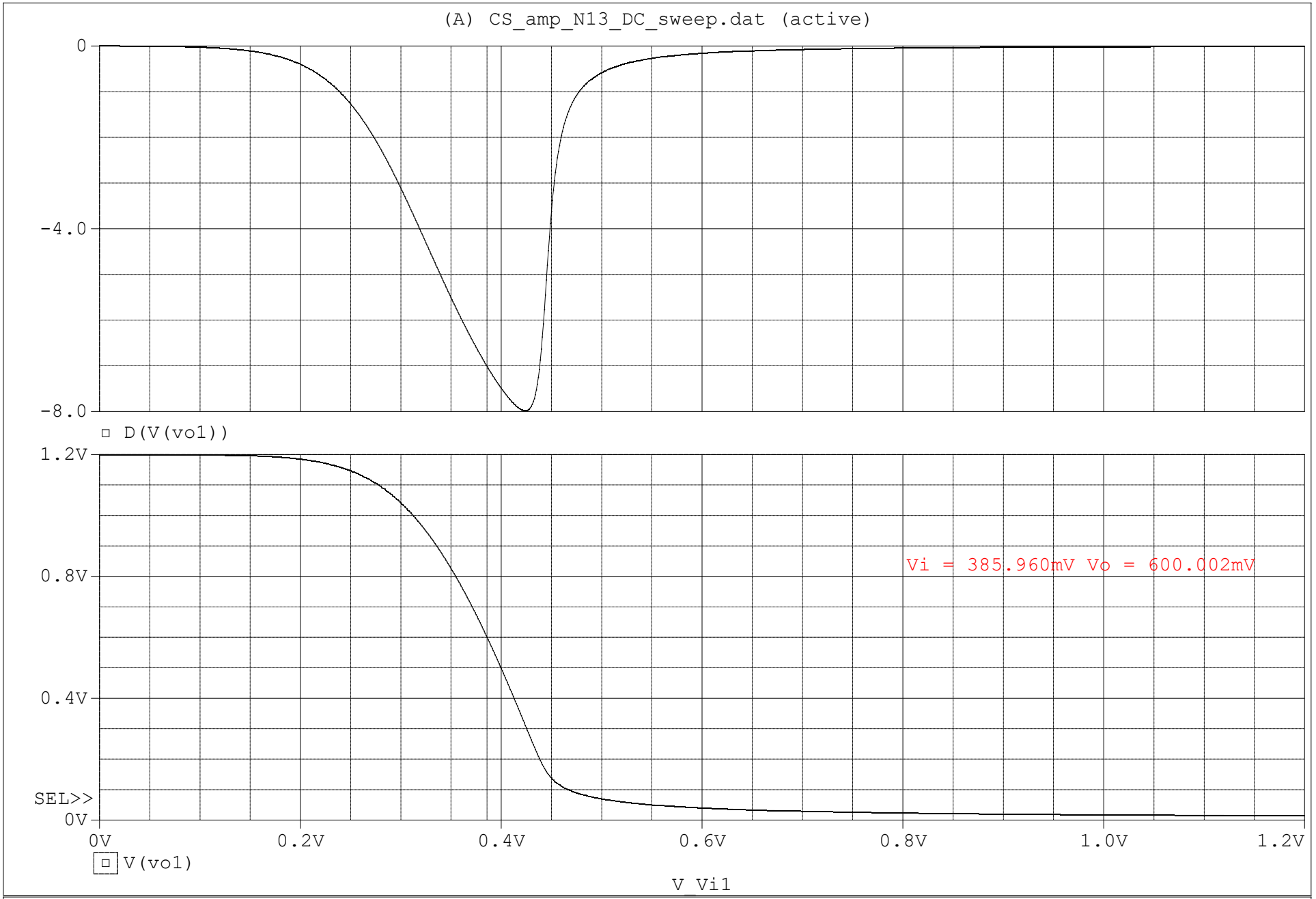
Author = Neha Gour

Title
Common-source amplifier with current source load

Size	Document Number	Rev
A	EEE 230 Project-1	

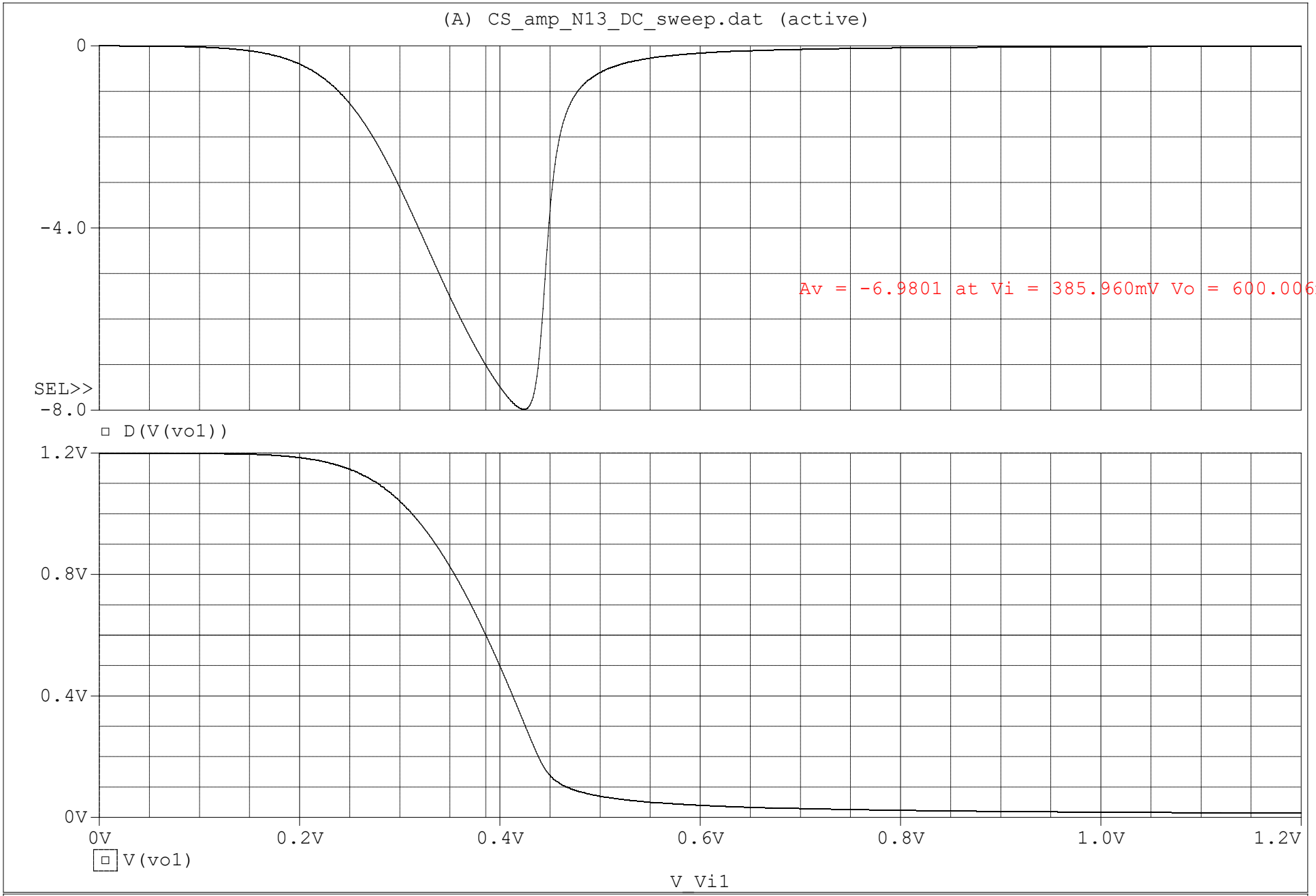
Date: Friday, September 30, 2022 Sheet 1 of 1

** Profile: "SCHEMATIC1-CS_amp_N13_DC_sweep" [U:\Desktop\230\Project_1\CS_amp\CS_amp\cs_amp-pspicefile...
Date/Time run: 09/30/22 16:28:32 Temperature: 27.0

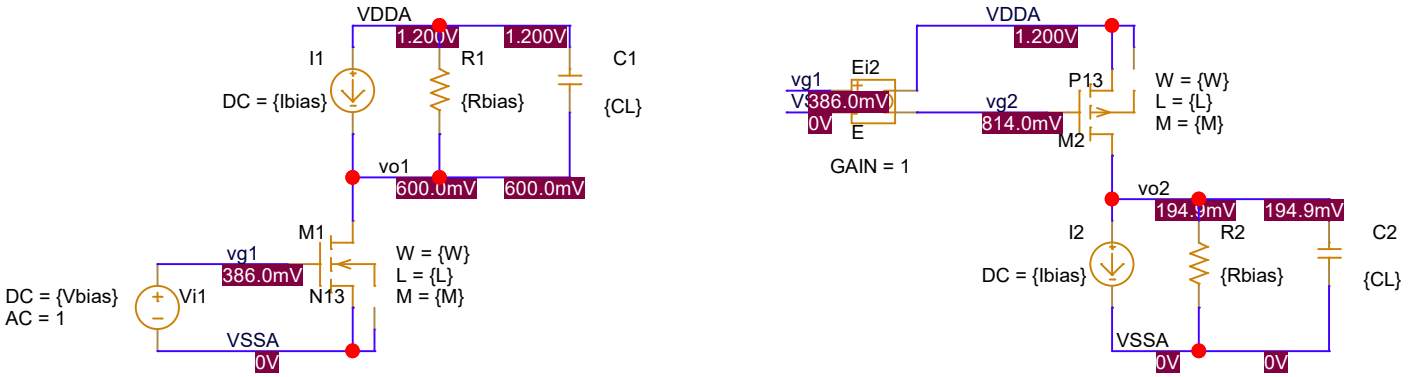


A1:(385.960m,599.957m) A2:(0.000,1.2000) DIFF(A):(385.960m,-600.002m)

** Profile: "SCHEMATIC1-CS_amp_N13_DC_sweep" [U:\Desktop\230\Project_1\CS_amp\CS_amp\cs_amp-pspicefile...
Date/Time run: 09/30/22 16:28:32 Temperature: 27.0



A1:(385.960m,599.954m) A2:(0.000,1.2000) DIFF(A):(385.960m,-600.006m)



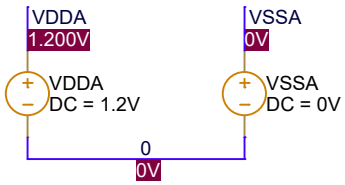
PARAMETERS:

W = 2.6u
L = .13u
M = 2

Vbias = 385.960mV

Rbias = 10k
Ibias = 0

CL = 100fF

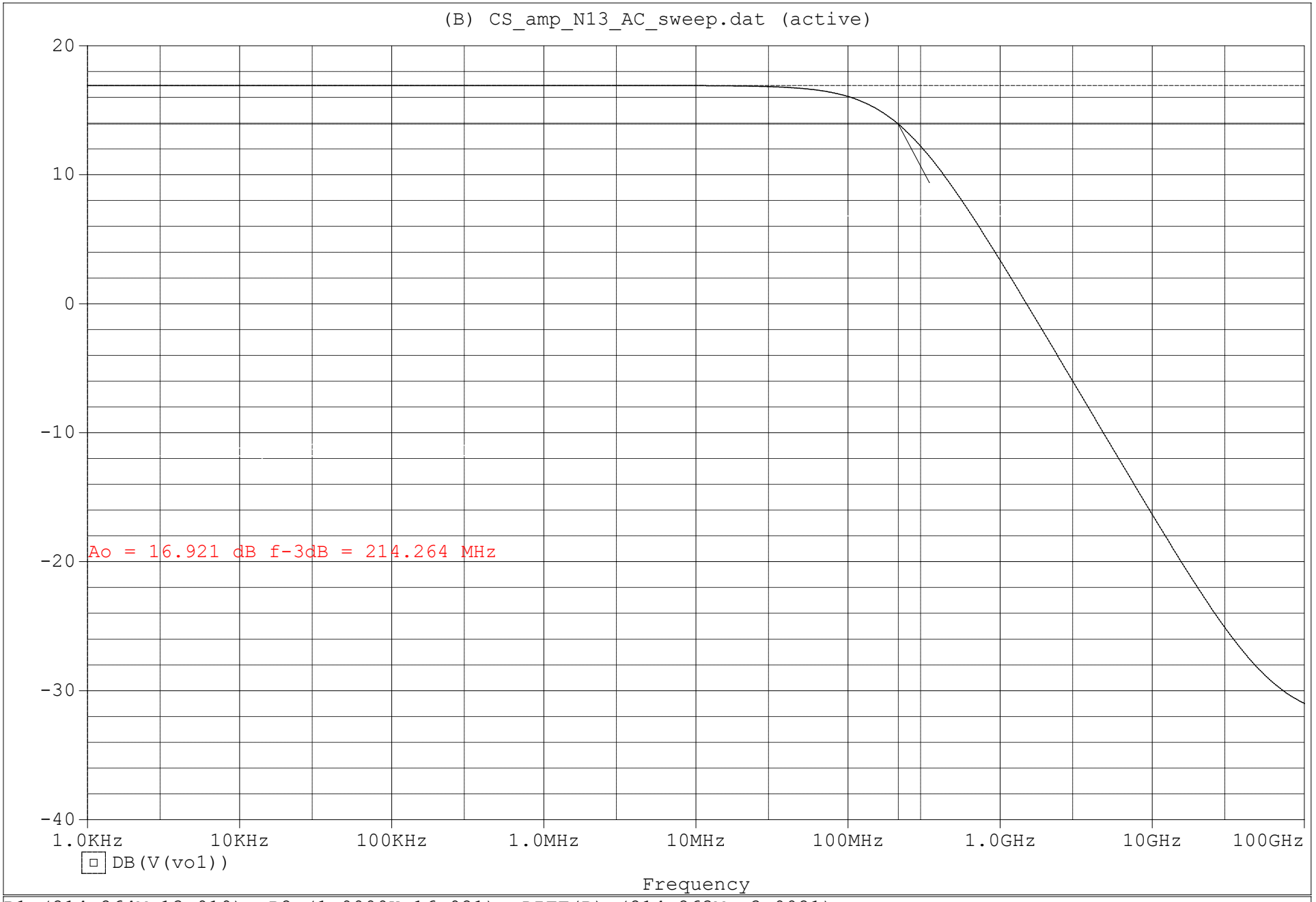


Author = Neha Gour		
Title: Common-source amplifier with current source load		
Size: A	Document Number: EEE 230 Project-1	Rev
Date: Friday, September 30, 2022	Sheet 1 of 1	

```
211:
212:
213: WARNING(ORPSIM-15235): Mosfet M_M1, model N13: Pd = 0 is less than W
214:
215: WARNING(ORPSIM-15235): Mosfet M_M1, model N13: Ps = 0 is less than W
216:
217: WARNING(ORPSIM-15236): Parameter CTA in model N13 is invalid - Ignored
218:
219: WARNING(ORPSIM-15236): Parameter CTP in model N13 is invalid - Ignored
220:
221: WARNING(ORPSIM-15236): Parameter PTA in model N13 is invalid - Ignored
222:
223: WARNING(ORPSIM-15236): Parameter PTP in model N13 is invalid - Ignored
224:
225: WARNING(ORPSIM-15235): Mosfet M_M2, model P13: Pd = 0 is less than W
226:
227: WARNING(ORPSIM-15235): Mosfet M_M2, model P13: Ps = 0 is less than W
228:
229: WARNING(ORPSIM-15236): Parameter CTA in model P13 is invalid - Ignored
230:
231: WARNING(ORPSIM-15236): Parameter CTP in model P13 is invalid - Ignored
232:
233: WARNING(ORPSIM-15236): Parameter PTA in model P13 is invalid - Ignored
234:
235: WARNING(ORPSIM-15236): Parameter PTP in model P13 is invalid - Ignored
236: □
237: **** 10/06/22 02:13:47 ******* PSpice 17.4.0 (Nov 2018) ******* ID# 0 ********
238:
239:  ** Profile: "SCHEMATIC1-CS_amp_N13_AC_sweep"  [ U:\Desktop\230\Project_1\CS_amp\CS_amp\c
     s_amp-pspicefiles\schematic1\cs_amp_n13_ac_s
240:
241:
242:  ****     SMALL SIGNAL BIAS SOLUTION       TEMPERATURE =   27.000 DEG C
243:
244:
245: ********************************************************************************
246:
247:
248:
249:  NODE   VOLTAGE     NODE   VOLTAGE     NODE   VOLTAGE     NODE   VOLTAGE
250:
251:
252: (  VG1)     .3860  (  VG2)     .8140  (  VO1)     .6000  (  VO2)     .1949
253:
254: ( VDDA)    1.2000  ( VSSA)    0.0000
255:
256:
257:
258:
259:     VOLTAGE SOURCE CURRENTS
260:     NAME         CURRENT
261:
262:     V_Vi1        0.000E+00
263:     V_VDDA      -7.950E-05
264:     V_VSSA       7.950E-05
265:
266:     TOTAL POWER DISSIPATION   9.54E-05  WATTS
267:
268: □
269: **** 10/06/22 02:13:47 ******* PSpice 17.4.0 (Nov 2018) ******* ID# 0 ********
270:
271:  ** Profile: "SCHEMATIC1-CS_amp_N13_AC_sweep"  [ U:\Desktop\230\Project_1\CS_amp\CS_amp\c
     s_amp-pspicefiles\schematic1\cs_amp_n13_ac_s
272:
273:
274:  ****     OPERATING POINT INFORMATION      TEMPERATURE =   27.000 DEG C
275:
276:
277: ********************************************************************************
278:
279:
```

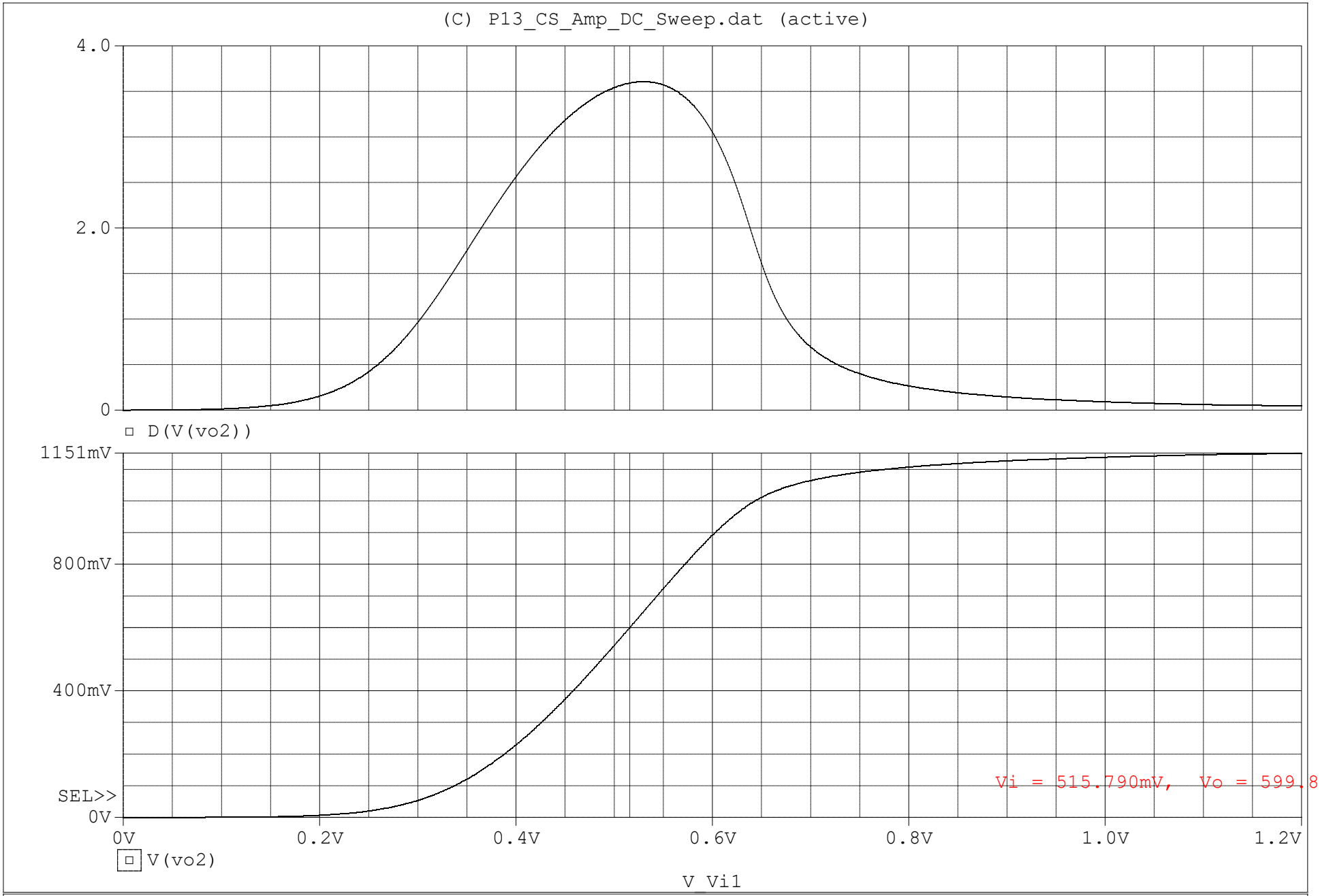
```
 280:
 281:
 282:
 283:
 284: **** VOLTAGE-CONTROLLED VOLTAGE SOURCES
 285:
 286:
 287: NAME         E_Ei2
 288: V-SOURCE     3.860E-01
 289: I-SOURCE     0.000E+00
 290:
 291:
 292: **** MOSFETS
 293:
 294:
 295: NAME         M_M1        M_M2
 296: MODEL        N13         P13
 297: ID           6.00E-05   -1.95E-05
 298: VGS          3.86E-01   -3.86E-01
 299: VDS          6.00E-01   -1.01E+00
 300: VBS          0.00E+00    0.00E+00
 301: VTH          2.97E-01   -3.43E-01
 302: VDSAT        1.03E-01   -8.31E-02
 303: Lin0/Sat1   -1.00E+00   -1.00E+00
 304: if          -1.00E+00   -1.00E+00
 305: ir          -1.00E+00   -1.00E+00
 306: TAU         -1.00E+00   -1.00E+00
 307: GM           9.69E-04    3.00E-04
 308: GDS          3.82E-05    2.79E-05
 309: GMB         -1.12E-05    3.46E-05
 310: CBD          0.00E+00    0.00E+00
 311: CBS          0.00E+00    0.00E+00
 312: CGSOV        1.43E-15    1.43E-15
 313: CGDOV        1.43E-15    1.43E-15
 314: CGBOV        0.00E+00    0.00E+00
 315:  Derivatives of gate (dQg/dVxy) and bulk (dQb/dVxy) charges
 316: DQGDVGB      8.47E-15    7.93E-15
 317: DQGDVDB     -2.35E-15   -2.12E-15
 318: DQGDVSB     -5.14E-15   -5.16E-15
 319: DQDDVGB     -2.45E-15   -2.32E-15
 320: DQDDVDB      2.44E-15    2.32E-15
 321: DQDDVSB      5.48E-18    1.72E-18
 322: DQBDVGB     -3.82E-16   -5.33E-16
 323: DQBDVDB     -8.81E-18   -3.26E-17
 324: DQBDVSB     -5.78E-16   -3.88E-16
 325:
 326:           JOB CONCLUDED
 327:
 328: **** 10/06/22 02:13:47 ******* PSpice 17.4.0 (Nov 2018) ******* ID# 0 ********
 329:
 330:  ** Profile: "SCHEMATIC1-CS_amp_N13_AC_sweep"  [ U:\Desktop\230\Project_1\CS_amp\CS_amp\c
      s_amp-pspicefiles\schematic1\cs_amp_n13_ac_s
 331:
 332:
 333:  ****     JOB STATISTICS SUMMARY
 334:
 335:
 336: ******************************************************************************
 337:
 338:
 339:
 340:   Total job time (using Solver 1)   =         .50
 341:
```

** Profile: "SCHEMATIC1-CS_amp_N13_AC_sweep" [U:\Desktop\230\Project_1\CS_amp\CS_amp\cs_amp-pspicefile...
Date/Time run: 09/30/22 17:21:18 Temperature: 27.0



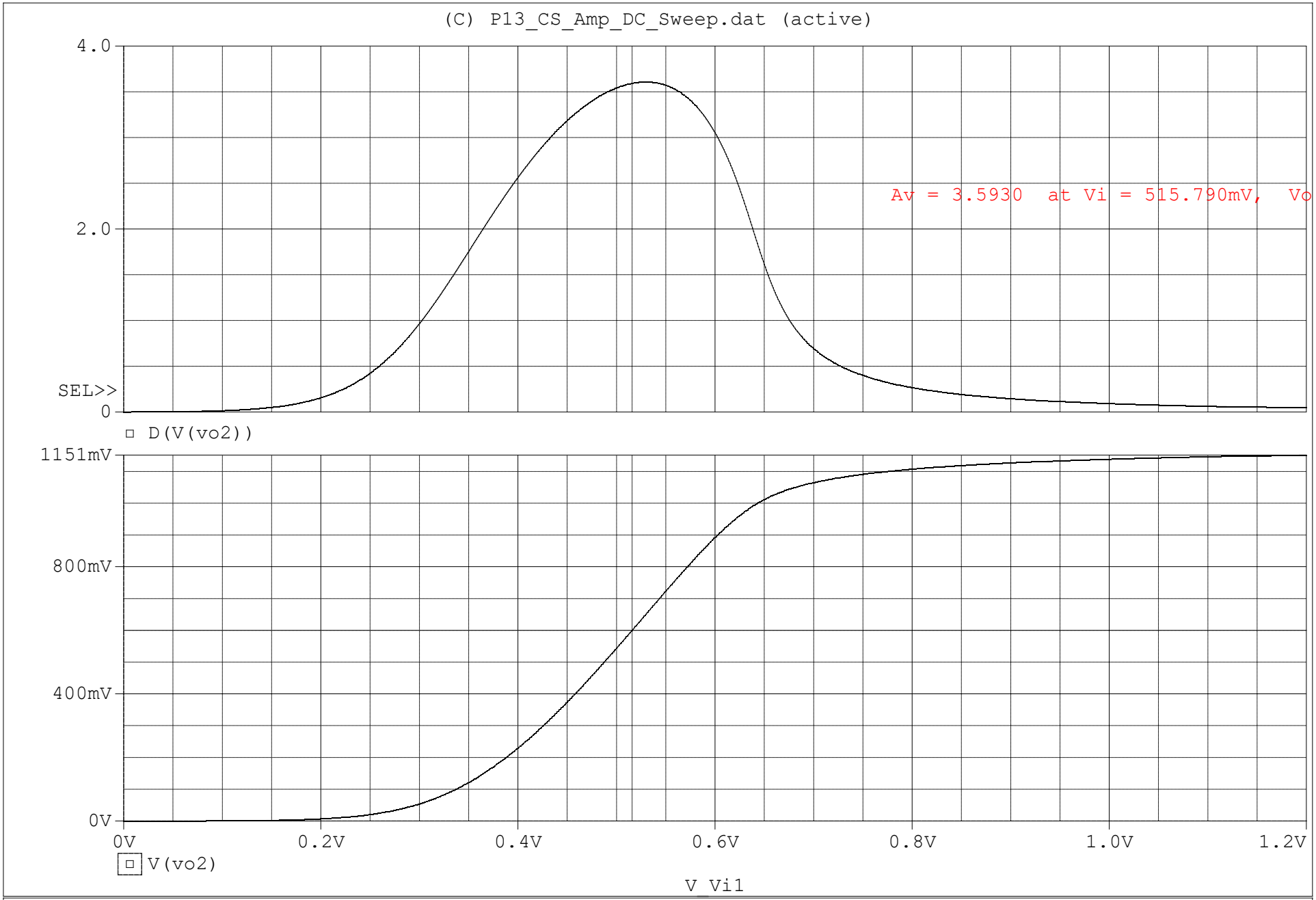
B1:(214.264M,13.919) B2:(1.0000K,16.921) DIFF(B):(214.263M,-3.0021)

** Profile: "SCHEMATIC1-P13_CS_Amp_DC_Sweep" [U:\Desktop\230\Project_1\CS_amp\CS_amp\CS_amp-PSpiceFile...
Date/Time run: 09/30/22 17:36:37 Temperature: 27.0



C1:(515.790m,599.930m) C2:(0.000,34.810u) DIFF(C):(515.790m,599.895m)

** Profile: "SCHEMATIC1-P13_CS_Amp_DC_Sweep" [U:\Desktop\230\Project_1\CS_amp\CS_amp\CS_amp-PSpiceFile...
Date/Time run: 09/30/22 17:36:37 Temperature: 27.0

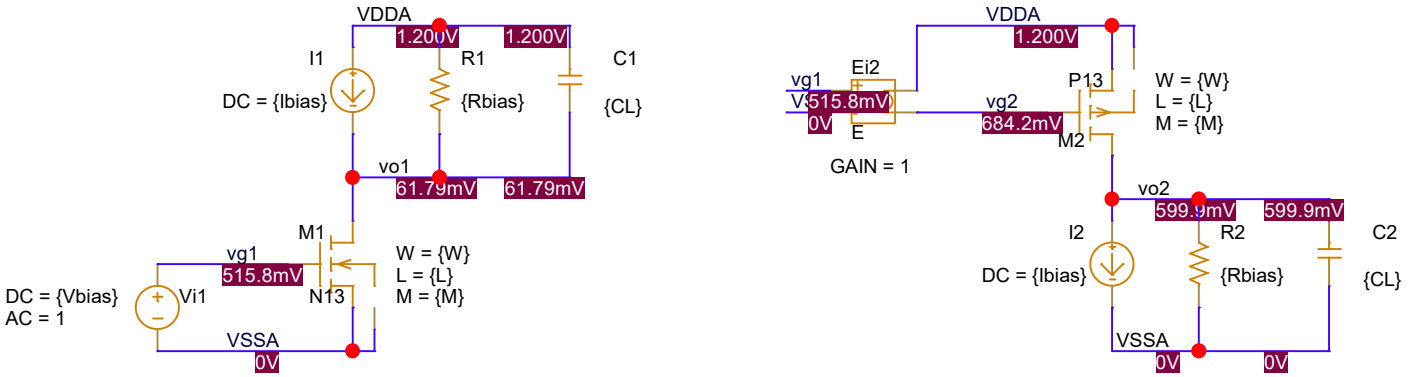


C1:(515.790m,599.930m) C2:(0.000,34.810u) DIFF(C):(515.790m,599.895m)

```
         LINT   25.000000E-09   20.000000E-09
          LLN                    0
          LWN    0               0
         LMIN  130.000000E-09  130.000000E-09
         LMAX  130.000000E-09  130.000000E-09
          WLN    0               0
          WWN                    0
         WMIN  130.000000E-09  130.000000E-09
         WMAX  100.000000E-06  100.000000E-06
          DLC   20.000000E-09   20.000000E-09
          DWC    0               0
           CF  111.300000E-12  111.300000E-12
         NOIA  100.000000E+18    9.900000E+18
         NOIB   50.000000E+03    2.400000E+03
         NOIC   -1.400000E-12    1.400000E-12
          VTM     .025864         .025864
      VERSION    3.1             3.1
        PBSWG     .773115         .773115
        MJSWG     .370699         .370699
        CJSWG  200.000000E-12  200.000000E-12
        JTSCD   25.000000E-09   25.000000E-09
       JSTSCD  400.000000E-15  400.000000E-15


WARNING(ORPSIM-15235): Mosfet M_M1, model N13: Pd = 0 is less than W

WARNING(ORPSIM-15235): Mosfet M_M1, model N13: Ps = 0 is less than W

WARNING(ORPSIM-15236): Parameter CTA in model N13 is invalid - Ignored

WARNING(ORPSIM-15236): Parameter CTP in model N13 is invalid - Ignored

WARNING(ORPSIM-15236): Parameter PTA in model N13 is invalid - Ignored

WARNING(ORPSIM-15236): Parameter PTP in model N13 is invalid - Ignored

WARNING(ORPSIM-15235): Mosfet M_M2, model P13: Pd = 0 is less than W

WARNING(ORPSIM-15235): Mosfet M_M2, model P13: Ps = 0 is less than W

WARNING(ORPSIM-15236): Parameter CTA in model P13 is invalid - Ignored

WARNING(ORPSIM-15236): Parameter CTP in model P13 is invalid - Ignored

WARNING(ORPSIM-15236): Parameter PTA in model P13 is invalid - Ignored

WARNING(ORPSIM-15236): Parameter PTP in model P13 is invalid - Ignored
□
**** 10/06/22 02:20:13 ******* PSpice 17.4.0 (Nov 2018) ******* ID# 0 ********

 ** Profile: "SCHEMATIC1-CS_amp_N13_AC_sweep"  [ U:\Desktop\230\Project_1\CS_am
p\CS_amp\cs_amp-pspicefiles\schematic1\cs_amp_n13_ac_s


 ****     SMALL SIGNAL BIAS SOLUTION       TEMPERATURE =   27.000 DEG C


*******************************************************************************



 NODE   VOLTAGE     NODE   VOLTAGE     NODE   VOLTAGE     NODE   VOLTAGE
```

```
( VG1)     .5158  ( VG2)     .6842  ( VO1)     .0618  ( VO2)     .5999

( VDDA)    1.2000  ( VSSA)    0.0000



    VOLTAGE SOURCE CURRENTS
    NAME         CURRENT

    V_Vi1         0.000E+00
    V_VDDA       -1.738E-04
    V_VSSA        1.738E-04

    TOTAL POWER DISSIPATION   2.09E-04  WATTS

□
**** 10/06/22 02:20:13 ******* PSpice 17.4.0 (Nov 2018) ******* ID# 0 ********

 ** Profile: "SCHEMATIC1-CS_amp_N13_AC_sweep"  [ U:\Desktop\230\Project_1\CS_am
    p\CS_amp\cs_amp-pspicefiles\schematic1\cs_amp_n13_ac_s


 ****     OPERATING POINT INFORMATION      TEMPERATURE =   27.000 DEG C


**********************************************************************************



**** VOLTAGE-CONTROLLED VOLTAGE SOURCES


NAME         E_Ei2
V-SOURCE     5.158E-01
I-SOURCE     0.000E+00


**** MOSFETS


NAME         M_M1        M_M2
MODEL        N13         P13
ID            1.14E-04   -6.00E-05
VGS           5.16E-01   -5.16E-01
VDS           6.18E-02   -6.00E-01
VBS           0.00E+00    0.00E+00
VTH           3.11E-01   -3.70E-01
VDSAT         1.78E-01   -1.36E-01
Lin0/Sat1    -1.00E+00   -1.00E+00
if           -1.00E+00   -1.00E+00
ir           -1.00E+00   -1.00E+00
TAU          -1.00E+00   -1.00E+00
GM            6.83E-04    6.01E-04
GDS           1.46E-03    6.73E-05
GMB          -4.73E-06    6.77E-05
CBD           0.00E+00    0.00E+00
CBS           0.00E+00    0.00E+00
CGSOV         1.43E-15    1.43E-15
CGDOV         1.43E-15    1.43E-15
```

```
 314: CGBOV        0.00E+00    0.00E+00
 315:  Derivatives of gate (dQg/dVxy) and bulk (dQb/dVxy) charges
 316: DQGDVGB      9.90E-15    8.72E-15
 317: DQGDVDB     -4.13E-15   -2.26E-15
 318: DQGDVSB     -4.80E-15   -5.90E-15
 319: DQDDVGB     -4.72E-15   -2.51E-15
 320: DQDDVDB      5.63E-15    2.50E-15
 321: DQDDVSB     -9.31E-16    7.60E-18
 322: DQBDVGB     -7.40E-17   -4.36E-16
 323: DQBDVDB     -4.00E-16   -2.69E-17
 324: DQBDVSB     -4.85E-16   -4.84E-16
 325:
 326:           JOB CONCLUDED
 327:
 328: **** 10/06/22 02:20:13 ******* PSpice 17.4.0 (Nov 2018) ******* ID# 0 ********
 329:
 330:  ** Profile: "SCHEMATIC1-CS_amp_N13_AC_sweep"  [ U:\Desktop\230\Project_1\CS_am
     p\CS_amp\cs_amp-pspicefiles\schematic1\cs_amp_n13_ac_s
 331:
 332:
 333:  ****     JOB STATISTICS SUMMARY
 334:
 335:
 336: ******************************************************************************
 337:
 338:
 339:
 340:   License check-out time            =         .67
 341:   Total job time (using Solver 1)   =         .11
 342:
```



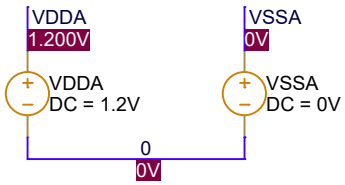
PARAMETERS:

W = 2.6u
L = .13u
M = 2

Vbias = 515.790mV

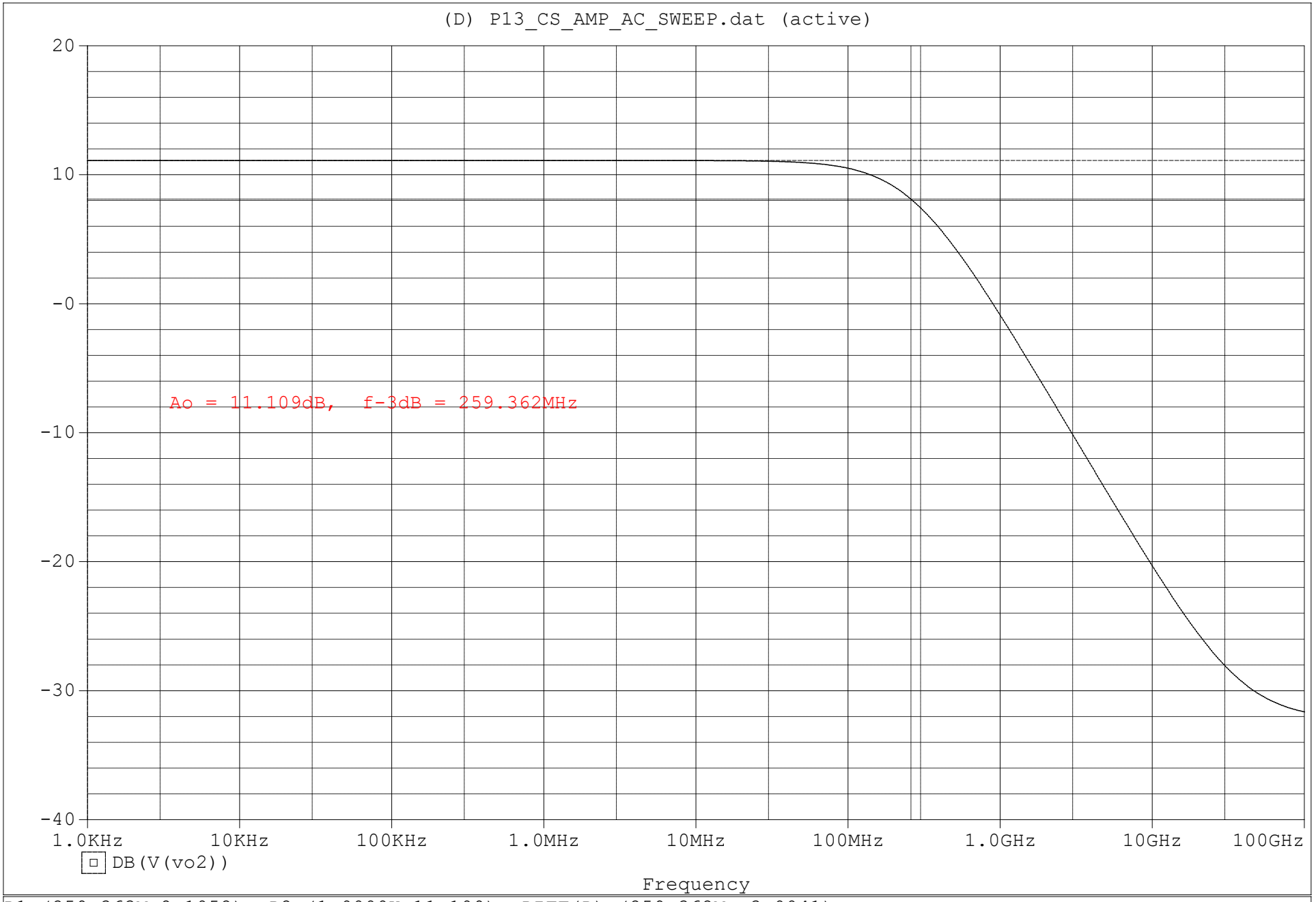
Rbias = 10k
Ibias = 0

CL = 100fF



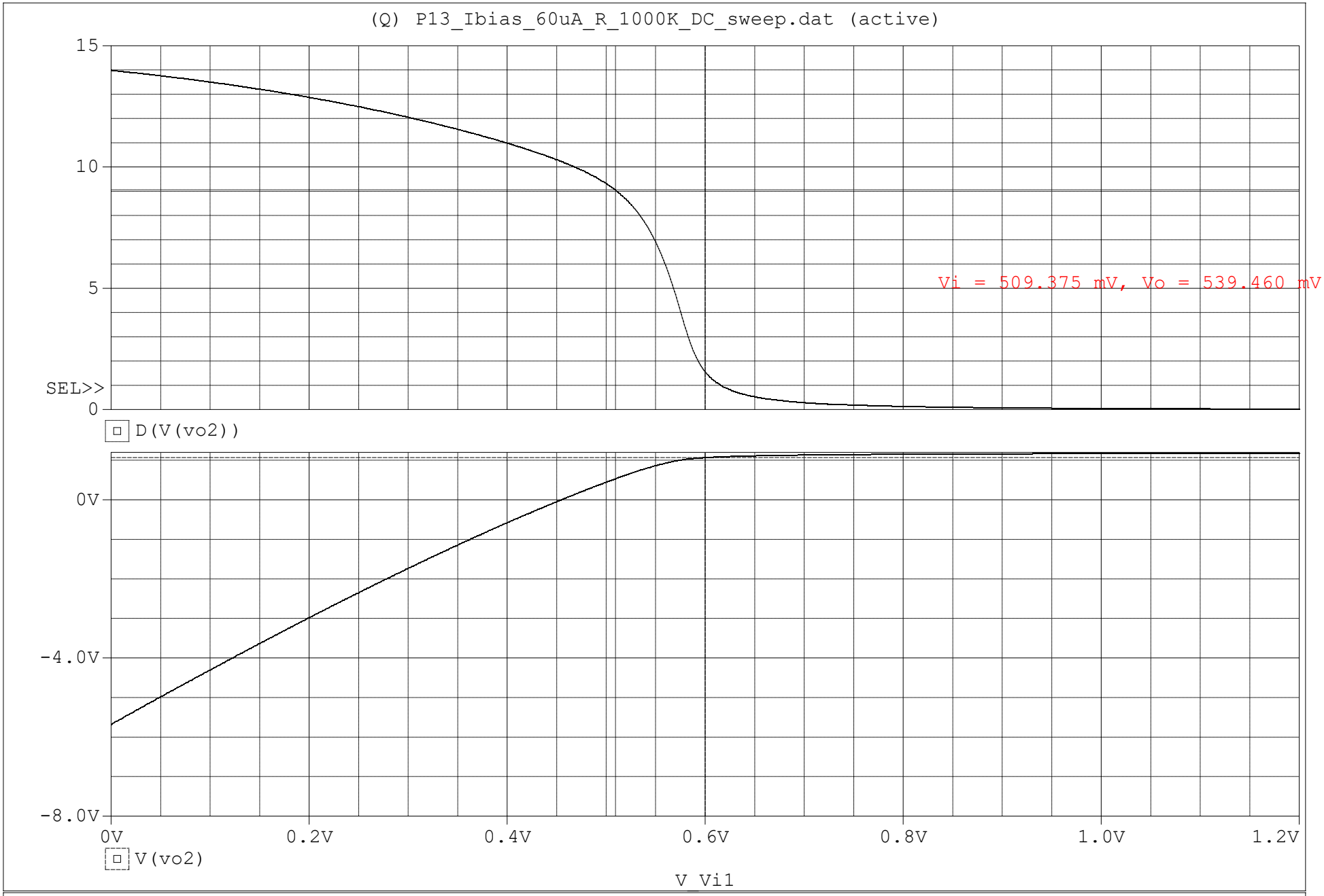
Author = Neha Gour		
Title: Common-source amplifier with current source load		
Size: A	Document Number: EEE 230 Project-1	Rev
Date: Friday, September 30, 2022	Sheet 1 of 1	

** Profile: "SCHEMATIC1-P13_CS_AMP_AC_SWEEP" [U:\Desktop\230\Project_1\CS_amp\CS_amp\CS_amp-PSpiceFile...
Date/Time run: 09/30/22 18:00:57 Temperature: 27.0



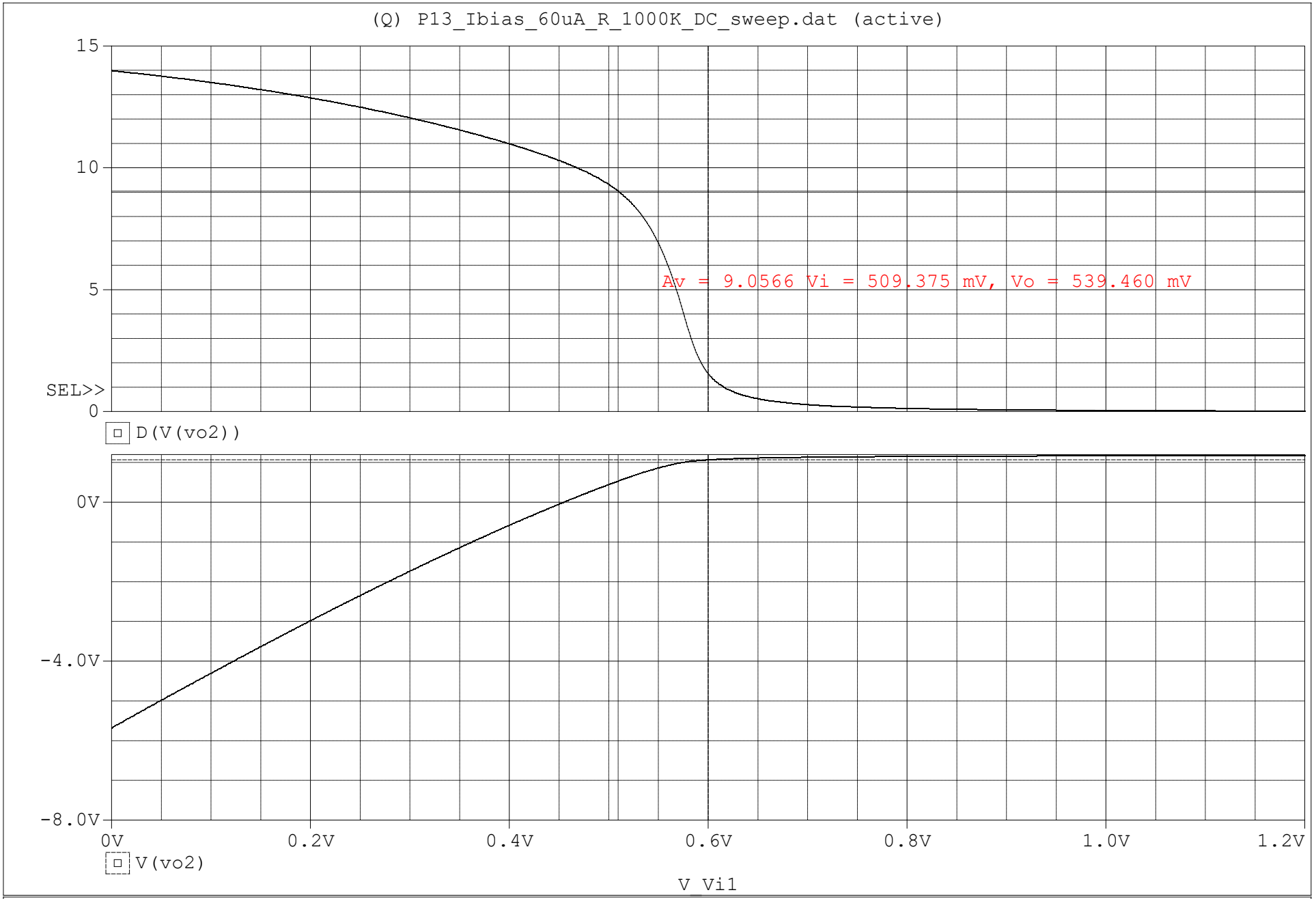
D1:(259.363M,8.1052) D2:(1.0000K,11.109) DIFF(D):(259.362M,-3.0041)

** Profile: "SCHEMATIC1-P13_Ibias_60uA_R_1000K_DC_sweep" [U:\Desktop\230\Project_1\CS_amp\CS_amp\CS_am...
Date/Time run: 09/30/22 22:32:53 Temperature: 27.0

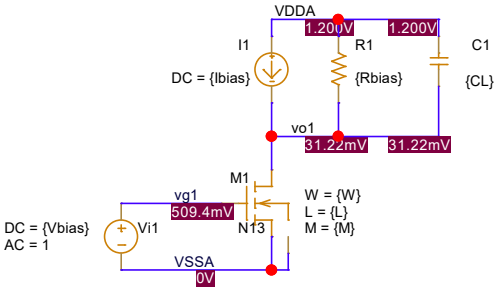


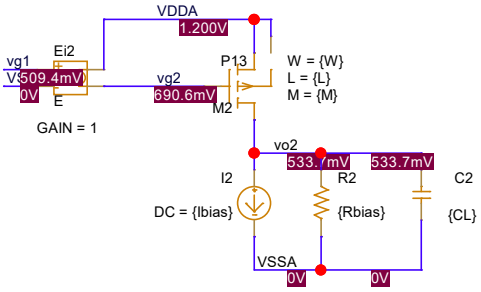
Q1:(509.375m,9.0566) Q2:(600.000m,1.0698) DIFF(Q):(-90.625m,7.9868)

** Profile: "SCHEMATIC1-P13_Ibias_60uA_R_1000K_DC_sweep" [U:\Desktop\230\Project_1\CS_amp\CS_amp\CS_am...
Date/Time run: 09/30/22 22:32:53 Temperature: 27.0



Q1:(509.375m,9.0447) Q2:(600.000m,1.0698) DIFF(Q):(-90.625m,7.9749)





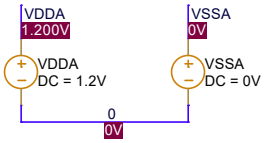
PARAMETERS:

W = 2.6u
L = .13u
M = 2

Vbias = 509.375mV

Rbias = 1000k
Ibias = 60u

CL = 100fF



Author = Neha Gour

Title
Common-source amplifier with current source load

Size	Document Number	Rev
A	EEE 230 Project-1	

Date: Friday, September 30, 2022 Sheet 1 of 1

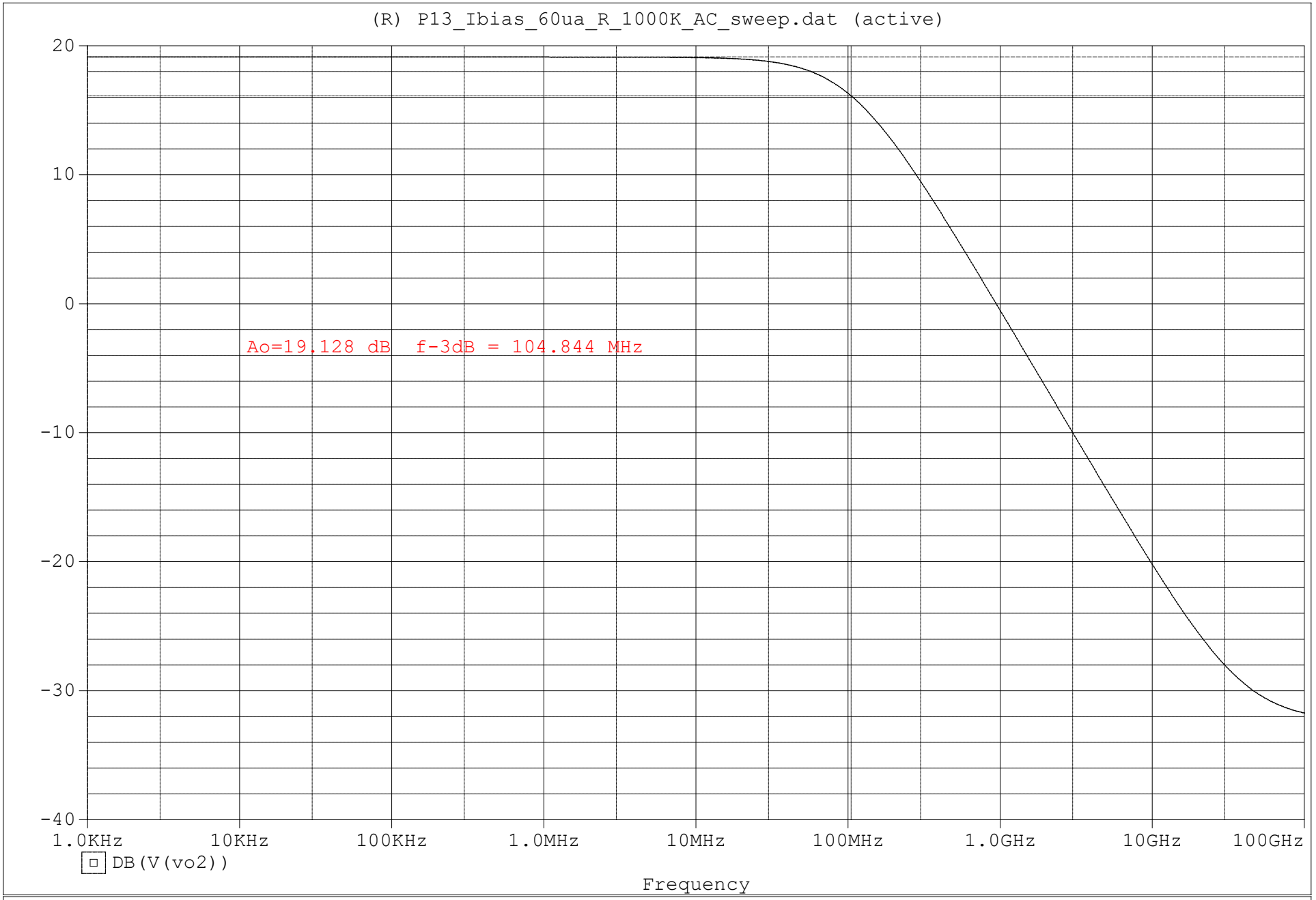
```
         LINT   25.000000E-09   20.000000E-09
          LLN                    0
          LWN    0               0
         LMIN  130.000000E-09  130.000000E-09
         LMAX  130.000000E-09  130.000000E-09
          WLN    0               0
          WWN                    0
         WMIN  130.000000E-09  130.000000E-09
         WMAX  100.000000E-06  100.000000E-06
          DLC   20.000000E-09   20.000000E-09
          DWC    0               0
           CF  111.300000E-12  111.300000E-12
         NOIA  100.000000E+18    9.900000E+18
         NOIB   50.000000E+03    2.400000E+03
         NOIC   -1.400000E-12    1.400000E-12
          VTM     .025864         .025864
      VERSION    3.1             3.1
        PBSWG     .773115         .773115
        MJSWG     .370699         .370699
        CJSWG  200.000000E-12  200.000000E-12
        JTSCD   25.000000E-09   25.000000E-09
       JSTSCD  400.000000E-15  400.000000E-15


WARNING(ORPSIM-15235): Mosfet M_M1, model N13: Pd = 0 is less than W

WARNING(ORPSIM-15235): Mosfet M_M1, model N13: Ps = 0 is less than W

WARNING(ORPSIM-15236): Parameter CTA in model N13 is invalid - Ignored

WARNING(ORPSIM-15236): Parameter CTP in model N13 is invalid - Ignored

WARNING(ORPSIM-15236): Parameter PTA in model N13 is invalid - Ignored

WARNING(ORPSIM-15236): Parameter PTP in model N13 is invalid - Ignored

WARNING(ORPSIM-15235): Mosfet M_M2, model P13: Pd = 0 is less than W

WARNING(ORPSIM-15235): Mosfet M_M2, model P13: Ps = 0 is less than W

WARNING(ORPSIM-15236): Parameter CTA in model P13 is invalid - Ignored

WARNING(ORPSIM-15236): Parameter CTP in model P13 is invalid - Ignored

WARNING(ORPSIM-15236): Parameter PTA in model P13 is invalid - Ignored

WARNING(ORPSIM-15236): Parameter PTP in model P13 is invalid - Ignored
□
**** 10/06/22 02:25:26 ******* PSpice 17.4.0 (Nov 2018) ******* ID# 0 ********

 ** Profile: "SCHEMATIC1-P13_Ibias_60ua_R_1000K_AC_sweep"  [ U:\Desktop\230\Pro
ject_1\CS_amp\CS_amp\cs_amp-pspicefiles\schematic1\p13


 ****     SMALL SIGNAL BIAS SOLUTION       TEMPERATURE =   27.000 DEG C


*******************************************************************************


 NODE   VOLTAGE     NODE   VOLTAGE     NODE   VOLTAGE     NODE   VOLTAGE
```

252: (VG1)   .5094 (VG2)   .6906 (VO1)   .0312 (VO2)   .5337

253:
254: (VDDA)   1.2000 (VSSA)   0.0000
255:
256:
257:
258:
259:     VOLTAGE SOURCE CURRENTS
260:     NAME   CURRENT
261:
262:     V_Vi1   0.000E+00
263:     V_VDDA   -1.217E-04
264:     V_VSSA   1.217E-04
265:
266:     TOTAL POWER DISSIPATION   1.46E-04 WATTS
267:
268:
269: **** 10/06/22 02:25:26 ******* PSpice 17.4.0 (Nov 2018) ******* ID# 0 ********
270:
271: ** Profile: "SCHEMATIC1-P13_Ibias_60ua_R_1000K_AC_sweep" [U:\Desktop\230\Pro
     ject_1\CS_amp\CS_amp\cs_amp-pspicefiles\schematic1\p13
272:
273:
274: ****   OPERATING POINT INFORMATION   TEMPERATURE =   27.000 DEG C
275:
276:
277: ***
278:
279:
280:
281:
282:
283:
284: **** VOLTAGE-CONTROLLED VOLTAGE SOURCES
285:
286:
287: NAME   E_Ei2
288: V-SOURCE   5.094E-01
289: I-SOURCE   0.000E+00
290:
291:
292: **** MOSFETS
293:
294:
295: NAME   M_M1   M_M2
296: MODEL   N13   P13
297: ID   6.12E-05   -6.05E-05
298: VGS   5.09E-01   -5.09E-01
299: VDS   3.12E-02   -6.66E-01
300: VBS   0.00E+00   0.00E+00
301: VTH   3.12E-01   -3.66E-01
302: VDSAT   1.73E-01   -1.35E-01
303: Lin0/Sat1   -1.00E+00   -1.00E+00
304: if   -1.00E+00   -1.00E+00
305: ir   -1.00E+00   -1.00E+00
306: TAU   -1.00E+00   -1.00E+00
307: GM   3.57E-04   6.10E-04
308: GDS   1.76E-03   6.64E-05
309: GMB   -2.15E-06   6.87E-05
310: CBD   0.00E+00   0.00E+00
311: CBS   0.00E+00   0.00E+00
312: CGSOV   1.43E-15   1.43E-15
313: CGDOV   1.43E-15   1.43E-15

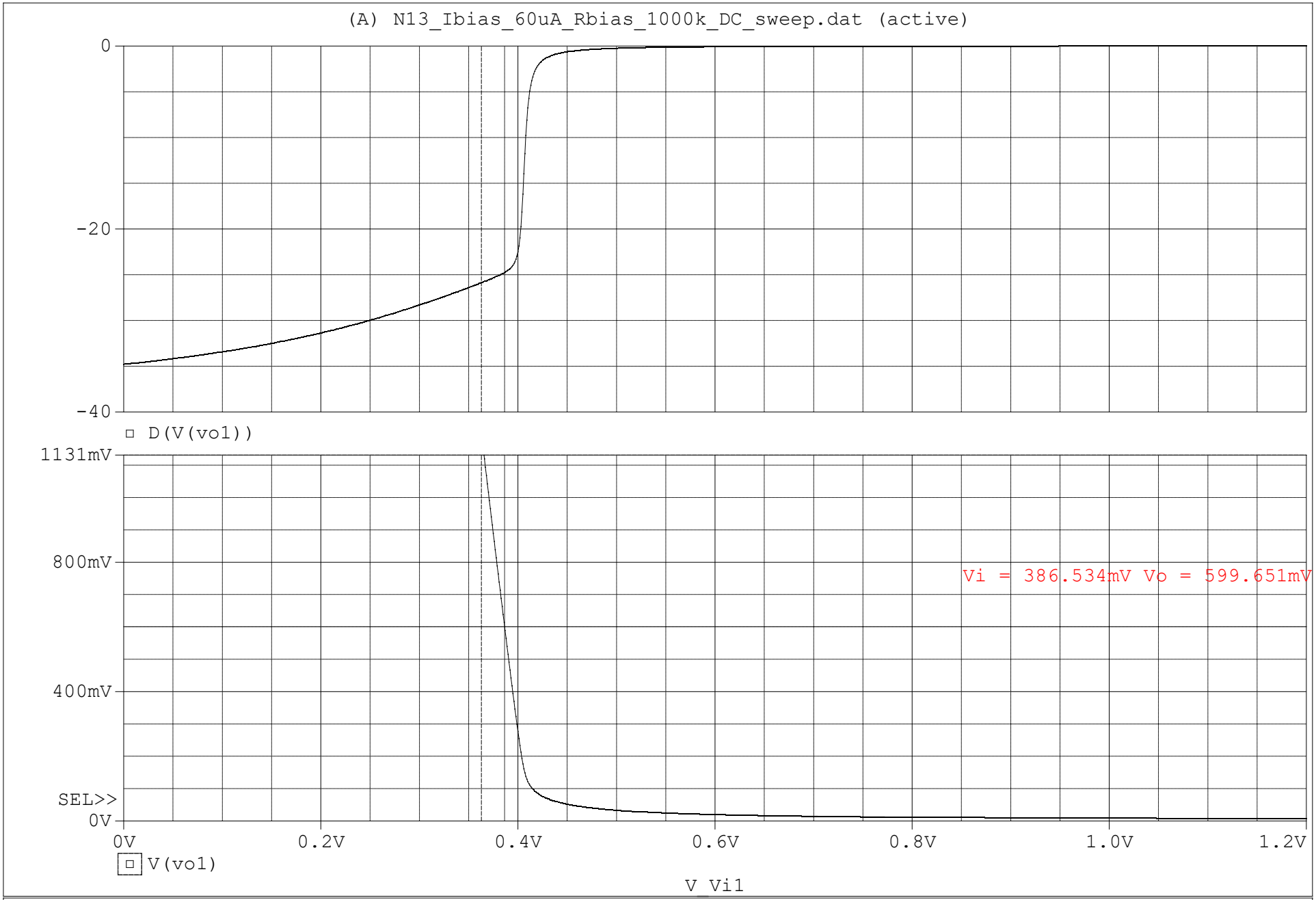
```
 CGBOV        0.00E+00    0.00E+00
  Derivatives of gate (dQg/dVxy) and bulk (dQb/dVxy) charges
 DQGDVGB      1.00E-14    8.68E-15
 DQGDVDB     -4.39E-15   -2.22E-15
 DQGDVSB     -4.63E-15   -5.90E-15
 DQDDVGB     -4.90E-15   -2.47E-15
 DQDDVDB      6.12E-15    2.47E-15
 DQDDVSB     -1.23E-15    6.04E-18
 DQBDVGB     -5.08E-17   -4.37E-16
 DQBDVDB     -4.63E-16   -2.67E-17
 DQBDVSB     -4.51E-16   -4.84E-16

           JOB CONCLUDED

**** 10/06/22 02:25:26 ******* PSpice 17.4.0 (Nov 2018) ******* ID# 0 ********

 ** Profile: "SCHEMATIC1-P13_Ibias_60ua_R_1000K_AC_sweep"  [ U:\Desktop\230\Pro
ject_1\CS_amp\CS_amp\cs_amp-pspicefiles\schematic1\p13


 ****     JOB STATISTICS SUMMARY


******************************************************************************


  Total job time (using Solver 1)   =         .45
```

** Profile: "SCHEMATIC1-P13_Ibias_60ua_R_1000K_AC_sweep" [U:\Desktop\230\Project_1\CS_amp\CS_amp\CS_am...
Date/Time run: 09/30/22 22:59:08 Temperature: 27.0



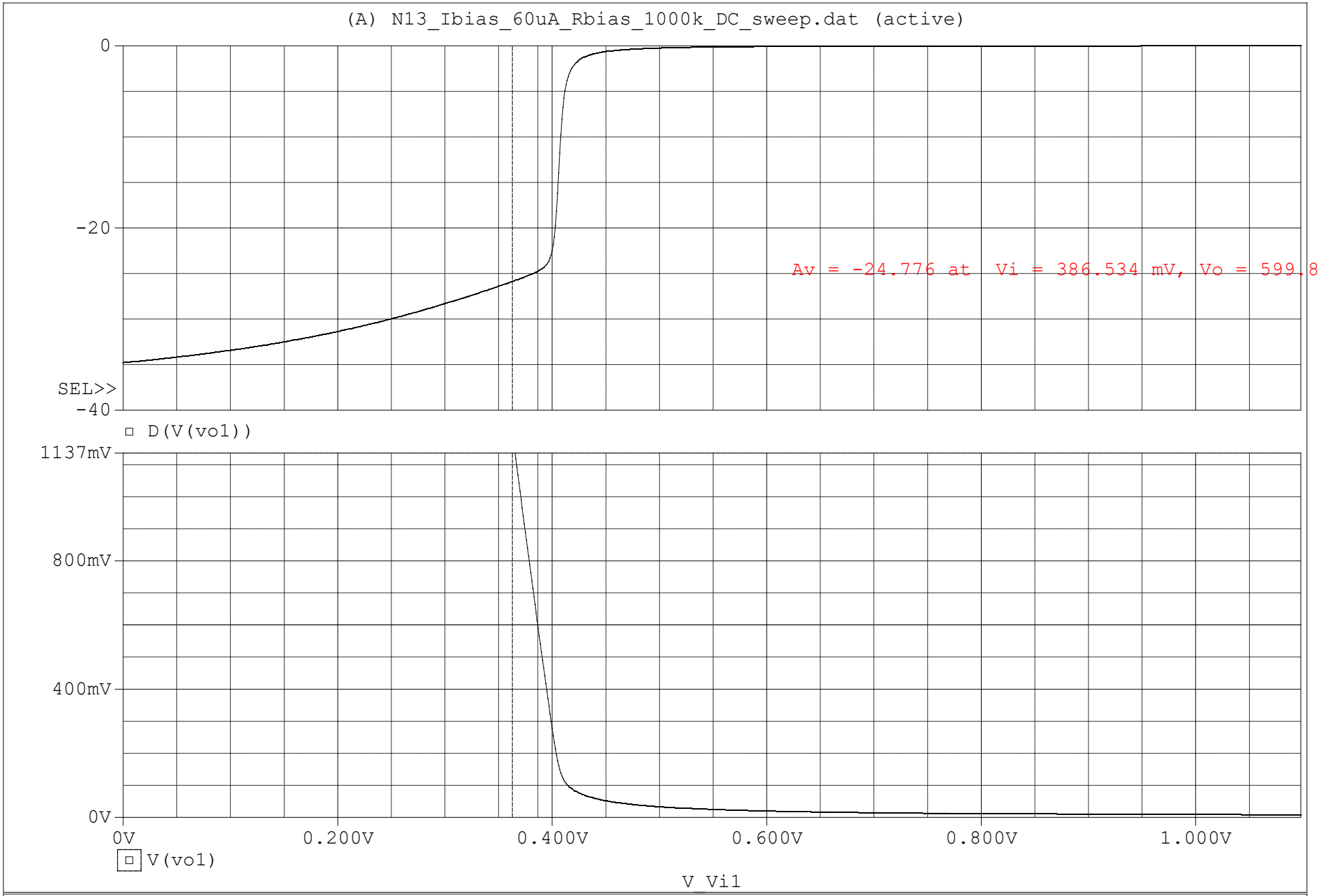
R1:(104.845M,16.119) R2:(1.0000K,19.128) DIFF(R):(104.844M,-3.0094)

** Profile: "SCHEMATIC1-N13_Ibias_60uA_Rbias_1000k_DC_sweep" [U:\Desktop\230\Project_1\CS_amp\CS_amp\c...
Date/Time run: 09/30/22 20:52:40 Temperature: 27.0

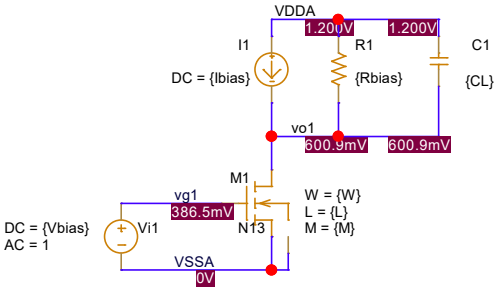


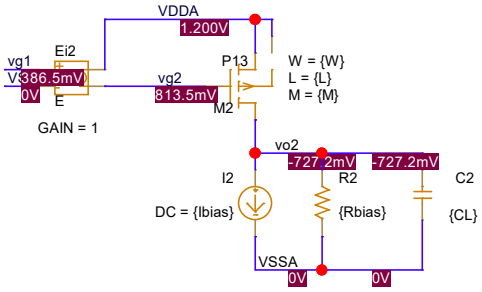
A1:(386.534m,600.911m) A2:(362.865m,1.2006) DIFF(A):(23.669m,-599.651m)

** Profile: "SCHEMATIC1-N13_Ibias_60uA_Rbias_1000k_DC_sweep" [U:\Desktop\230\Project_1\CS_amp\CS_amp\c...
Date/Time run: 09/30/22 20:52:40 Temperature: 27.0



A1:(386.534m,600.904m) A2:(362.858m,1.2007) DIFF(A):(23.676m,-599.837m)





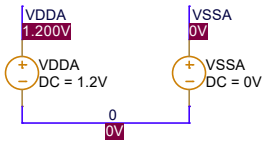
PARAMETERS:

W = 2.6u
L = .13u
M = 2

Vbias = 386.534mV

Rbias = 1000k
Ibias = 60u

CL = 100fF



Author = Neha Gour

Title
Common-source amplifier with current source load

Size	Document Number	Rev
A	EEE 230 Project-1	

Date: Friday, September 30, 2022 Sheet 1 of 1

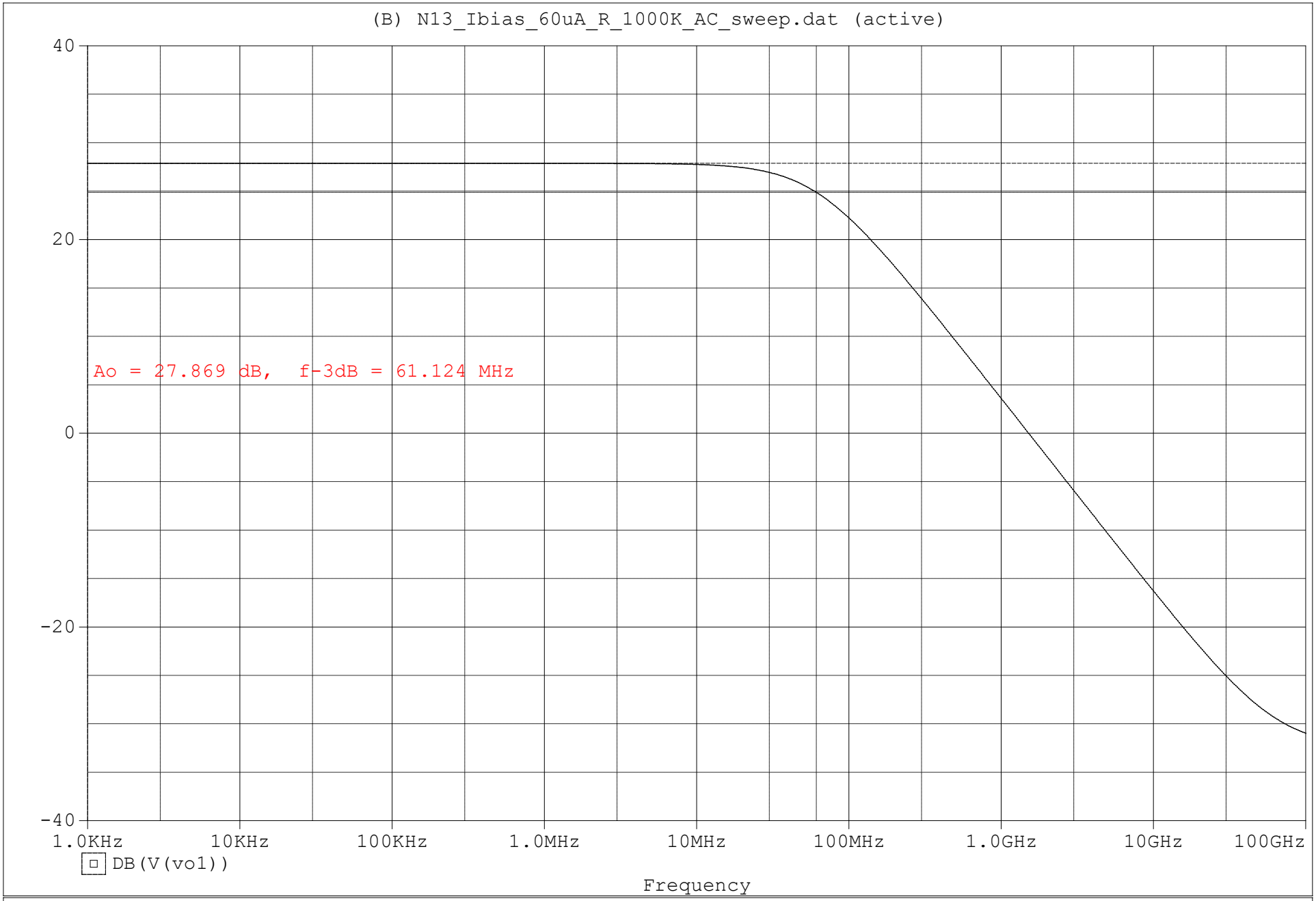
```
         LINT   25.000000E-09   20.000000E-09
          LLN                    0
          LWN    0               0
         LMIN  130.000000E-09  130.000000E-09
         LMAX  130.000000E-09  130.000000E-09
          WLN    0               0
          WWN                    0
         WMIN  130.000000E-09  130.000000E-09
         WMAX  100.000000E-06  100.000000E-06
          DLC   20.000000E-09   20.000000E-09
          DWC    0               0
           CF  111.300000E-12  111.300000E-12
         NOIA  100.000000E+18    9.900000E+18
         NOIB   50.000000E+03    2.400000E+03
         NOIC   -1.400000E-12    1.400000E-12
          VTM     .025864         .025864
      VERSION    3.1             3.1
        PBSWG     .773115         .773115
        MJSWG     .370699         .370699
        CJSWG  200.000000E-12  200.000000E-12
        JTSCD   25.000000E-09   25.000000E-09
       JSTSCD  400.000000E-15  400.000000E-15


WARNING(ORPSIM-15235): Mosfet M_M1, model N13: Pd = 0 is less than W

WARNING(ORPSIM-15235): Mosfet M_M1, model N13: Ps = 0 is less than W

WARNING(ORPSIM-15236): Parameter CTA in model N13 is invalid - Ignored

WARNING(ORPSIM-15236): Parameter CTP in model N13 is invalid - Ignored

WARNING(ORPSIM-15236): Parameter PTA in model N13 is invalid - Ignored

WARNING(ORPSIM-15236): Parameter PTP in model N13 is invalid - Ignored

WARNING(ORPSIM-15235): Mosfet M_M2, model P13: Pd = 0 is less than W

WARNING(ORPSIM-15235): Mosfet M_M2, model P13: Ps = 0 is less than W

WARNING(ORPSIM-15236): Parameter CTA in model P13 is invalid - Ignored

WARNING(ORPSIM-15236): Parameter CTP in model P13 is invalid - Ignored

WARNING(ORPSIM-15236): Parameter PTA in model P13 is invalid - Ignored

WARNING(ORPSIM-15236): Parameter PTP in model P13 is invalid - Ignored
□
**** 10/06/22 02:22:45 ******* PSpice 17.4.0 (Nov 2018) ******* ID# 0 ********

 ** Profile: "SCHEMATIC1-N13_Ibias_60uA_R_1000K_AC_sweep"  [ U:\Desktop\230\Pro
ject_1\CS_amp\CS_amp\cs_amp-pspicefiles\schematic1\n13


 ****     SMALL SIGNAL BIAS SOLUTION       TEMPERATURE =   27.000 DEG C


*******************************************************************************



 NODE   VOLTAGE     NODE   VOLTAGE     NODE   VOLTAGE     NODE   VOLTAGE
```

252: (VG1)   .3865 (VG2)   .8135 (VO1)   .6009 (VO2)   -.7272

253:
254: (VDDA)   1.2000 (VSSA)   0.0000
255:
256:
257:
258:
259:     VOLTAGE SOURCE CURRENTS
260:     NAME   CURRENT
261:
262:     V_Vi1   0.000E+00
263:     V_VDDA   -1.199E-04
264:     V_VSSA   1.199E-04
265:
266:     TOTAL POWER DISSIPATION   1.44E-04 WATTS
267:
268:
269: **** 10/06/22 02:22:45 ******* PSpice 17.4.0 (Nov 2018) ******* ID# 0 ********
270:
271: ** Profile: "SCHEMATIC1-N13_Ibias_60uA_R_1000K_AC_sweep" [U:\Desktop\230\Pro
     ject_1\CS_amp\CS_amp\cs_amp-pspicefiles\schematic1\n13
272:
273:
274: ****   OPERATING POINT INFORMATION   TEMPERATURE =   27.000 DEG C
275:
276:
277: ***
278:
279:
280:
281:
282:
283:
284: **** VOLTAGE-CONTROLLED VOLTAGE SOURCES
285:
286:
287: NAME   E_Ei2
288: V-SOURCE   3.865E-01
289: I-SOURCE   0.000E+00
290:
291:
292: **** MOSFETS
293:
294:
295: NAME   M_M1   M_M2
296: MODEL   N13   P13
297: ID   6.06E-05   -5.93E-05
298: VGS   3.87E-01   -3.87E-01
299: VDS   6.01E-01   -1.93E+00
300: VBS   0.00E+00   0.00E+00
301: VTH   2.97E-01   -2.81E-01
302: VDSAT   1.04E-01   -1.15E-01
303: Lin0/Sat1   -1.00E+00   -1.00E+00
304: if   -1.00E+00   -1.00E+00
305: ir   -1.00E+00   -1.00E+00
306: TAU   -1.00E+00   -1.00E+00
307: GM   9.76E-04   6.68E-04
308: GDS   3.84E-05   5.89E-05
309: GMB   -1.13E-05   7.54E-05
310: CBD   0.00E+00   0.00E+00
311: CBS   0.00E+00   0.00E+00
312: CGSOV   1.43E-15   1.43E-15
313: CGDOV   1.43E-15   1.43E-15

```
 CGBOV        0.00E+00    0.00E+00
  Derivatives of gate (dQg/dVxy) and bulk (dQb/dVxy) charges
 DQGDVGB      8.47E-15    8.35E-15
 DQGDVDB     -2.35E-15   -1.98E-15
 DQGDVSB     -5.14E-15   -5.79E-15
 DQDDVGB     -2.45E-15   -2.22E-15
 DQDDVDB      2.44E-15    2.22E-15
 DQDDVSB      5.47E-18    6.15E-19
 DQBDVGB     -3.81E-16   -4.55E-16
 DQBDVDB     -8.80E-18   -2.75E-17
 DQBDVSB     -5.79E-16   -4.71E-16

           JOB CONCLUDED

**** 10/06/22 02:22:45 ******* PSpice 17.4.0 (Nov 2018) ******* ID# 0 ********

 ** Profile: "SCHEMATIC1-N13_Ibias_60uA_R_1000K_AC_sweep"  [ U:\Desktop\230\Pro
ject_1\CS_amp\CS_amp\cs_amp-pspicefiles\schematic1\n13


 ****     JOB STATISTICS SUMMARY


******************************************************************************


  Total job time (using Solver 1)   =         .45
```

** Profile: "SCHEMATIC1-N13_Ibias_60uA_R_1000K_AC_sweep" [U:\Desktop\230\Project_1\CS_amp\CS_amp\CS_am...
Date/Time run: 09/30/22 21:16:28 Temperature: 27.0



B1:(61.125M,24.868) B2:(1.0000K,27.869) DIFF(B):(61.124M,-3.0010)

Results of CS amplifier

- For Rbias = 10kohm, Ibias = 0A

Properties	NMOS_0	PMOS_0
DC gain	-6.9	3.5
AC gain	16.9	11.10
f-3db	214.2MHz	259.36MHz

- For Rbias = 1000kohm, Ibias = 60uA

Properties	NMOS_1	PMOS_1
DC gain	-24.776	9.0566
AC gain	27.869	19.128
f-3db	61.12MHz	104.8MHz

1. **Calculate and compare the values of gain obtained from the DC and AC simulations for each amplifier. Are they approximately the same? Is that what you would expect? Why?**
   As per the results, expected gain from both the simulation is same because we are biasing amplifier at VDD/2 in saturation region which is linear amplification region. As we using the same biasing point for ac simulation. So, the DC gain (derivative of (Vout /Vin) will be approximately equal to 20 log (Av).

2. **Compare the low frequency gain obtained with each circuit. Explain why one is higher.**
   As per theory,
   Av = $-g_m * R_{out}$, As Rbias increases, gain increases and as Ibias increases gm increases and overall, it increases gain Av.
   Hence**, NMOS_0(16.9) < NMOS_1(27.869)**
   and **PMOS_0(11.10) < PMOS_1(19.128)**

   where,
   Av: gain of amplifier
   G_m: Transconductance of amplifier
   Rout or Rbias: Output Resistance of circuit

3. **Compare the -3dB frequency obtained with each circuit. Explain why one is higher?**
   By comparing, -3dB frequency of each circuit, frequency is higher in the circuit with low resistance (Rbias) and low Ibias. With the Increase in resistance (Rbias) & current (Ibias), gain increases and as change (increase) in gain the actual capacitance increases (1+|Av|) times of amplifier. Hence amplifier Frequency reduces. So we get higher frequency at less value of Rbias & ibias.

   Hence, **NMOS_0 (214.2MHz) > NMOS_1 (61.12MHz)** and
   PMOS_0 (259.36MHz) > PMOS_1 (104.8MHz)