



SACRAMENTO  
STATE

PROJECT-1

INSTRUCTOR: Dr.Perry L Heedley

Sriharsha S Jadhav

EEE 230 - Analog & Mixed-Signal IC Design

10/14/16

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## Circuits being simulated:

A schematic of the common-source amplifier to be simulated using Cadence Allegro Design Entry CIS and the waveforms are generated using Allegro Pspice Simulator.

The process that is being used for this project is 0.25 $\mu$ m CMOS, with VDD = 2.5V. The device sizes to be used are W=2.5 $\mu$ m, L=0.25 $\mu$ m, and M=2. Transistor models for the MOSFETs in the 0.25 $\mu$ m. The capacitor C<sub>L</sub>=100fF. The temperature is assumed to be 27°C.

The project has two set of circuits

1. When R<sub>bias</sub> = 10k $\Omega$  and I<sub>bias</sub> = 0A.
2. When R<sub>bias</sub> = 1000k $\Omega$  and I<sub>bias</sub> = 125 $\mu$ A.

For the given circuit DC sweep analysis is conducted for the input source, Vi1, from 0V to 2.5V in 1mV steps. The circuit is biased with the DC input voltage at the value found from the DC sweep analysis.

Using an AC input equal to 1V, simulate an AC sweep of Vo1(or Vo2 in case of PMOS) from 1kHz to 10GHz using 10 points per decade.

Plot the magnitude of Vo in dB from 1kHz to 10GHz. The gain in dB is measured at 1kHz, and the -3dB frequency.

1.NMOS

$R_{bias}=10k\Omega$  and

$I_{bias}=0A$

D

D

C

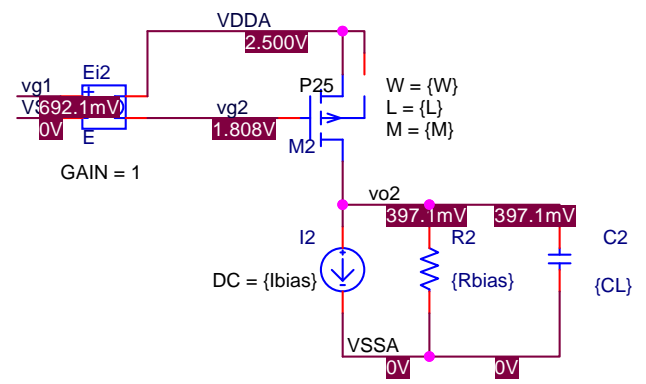
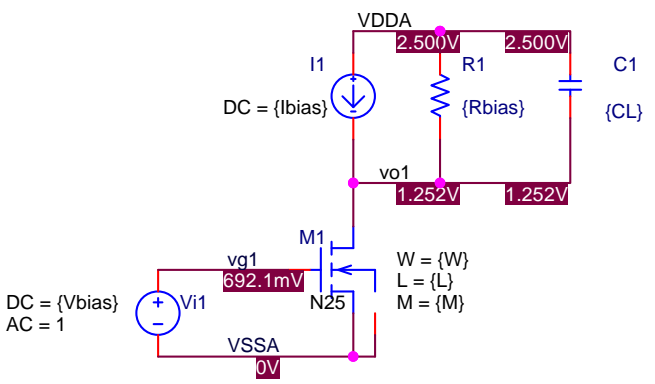
C

B

B

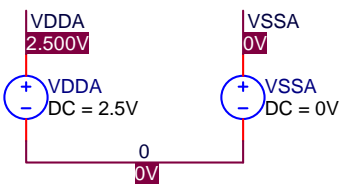
A

A

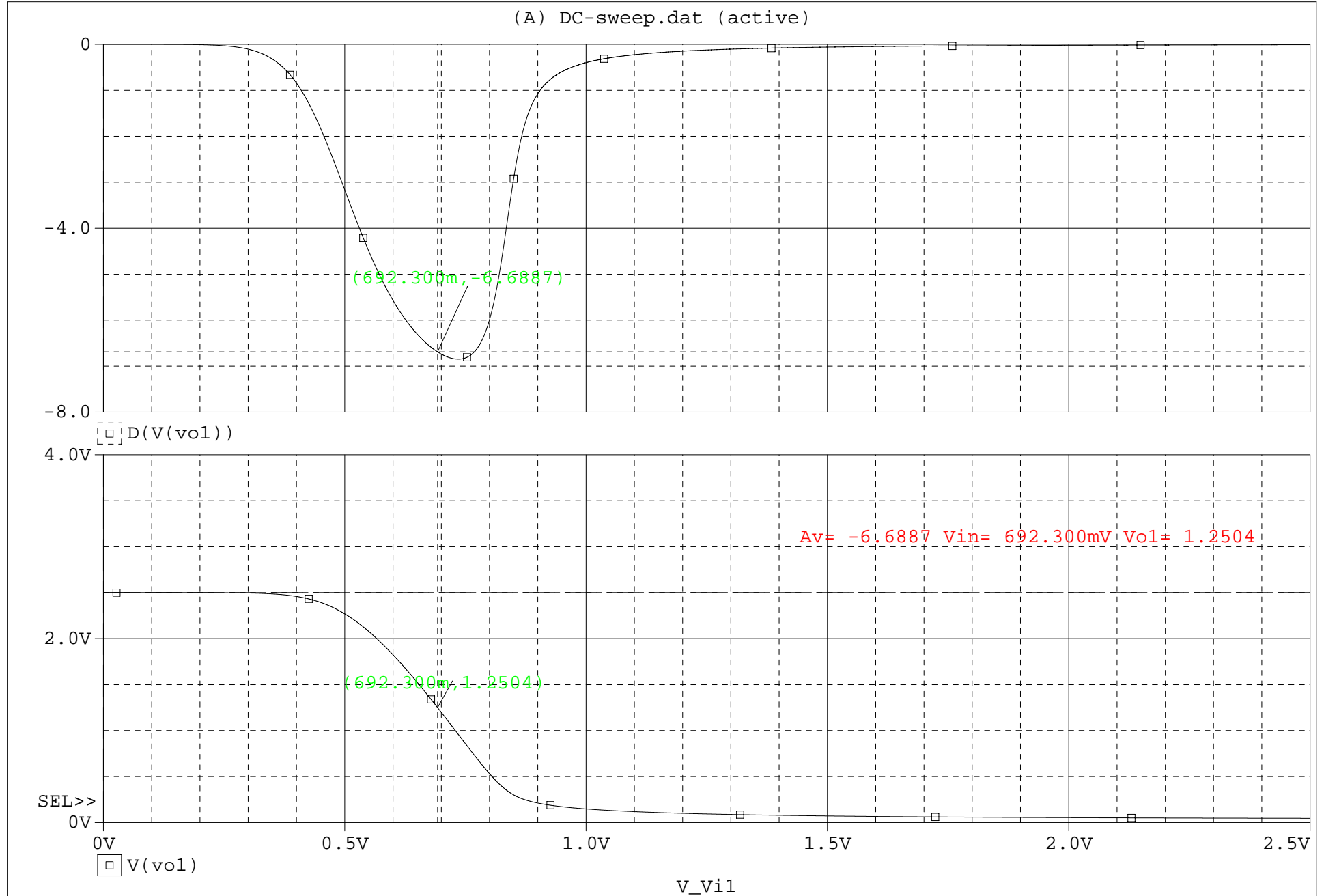


PARAMETERS:

W = 2.5u  
L = 0.25u  
M = 2  
  
Vbias = 1.5  
  
Rbias = 10k  
Ibias = 0  
CL = 100fF



Author = Sriharsha s jadhav		
Title Common-source amplifier with current source load		
Size A	Document Number EEE 230 project	Rev A1
Date:	Monday, October 10, 2016	Sheet 1 of 1



A1: (692.300m, -6.6887) A2: (0.000, 2.5000) DIFF(A): (692.300m, -9.1887)

D

D

C

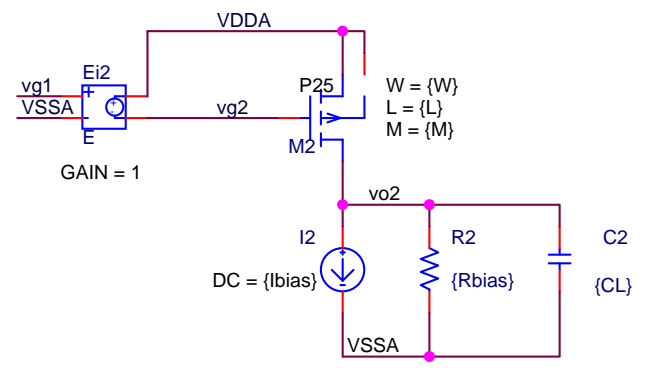
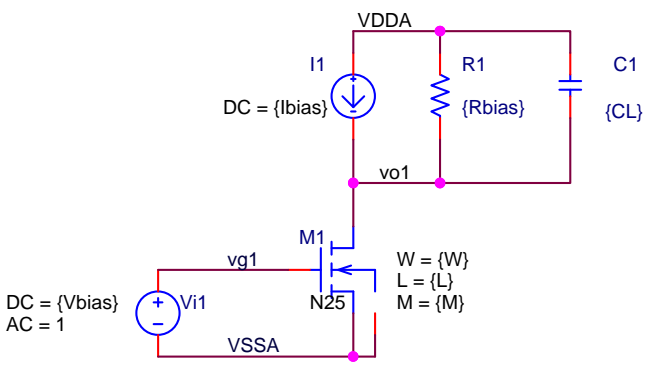
C

B

B

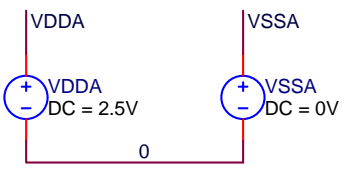
A

A

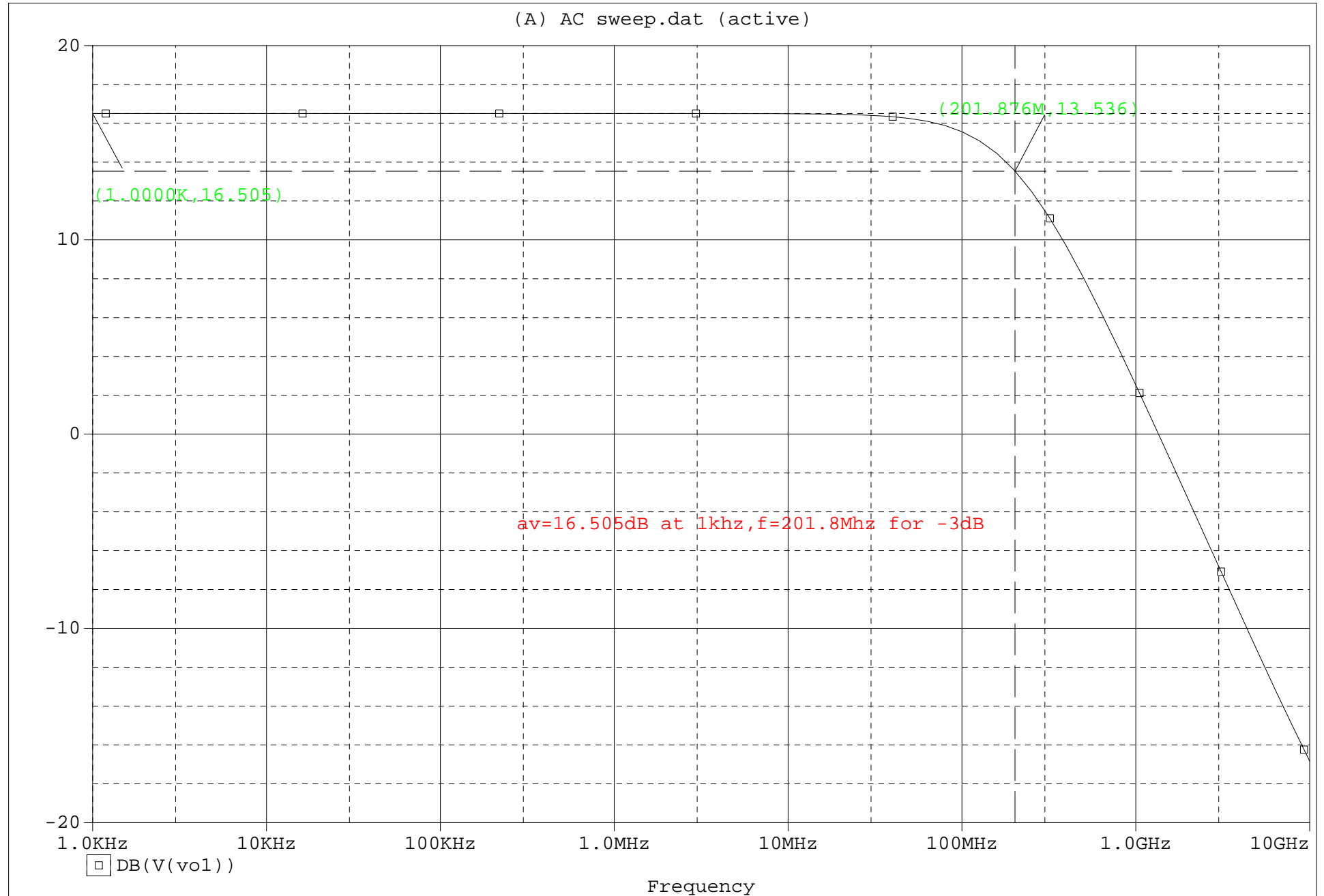


PARAMETERS:

$W = 2.5\mu$   
 $L = 0.25\mu$   
 $M = 2$   
 $V_{bias} = 692.077m$   
 $R_{bias} = 10k$   
 $I_{bias} = 0$   
 $CL = 100fF$



Author = sriharsha s jadhav		
Title Common-source amplifier with current source load		
Size A	Document Number EEE 230 project-1	Rev A1
Date:	Friday, October 14, 2016	Sheet 1 of 1



A1:(1.0000K,16.505) A2:(201.876M,13.536) DIFF(A):(-201.875M,2.9691)



\*\*\*\* 10/14/16 17:57:01 \*\*\*\* PSpice 16.6.0 (October 2012) \*\*\*\* ID# 0 \*\*\*\*

\*\* Profile: "SCHEMATIC1-DC-bias" [ \\gaia.ecs.csus.edu\jadhavs\eee\_230\CS\_amp\cs\_amp-pspicefiles\schematic1\dc-bias.sim ]

\*\*\*\* CIRCUIT DESCRIPTION

\*\*\*\*\*

\*\* Creating circuit file "DC-bias.cir"

\*\* WARNING: THIS AUTOMATICALLY GENERATED FILE MAY BE OVERWRITTEN BY SUBSEQUENT SIMULATIONS

\*Libraries:

\* Profile Libraries :

\* Local Libraries :

.LIB "..\..\..\cs\_amp-pspicefiles\cs\_amp.lib"

\* From [PSPICE NETLIST] section of C:\Users\jadhavs\cdssetup\OrCAD\_PSpice\16.6.0\PSpice.ini file:

.lib "nom.lib"

\*Analysis directives:

.OP

.OPTIONS ADVCONV

.PROBE64 V(alias(\*)) I(alias(\*)) W(alias(\*)) D(alias(\*)) NOISE(alias(\*))

.INC "..\SCHEMATIC1.net"

\*\*\*\* INCLUDING SCHEMATIC1.net \*\*\*\*

\* source CS AMP

V Vi1 VG1 VSSA DC {Vbias} AC 1 0

E Ei2 VDDA VG2 VG1 VSSA 1

V VDDA VDDA 0 DC 2.5V

V VSSA VSSA 0 DC 0V

I I1 VDDA VO1 DC {Ibias}

R R1 VO1 VDDA {Rbias} TC=0,0

I I2 VO2 VSSA DC {Ibias}

R R2 VSSA VO2 {Rbias} TC=0,0

M M1 VO1 VG1 VSSA VSSA N25

+ L={L}

+ W={W}

+ M={M}

M M2 VO2 VG2 VDDA VDDA P25

+ L={L}

+ W={W}

```
+ M={M}
C C1          VO1 VDDA  {CL}  TC=0,0
C C2          VSSA VO2   {CL}  TC=0,0
.PARAM  w=2.5u rbias=10k l=0.25u m=2 vbias=692.077m cl=100ff ibias=0
```

```
**** RESUMING DC-bias.cir ****
.END
```

WARNING(ORPSIM-15235): Mosfet M\_M1, model N25: Pd = 0 is less than W

WARNING(ORPSIM-15235): Mosfet M\_M1, model N25: Ps = 0 is less than W

WARNING(ORPSIM-15236): Parameter XW in model N25 is invalid - Ignored

WARNING(ORPSIM-15235): Mosfet M\_M2, model P25: Pd = 0 is less than W

WARNING(ORPSIM-15235): Mosfet M\_M2, model P25: Ps = 0 is less than W

WARNING(ORPSIM-15236): Parameter XW in model P25 is invalid - Ignored

INFO(ORPSIM-15454): Model N25: Using BSIM VERSION 3.1 or lower

INFO(ORPSIM-15454): Model P25: Using BSIM VERSION 3.1 or lower

•  
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\*\* Profile: "SCHEMATIC1-DC-bias" [ \\gaia.ecs.csus.edu\jadhavs\eee\_230\CS\_amp\cs\_amp-pspicefiles\schematic1\dc-bias.sim ]

\*\*\*\* MOSFET MODEL PARAMETERS

\*\*\*\*\*

	N25	P25
	NMOS	PMOS
T Measured	27	27
T Current	27	27
LEVEL	7	7
L	100.000000E-06	100.000000E-06
W	100.000000E-06	100.000000E-06
VTO	.355168	-.547882
KP	357.221800E-06	357.221800E-06
GAMMA	0	0
LAMBDA	0	0
RSH	3.8	2.9

IS	1.000000E-15	1.000000E-15
JS	100.000000E-06	100.000000E-06
PB	.99	.961669
PBSW	.981431	.8
CJ	1.556442E-03	1.870360E-03
CJSW	421.795200E-12	311.598500E-12
MJ	.422704	.475679
MJSW	.19742	.268452
CGSO	457.000000E-12	559.000000E-12
CGDO	457.000000E-12	559.000000E-12
CGBO	1.000000E-12	1.000000E-12
TOX	5.800000E-09	5.800000E-09
XJ	100.000000E-09	100.000000E-09
UCRIT	10.000000E+03	10.000000E+03
DELTA	.01	.01
DIOMOD	2	2
K1	.488168	.645808
K2	-1.465714E-06	-1.621568E-03
LETA	0	0
WETA	0	0
U0	305.8067	100
XPART	.5	.5
VTH0	.355168	-.547882
K3	1.000000E-03	.096322
W0	100.000000E-09	1.000000E-06
NLX	192.736100E-09	14.689740E-09
DVT0	.575129	2.726151
DVT1	.566083	.74709
UA	-1.152667E-09	875.490400E-12
UB	2.428080E-18	1.000000E-21
UC	41.273400E-12	-100.000000E-12
VSAT	128.759100E+03	129.251900E+03
RDSW	175	839.1661
VOFF	-.109017	-.129264
NFACTOR	1.531998	.936195
PCLM	1.620562	1.397517
PDIBL1	.959482	4.013259E-03
PDIBL2	2.748496E-03	5.534487E-06
DROUT	1	.059113
PSCBE1	683.743800E+06	5.132455E+09
PSCBE2	231.977200E-06	1.189024E-09
A0	1.795768	.903978
A1	456.914600E-06	.03521
A2	.531924	.3
NPEAK	235.490000E+15	415.890000E+15
LDD	0	0
LITL	41.713310E-09	41.713310E-09
UA1	4.310000E-09	4.310000E-09
UB1	-7.610000E-18	-7.610000E-18
UC1	-56.000000E-12	-56.000000E-12

PVAG	9.534150E-03	
KETA	-9.762332E-03	7.291800E-03
ETA0	6.182294E-03	.243084
ETAB	269.257900E-06	-.020463
K3B	3.222249	5.987855
DVT2	-.302613	-.114714
DSUB	.045455	.997855
MOBMOD	1	1
AGS	.359392	.084443
DVT1W	0	0
DVT2W	0	0
PRWG	.15	.233163
PRWB	-.124343	-.051475
PDIBLCB	-.022086	-1.000000E-03
DWG	-15.000000E-09	-47.227750E-09
DWB	2.371290E-09	-16.212000E-09
B0	127.264200E-12	1.473225E-06
B1	4.171173E-09	5.000000E-06
LINT	2.800000E-09	33.490790E-09
DLC	2.800000E-09	33.490790E-09
DWC	0	0
CF	0	0
NOIA	100.000000E+18	9.900001E+18
NOIB	50.000000E+03	2.400000E+03
NOIC	-1.400000E-12	1.400000E-12
LKETA	879.276400E-06	-3.261413E-03
WKETA	3.502570E-03	1.257100E-03
PVTH0	-6.690647E-03	6.913576E-03
PRDSW	-8.4	10.49393
PK2	1.959318E-03	1.392595E-03
VTM	.025864	.025864
VERSION	3.1	3.1
PBSWG	.851594	.8
MJSWG	.268491	.278699
CJSWG	329.000000E-12	250.000000E-12

WARNING(ORPSIM-15235): Mosfet M\_M1, model N25: Pd = 0 is less than W

WARNING(ORPSIM-15235): Mosfet M\_M1, model N25: Ps = 0 is less than W

WARNING(ORPSIM-15236): Parameter XW in model N25 is invalid - Ignored

WARNING(ORPSIM-15235): Mosfet M\_M2, model P25: Pd = 0 is less than W

WARNING(ORPSIM-15235): Mosfet M\_M2, model P25: Ps = 0 is less than W

WARNING(ORPSIM-15236): Parameter XW in model P25 is invalid - Ignored

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 \*\*\*\* 10/14/16 17:57:01 \*\*\*\*\* PSpice 16.6.0 (October 2012) \*\*\*\*\* ID# 0 \*\*\*\*\*

\*\* Profile: "SCHEMATIC1-DC-bias" [ \\gaia.ecs.csus.edu\jadhavs\eee\_230\CS\_amp\cs\_amp-pspicefiles\schematic1\dc-bias.sim ]

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

\*\*\*\*\*

NODE	VOLTAGE	NODE	VOLTAGE	NODE	VOLTAGE	NODE	VOLTAGE
( VG1)	.6921	( VG2)	1.8079	( VO1)	1.2519	( VO2)	.3971
( VDDA)	2.5000	( VSSA)	0.0000				

VOLTAGE SOURCE CURRENTS  
NAME CURRENT

V Vi1	0.000E+00
V VDDA	-1.645E-04
V_VSSA	1.645E-04

TOTAL POWER DISSIPATION 4.11E-04 WATTS

•

\*\*\*\* 10/14/16 17:57:01 \*\*\*\*\* PSpice 16.6.0 (October 2012) \*\*\*\*\* ID# 0 \*\*\*\*\*

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

\*\*\*\*\*

\*\*\*\* VOLTAGE-CONTROLLED VOLTAGE SOURCES

NAME            E Ei2  
V-SOURCE       6.921E-01  
I-SOURCE       0.000E+00

\*\*\*\* MOSFETS

NAME	M M1	M M2
MODEL	N25	P25
ID	1.25E-04	-3.97E-05
VGS	6.92E-01	-6.92E-01
VDS	1.25E+00	-2.10E+00
VBS	0.00E+00	0.00E+00
VTH	4.64E-01	-4.81E-01
VDSAT	1.75E-01	-1.89E-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	8.77E-04	2.99E-04
GDS	3.11E-05	6.27E-06
GMB	1.87E-04	8.24E-05
CBD	0.00E+00	0.00E+00
CBS	0.00E+00	0.00E+00
CGSOV	2.29E-15	2.80E-15
CGDOV	2.29E-15	2.80E-15
CGBOV	2.50E-19	2.50E-19
Derivatives of gate (dQg/dVxy) and bulk (dQb/dVxy) charges		
DQGDVGB	1.07E-14	1.02E-14
DQGDVDB	-2.20E-15	-2.74E-15
DQGDVSB	-8.03E-15	-6.89E-15
DQDDVGB	-4.71E-15	-4.61E-15
DQDDVDB	2.25E-15	2.77E-15
DQDDVSB	3.03E-15	2.35E-15
DQBDVGB	-1.27E-15	-9.81E-16
DQBDVDB	-1.73E-17	-1.22E-17
DQBDVSB	-3.22E-16	-6.00E-16

JOB CONCLUDED

•  
\*\*\*\* 10/14/16 17:57:01 \*\*\*\*\* PSpice 16.6.0 (October 2012) \*\*\*\*\* ID# 0 \*\*\*\*\*

\*\* Profile: "SCHEMATIC1-DC-bias" [ \\gaia.ecs.csus.edu\jadhavs\eee\_230\CS\_amp\cs\_amp-pspicefiles\schematic1\dc-bias.s  
m ]

\*\*\*\* JOB STATISTICS SUMMARY

\*\*\*\*\*

• Total job time (using Solver 1) = .47

2.PMOS  
Rbias=10k $\Omega$  and  
Ibias =0A



D

D

C

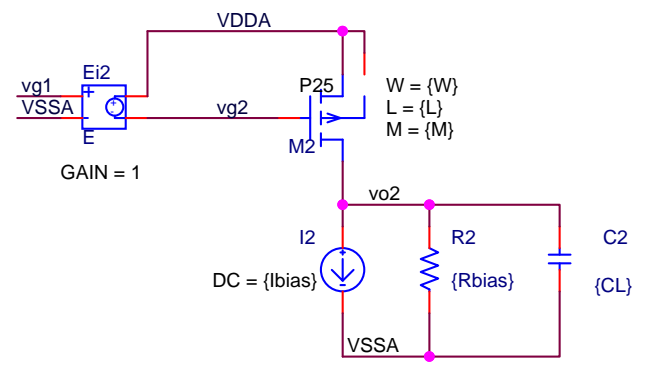
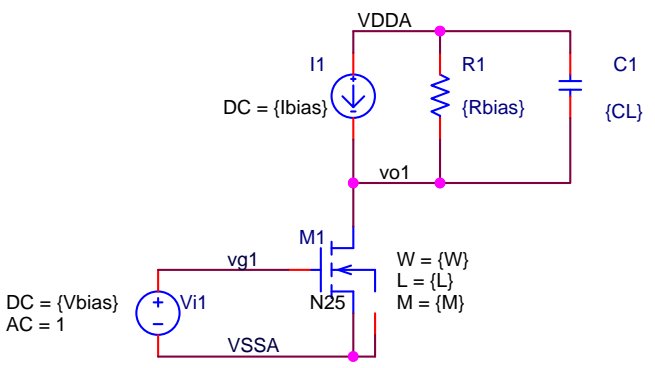
C

B

B

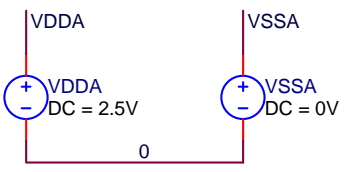
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A

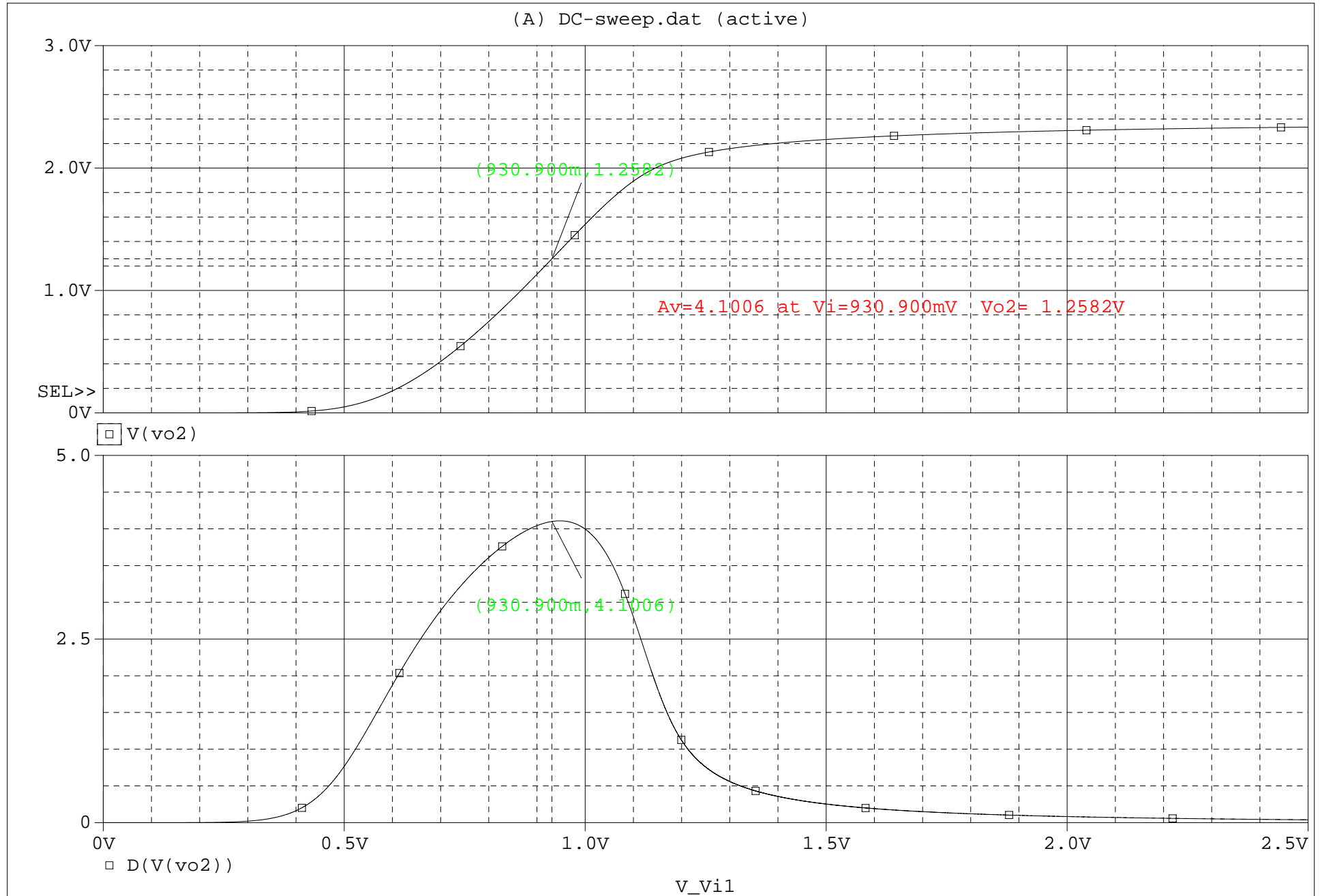


PARAMETERS:

$W = 2.5\mu$   
 $L = 0.25\mu$   
 $M = 2$   
 $V_{bias} = 1.5$   
 $R_{bias} = 10k$   
 $I_{bias} = 0$   
 $CL = 100fF$



Author = sriharsha s jadhav		
Title Common-source amplifier with current source load		
Size A	Document Number EEE 230 project-1	Rev A1
Date:	Friday, October 14, 2016	Sheet 1 of 1



A1: (930.900m, 1.2582) A2: (0.000, 223.758n) DIFF(A): (930.900m, 1.2582)

D

D

C

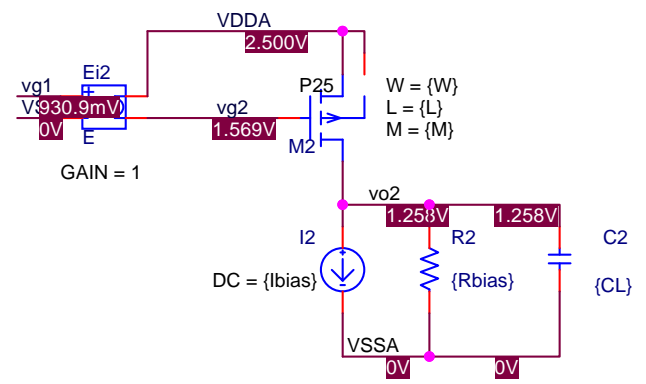
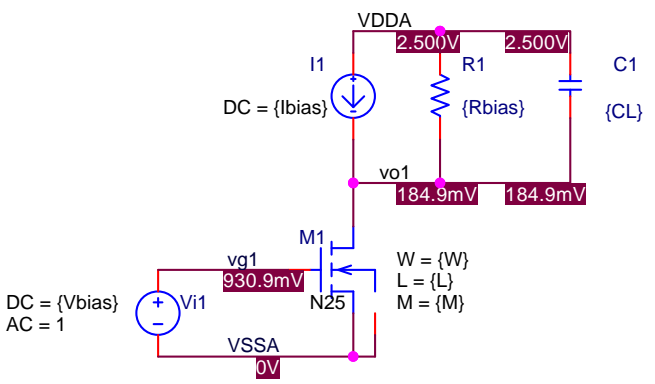
C

B

B

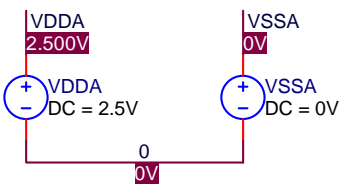
A

A

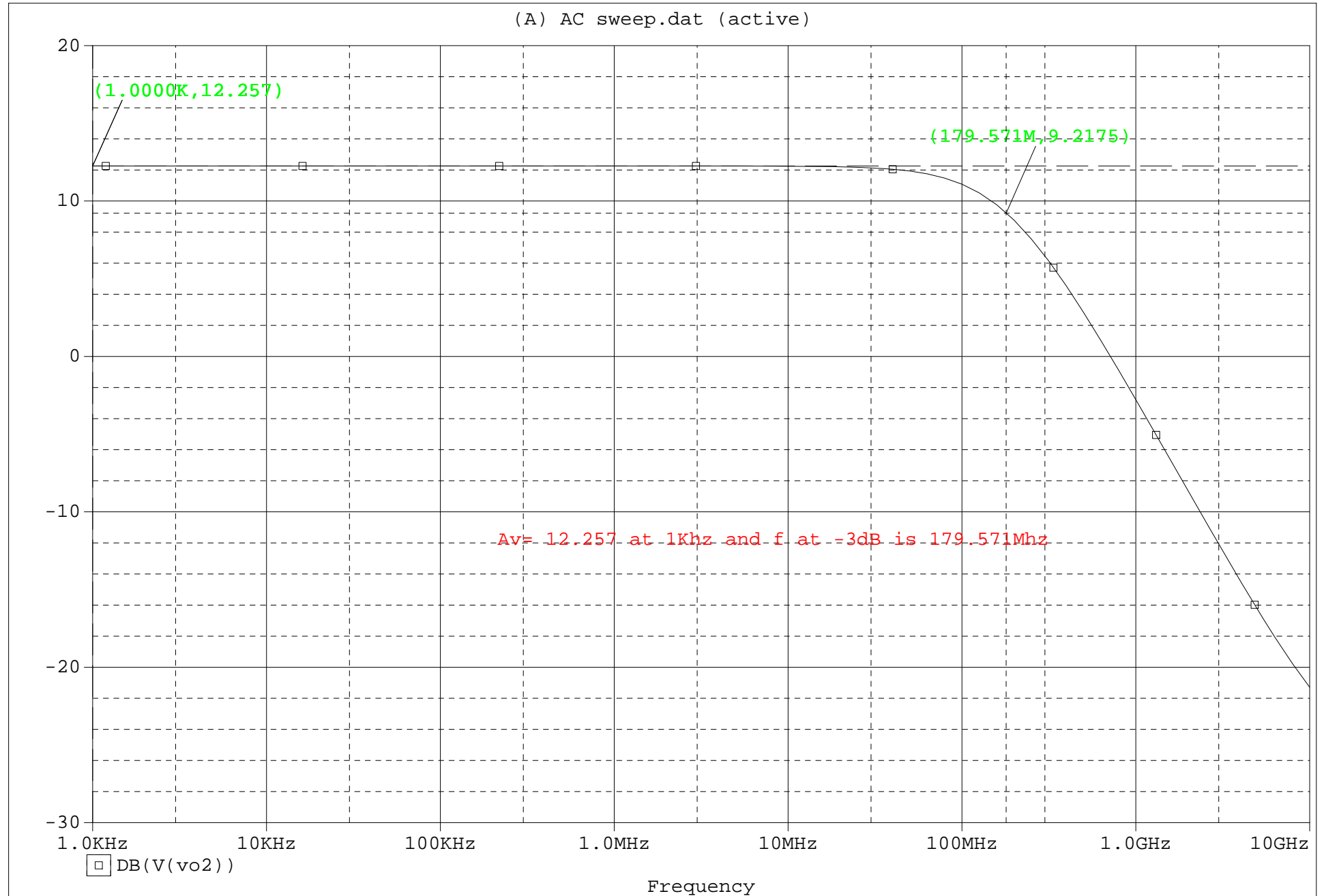


PARAMETERS:

W = 2.5u  
L = 0.25u  
M = 2  
  
Vbias = 930.900m  
  
Rbias = 10k  
Ibias = 0  
CL = 100fF



Author = sriharsha s jadhav		
Title Common-source amplifier with current source load		
Size A	Document Number EEE 230 project-1	Rev A1
Date:	Friday, October 14, 2016	Sheet 1 of 1



A1:(179.571M,9.2175) A2:(1.0000K,12.257) DIFF(A):(179.570M,-3.0395)

\*\*\*\* 10/14/16 18:47:02 \*\*\*\* PSpice 16.6.0 (October 2012) \*\*\*\* ID# 0 \*\*\*\*

\*\* Profile: "SCHEMATIC1-DC-bias" [ \\gaia.ecs.csus.edu\jadhavs\eee\_230\CS\_amp\cs\_amp-pspicefiles\schematic1\dc-bias.sim ]

\*\*\*\* CIRCUIT DESCRIPTION

\*\*\*\*\*

\*\* Creating circuit file "DC-bias.cir"

\*\* WARNING: THIS AUTOMATICALLY GENERATED FILE MAY BE OVERWRITTEN BY SUBSEQUENT SIMULATIONS

\*Libraries:

\* Profile Libraries :

\* Local Libraries :

.LIB "..\..\..\cs\_amp-pspicefiles\cs\_amp.lib"

\* From [PSPICE NETLIST] section of C:\Users\jadhavs\cdssetup\OrCAD\_PSpice\16.6.0\PSpice.ini file:

.lib "nom.lib"

\*Analysis directives:

.OP

.OPTIONS ADVCONV

.PROBE64 V(alias(\*)) I(alias(\*)) W(alias(\*)) D(alias(\*)) NOISE(alias(\*))

.INC "..\SCHEMATIC1.net"

\*\*\*\* INCLUDING SCHEMATIC1.net \*\*\*\*

\* source CS AMP

V Vi1 VG1 VSSA DC {Vbias} AC 1 0

E Ei2 VDDA VG2 VG1 VSSA 1

V VDDA VDDA 0 DC 2.5V

V VSSA VSSA 0 DC 0V

I I1 VDDA VO1 DC {Ibias}

R R1 VO1 VDDA {Rbias} TC=0,0

I I2 VO2 VSSA DC {Ibias}

R R2 VSSA VO2 {Rbias} TC=0,0

M M1 VO1 VG1 VSSA VSSA N25

+ L={L}

+ W={W}

+ M={M}

M M2 VO2 VG2 VDDA VDDA P25

+ L={L}

+ W={W}

```
+ M={M}
C C1          VO1 VDDA  {CL}  TC=0,0
C C2          VSSA VO2   {CL}  TC=0,0
.PARAM  w=2.5u rbias=10k l=0.25u m=2 vbias=1.5 cl=100ff ibias=0
```

```
**** RESUMING DC-bias.cir ****
.END
```

WARNING(ORPSIM-15235): Mosfet M\_M1, model N25: Pd = 0 is less than W

WARNING(ORPSIM-15235): Mosfet M\_M1, model N25: Ps = 0 is less than W

WARNING(ORPSIM-15236): Parameter XW in model N25 is invalid - Ignored

WARNING(ORPSIM-15235): Mosfet M\_M2, model P25: Pd = 0 is less than W

WARNING(ORPSIM-15235): Mosfet M\_M2, model P25: Ps = 0 is less than W

WARNING(ORPSIM-15236): Parameter XW in model P25 is invalid - Ignored

INFO(ORPSIM-15454): Model N25: Using BSIM VERSION 3.1 or lower

INFO(ORPSIM-15454): Model P25: Using BSIM VERSION 3.1 or lower

•  
\*\*\*\* 10/14/16 18:47:02 \*\*\*\*\* PSpice 16.6.0 (October 2012) \*\*\*\*\* ID# 0 \*\*\*\*\*

\*\* Profile: "SCHEMATIC1-DC-bias" [ \\gaia.ecs.csus.edu\jadhavs\eee\_230\CS\_amp\cs\_amp-pspicefiles\schematic1\dc-bias.sim ]

\*\*\*\* MOSFET MODEL PARAMETERS

\*\*\*\*\*

	N25	P25
	NMOS	PMOS
T Measured	27	27
T Current	27	27
LEVEL	7	7
L	100.000000E-06	100.000000E-06
W	100.000000E-06	100.000000E-06
VTO	.355168	-.547882
KP	357.221800E-06	357.221800E-06
GAMMA	0	0
LAMBDA	0	0
RSH	3.8	2.9

IS	1.000000E-15	1.000000E-15
JS	100.000000E-06	100.000000E-06
PB	.99	.961669
PBSW	.981431	.8
CJ	1.556442E-03	1.870360E-03
CJSW	421.795200E-12	311.598500E-12
MJ	.422704	.475679
MJSW	.19742	.268452
CGSO	457.000000E-12	559.000000E-12
CGDO	457.000000E-12	559.000000E-12
CGBO	1.000000E-12	1.000000E-12
TOX	5.800000E-09	5.800000E-09
XJ	100.000000E-09	100.000000E-09
UCRIT	10.000000E+03	10.000000E+03
DELTA	.01	.01
DIOMOD	2	2
K1	.488168	.645808
K2	-1.465714E-06	-1.621568E-03
LETA	0	0
WETA	0	0
U0	305.8067	100
XPART	.5	.5
VTH0	.355168	-.547882
K3	1.000000E-03	.096322
W0	100.000000E-09	1.000000E-06
NLX	192.736100E-09	14.689740E-09
DVT0	.575129	2.726151
DVT1	.566083	.74709
UA	-1.152667E-09	875.490400E-12
UB	2.428080E-18	1.000000E-21
UC	41.273400E-12	-100.000000E-12
VSAT	128.759100E+03	129.251900E+03
RDSW	175	839.1661
VOFF	-.109017	-.129264
NFACTOR	1.531998	.936195
PCLM	1.620562	1.397517
PDIBL1	.959482	4.013259E-03
PDIBL2	2.748496E-03	5.534487E-06
DROUT	1	.059113
PSCBE1	683.743800E+06	5.132455E+09
PSCBE2	231.977200E-06	1.189024E-09
A0	1.795768	.903978
A1	456.914600E-06	.03521
A2	.531924	.3
NPEAK	235.490000E+15	415.890000E+15
LDD	0	0
LITL	41.713310E-09	41.713310E-09
UA1	4.310000E-09	4.310000E-09
UB1	-7.610000E-18	-7.610000E-18
UC1	-56.000000E-12	-56.000000E-12

PVAG	9.534150E-03	
KETA	-9.762332E-03	7.291800E-03
ETA0	6.182294E-03	.243084
ETAB	269.257900E-06	-.020463
K3B	3.222249	5.987855
DVT2	-.302613	-.114714
DSUB	.045455	.997855
MOBMOD	1	1
AGS	.359392	.084443
DVT1W	0	0
DVT2W	0	0
PRWG	.15	.233163
PRWB	-.124343	-.051475
PDIBLCB	-.022086	-1.000000E-03
DWG	-15.000000E-09	-47.227750E-09
DWB	2.371290E-09	-16.212000E-09
B0	127.264200E-12	1.473225E-06
B1	4.171173E-09	5.000000E-06
LINT	2.800000E-09	33.490790E-09
DLC	2.800000E-09	33.490790E-09
DWC	0	0
CF	0	0
NOIA	100.000000E+18	9.900001E+18
NOIB	50.000000E+03	2.400000E+03
NOIC	-1.400000E-12	1.400000E-12
LKETA	879.276400E-06	-3.261413E-03
WKETA	3.502570E-03	1.257100E-03
PVTH0	-6.690647E-03	6.913576E-03
PRDSW	-8.4	10.49393
PK2	1.959318E-03	1.392595E-03
VTM	.025864	.025864
VERSION	3.1	3.1
PBSWG	.851594	.8
MJSWG	.268491	.278699
CJSWG	329.000000E-12	250.000000E-12

WARNING(ORPSIM-15235): Mosfet M\_M1, model N25: Pd = 0 is less than W

WARNING(ORPSIM-15235): Mosfet M\_M1, model N25: Ps = 0 is less than W

WARNING(ORPSIM-15236): Parameter XW in model N25 is invalid - Ignored

WARNING(ORPSIM-15235): Mosfet M\_M2, model P25: Pd = 0 is less than W

WARNING(ORPSIM-15235): Mosfet M\_M2, model P25: Ps = 0 is less than W

WARNING(ORPSIM-15236): Parameter XW in model P25 is invalid - Ignored

•  
 \*\*\*\* 10/14/16 18:47:02 \*\*\*\*\* PSpice 16.6.0 (October 2012) \*\*\*\*\* ID# 0 \*\*\*\*\*



\*\* Profile: "SCHEMATIC1-DC-bias" [ \\gaia.ecs.csus.edu\jadhavs\eee\_230\CS\_amp\cs\_amp-pspicefiles\schematic1\dc-bias.sim ]

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

\*\*\*\*\*

NODE	VOLTAGE	NODE	VOLTAGE	NODE	VOLTAGE	NODE	VOLTAGE
( VG1)	1.5000	( VG2)	1.0000	( VO1)	.0716	( VO2)	2.2334
( VDDA)	2.5000	( VSSA)	0.0000				

VOLTAGE SOURCE CURRENTS  
NAME CURRENT

V Vi1	0.000E+00
V VDDA	-4.662E-04
V_VSSA	4.662E-04

TOTAL POWER DISSIPATION 1.17E-03 WATTS

●  
\*\*\*\* 10/14/16 18:47:02 \*\*\*\*\* PSpice 16.6.0 (October 2012) \*\*\*\*\* ID# 0 \*\*\*\*\*

\*\* Profile: "SCHEMATIC1-DC-bias" [ \\gaia.ecs.csus.edu\jadhavs\eee\_230\CS\_amp\cs\_amp-pspicefiles\schematic1\dc-bias.sim ]

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

\*\*\*\*\*

\*\*\*\* VOLTAGE-CONTROLLED VOLTAGE SOURCES

NAME            E Ei2  
V-SOURCE       1.500E+00  
I-SOURCE       0.000E+00

\*\*\*\* MOSFETS

NAME	M M1	M M2
MODEL	N25	P25
ID	2.43E-04	-2.23E-04
VGS	1.50E+00	-1.50E+00
VDS	7.16E-02	-2.67E-01
VBS	0.00E+00	0.00E+00
VTH	4.80E-01	-5.05E-01
VDSAT	4.38E-01	-6.00E-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	1.98E-04	1.99E-04
GDS	3.16E-03	6.83E-04
GMB	5.01E-05	6.54E-05
CBD	0.00E+00	0.00E+00
CBS	0.00E+00	0.00E+00
CGSOV	2.29E-15	2.80E-15
CGDOV	2.29E-15	2.80E-15
CGBOV	2.50E-19	2.50E-19
Derivatives of gate (dQg/dVxy) and bulk (dQb/dVxy) charges		
DQGDVGB	1.18E-14	1.09E-14
DQGDVDB	-5.46E-15	-4.40E-15
DQGDVSB	-6.19E-15	-6.12E-15
DQDDVGB	-5.90E-15	-5.33E-15
DQDDVDB	5.56E-15	4.52E-15
DQDDVSB	1.17E-15	1.47E-15
DQBDVGB	-3.64E-17	-2.12E-16
DQBDVDB	-3.38E-15	-1.85E-15
DQBDVSB	1.57E-15	3.86E-16

JOB CONCLUDED

•  
\*\*\*\* 10/14/16 18:47:02 \*\*\*\*\* PSpice 16.6.0 (October 2012) \*\*\*\*\* ID# 0 \*\*\*\*\*

\*\* Profile: "SCHEMATIC1-DC-bias" [ \\gaia.ecs.csus.edu\jadhavs\eee\_230\CS\_amp\cs\_amp-pspicefiles\schematic1\dc-bias.sim ]

\*\*\*\* JOB STATISTICS SUMMARY

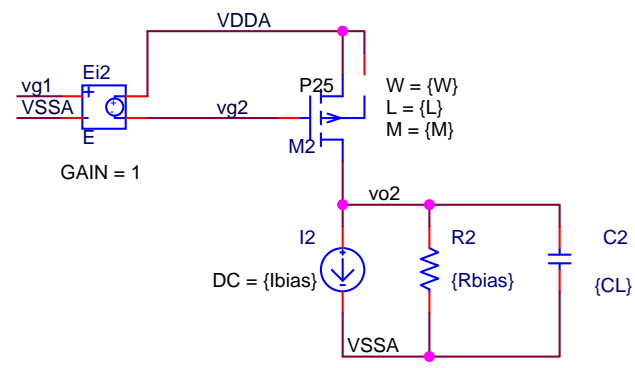
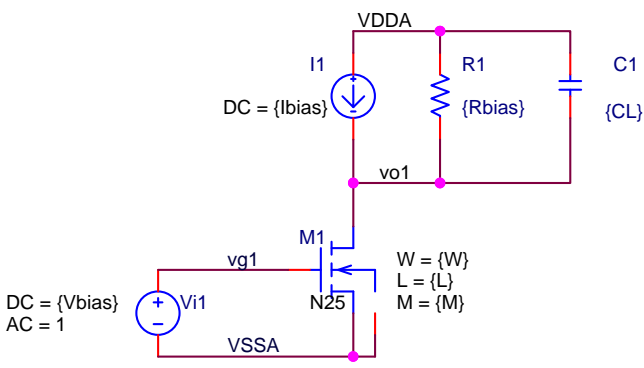
\*\*\*\*\*

• Total job time (using Solver 1) = .39

# 3.NMOS

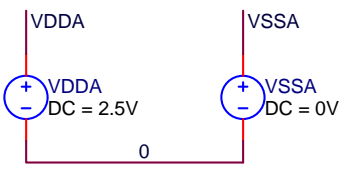
$R_{bias}=1000k\Omega$  and

$I_{bias} = 125\mu A$

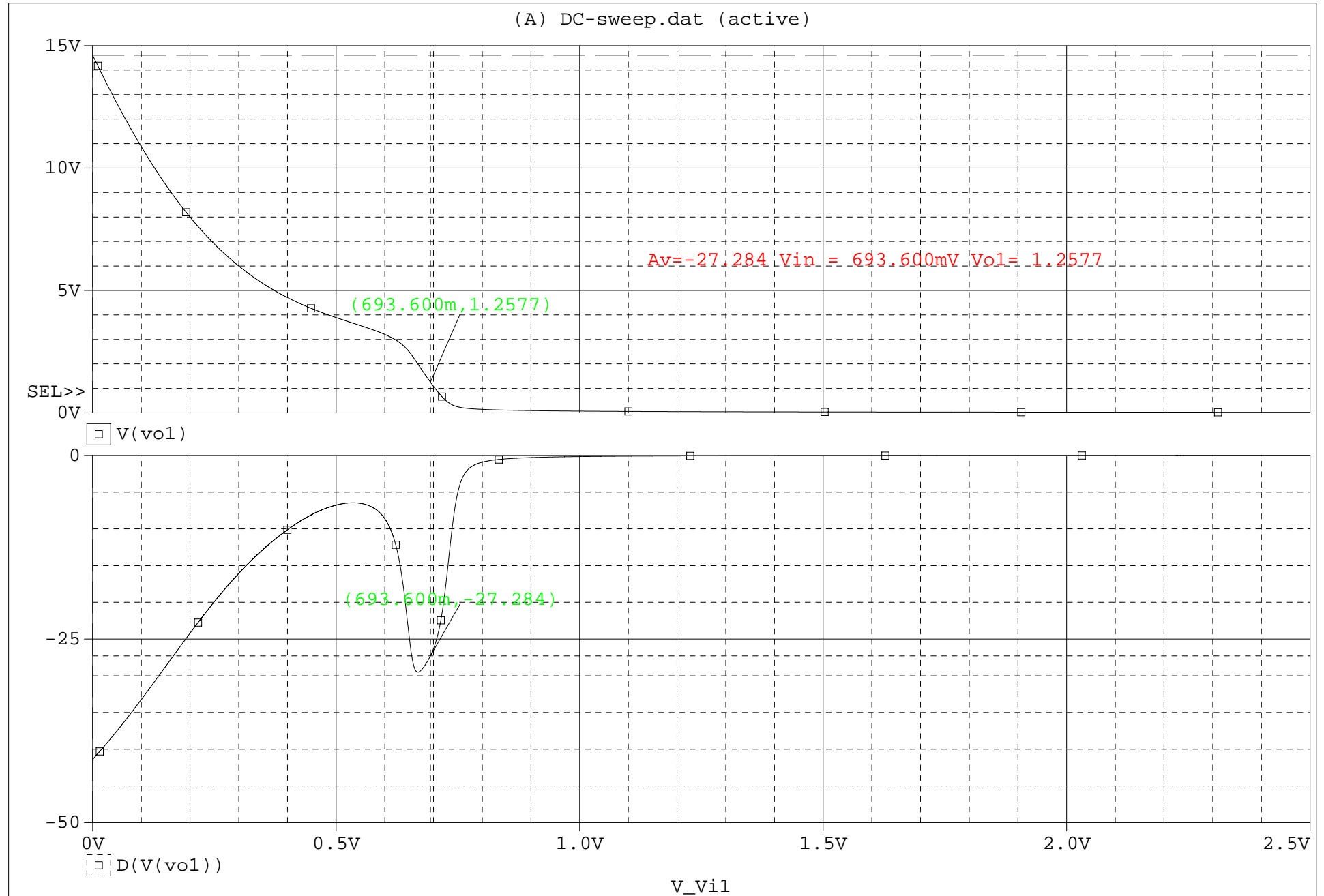


PARAMETERS:

W = 2.5u  
L = 0.25u  
M = 2  
  
Vbias = 1.5  
  
Rbias = 1000k  
Ibias = 125u  
CL = 100fF



Author = sriharsha s jadhav		
Title Common-source amplifier with current source load		
Size A	Document Number EEE 230 project-1	Rev A1
Date:	Friday, October 14, 2016	Sheet 1 of 1



A1: (693.600m, -27.284) A2: (0.000, 14.613) DIFF(A): (693.600m, -41.896)

D

D

C

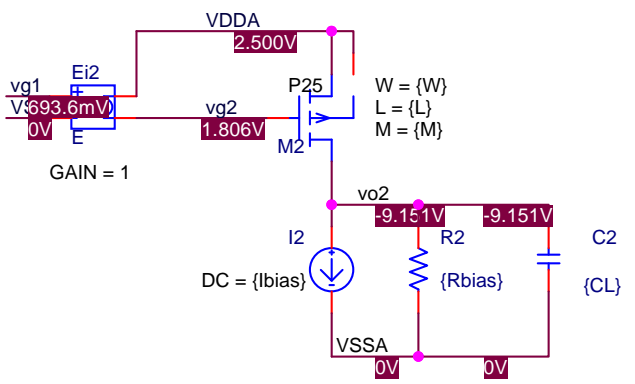
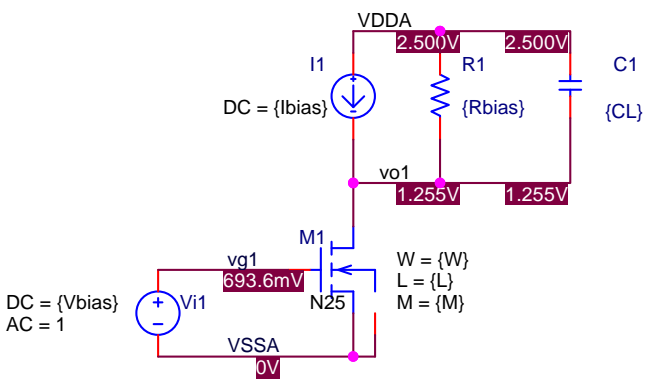
C

B

B

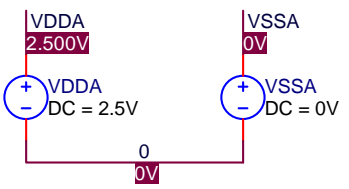
A

A

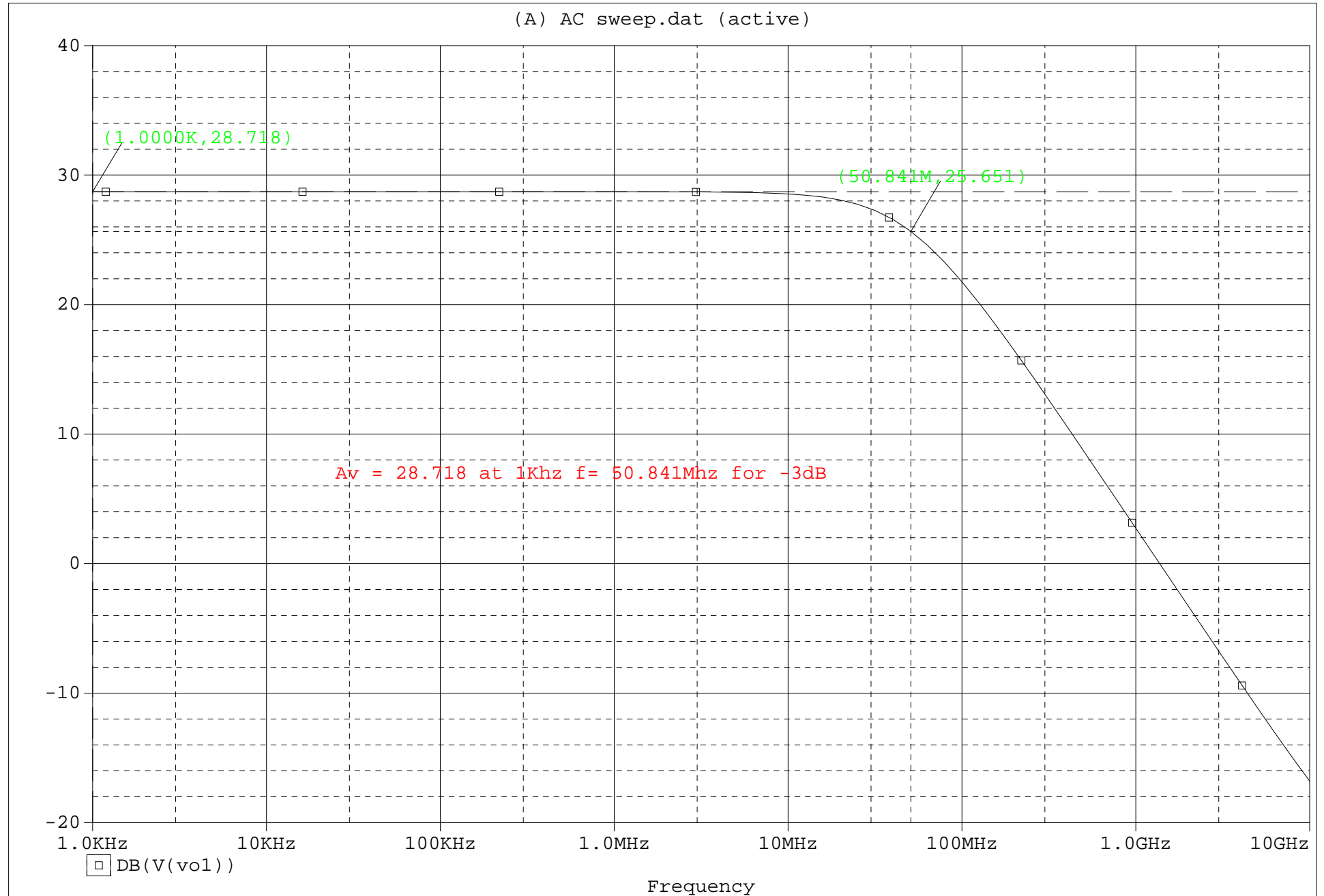


PARAMETERS:

W = 2.5u  
L = 0.25u  
M = 2  
  
Vbias = 693.600m  
  
Rbias = 1000k  
Ibias = 125u  
CL = 100fF



Author = sriharsha s jadhav		
Title Common-source amplifier with current source load		
Size A	Document Number EEE 230 project-1	Rev A1
Date:	Friday, October 14, 2016	Sheet 1 of 1



A1: (50.841M, 25.651) A2: (1.0000K, 28.718) DIFF(A): (50.840M, -3.0675)



•  
\*\*\*\* 10/14/16 20:01:24 \*\*\*\*\* PSpice 16.6.0 (October 2012) \*\*\*\*\* ID# 0 \*\*\*\*\*  
  
\*\* Profile: "SCHEMATIC1-DC-bias" [ \\gaia.ecs.csus.edu\jadhavs\eee\_230\CS\_amp\cs\_amp-pspicefiles\schematic1\dc-bias.sim ]  
  
\*\*\*\* CIRCUIT DESCRIPTION  
  
\*\*\*\*\*  
  
\*\* Creating circuit file "DC-bias.cir"  
\*\* WARNING: THIS AUTOMATICALLY GENERATED FILE MAY BE OVERWRITTEN BY SUBSEQUENT SIMULATIONS  
  
\*Libraries:  
\* Profile Libraries :  
\* Local Libraries :  
.LIB "..../..../cs\_amp-pspicefiles/cs\_amp.lib"  
\* From [PSPICE NETLIST] section of C:\Users\jadhavs\cdssetup\OrCAD\_PSpice/16.6.0/PSpice.ini file:  
.lib "nom.lib"  
  
\*Analysis directives:  
.OP  
.OPTIONS ADVCONV  
.PROBE64 V(alias(\*)) I(alias(\*)) W(alias(\*)) D(alias(\*)) NOISE(alias(\*))  
.INC "..\SCHEMATIC1.net"  
  
\*\*\*\* INCLUDING SCHEMATIC1.net \*\*\*\*  
\* source CS AMP  
V Vi1 VG1 VSSA DC {Vbias} AC 1 0  
E Ei2 VDDA VG2 VG1 VSSA 1  
V VDDA VDDA 0 DC 2.5V  
V VSSA VSSA 0 DC 0V  
I I1 VDDA VO1 DC {Ibias}  
R R1 VO1 VDDA {Rbias} TC=0,0  
I I2 VO2 VSSA DC {Ibias}  
R R2 VSSA VO2 {Rbias} TC=0,0  
M M1 VO1 VG1 VSSA VSSA N25  
+ L={L}  
+ W={W}  
+ M={M}  
M M2 VO2 VG2 VDDA VDDA P25  
+ L={L}  
+ W={W}

```
+ M={M}
C C1          VO1 VDDA  {CL}  TC=0,0
C C2          VSSA VO2   {CL}  TC=0,0
.PARAM  w=2.5u rbias=1000k l=0.25u m=2 vbias=693.600m cl=100ff ibias=125u
```

```
**** RESUMING DC-bias.cir ****
.END
```

WARNING(ORPSIM-15235): Mosfet M\_M1, model N25: Pd = 0 is less than W

WARNING(ORPSIM-15235): Mosfet M\_M1, model N25: Ps = 0 is less than W

WARNING(ORPSIM-15236): Parameter XW in model N25 is invalid - Ignored

WARNING(ORPSIM-15235): Mosfet M\_M2, model P25: Pd = 0 is less than W

WARNING(ORPSIM-15235): Mosfet M\_M2, model P25: Ps = 0 is less than W

WARNING(ORPSIM-15236): Parameter XW in model P25 is invalid - Ignored

INFO(ORPSIM-15454): Model N25: Using BSIM VERSION 3.1 or lower

INFO(ORPSIM-15454): Model P25: Using BSIM VERSION 3.1 or lower

•  
\*\*\*\* 10/14/16 20:01:24 \*\*\*\*\* PSpice 16.6.0 (October 2012) \*\*\*\*\* ID# 0 \*\*\*\*\*

\*\* Profile: "SCHEMATIC1-DC-bias" [ \\gaia.ecs.csus.edu\jadhavs\eee\_230\CS\_amp\cs\_amp-pspicefiles\schematic1\dc-bias.sim ]

\*\*\*\* MOSFET MODEL PARAMETERS

\*\*\*\*\*

	N25	P25
	NMOS	PMOS
T Measured	27	27
T Current	27	27
LEVEL	7	7
L	100.000000E-06	100.000000E-06
W	100.000000E-06	100.000000E-06
VTO	.355168	-.547882
KP	357.221800E-06	357.221800E-06
GAMMA	0	0
LAMBDA	0	0
RSH	3.8	2.9

IS	1.000000E-15	1.000000E-15
JS	100.000000E-06	100.000000E-06
PB	.99	.961669
PBSW	.981431	.8
CJ	1.556442E-03	1.870360E-03
CJSW	421.795200E-12	311.598500E-12
MJ	.422704	.475679
MJSW	.19742	.268452
CGSO	457.000000E-12	559.000000E-12
CGDO	457.000000E-12	559.000000E-12
CGBO	1.000000E-12	1.000000E-12
TOX	5.800000E-09	5.800000E-09
XJ	100.000000E-09	100.000000E-09
UCRIT	10.000000E+03	10.000000E+03
DELTA	.01	.01
DIOMOD	2	2
K1	.488168	.645808
K2	-1.465714E-06	-1.621568E-03
LETA	0	0
WETA	0	0
U0	305.8067	100
XPART	.5	.5
VTH0	.355168	-.547882
K3	1.000000E-03	.096322
W0	100.000000E-09	1.000000E-06
NLX	192.736100E-09	14.689740E-09
DVT0	.575129	2.726151
DVT1	.566083	.74709
UA	-1.152667E-09	875.490400E-12
UB	2.428080E-18	1.000000E-21
UC	41.273400E-12	-100.000000E-12
VSAT	128.759100E+03	129.251900E+03
RDSW	175	839.1661
VOFF	-.109017	-.129264
NFACTOR	1.531998	.936195
PCLM	1.620562	1.397517
PDIBL1	.959482	4.013259E-03
PDIBL2	2.748496E-03	5.534487E-06
DROUT	1	.059113
PSCBE1	683.743800E+06	5.132455E+09
PSCBE2	231.977200E-06	1.189024E-09
A0	1.795768	.903978
A1	456.914600E-06	.03521
A2	.531924	.3
NPEAK	235.490000E+15	415.890000E+15
LDD	0	0
LITL	41.713310E-09	41.713310E-09
UA1	4.310000E-09	4.310000E-09
UB1	-7.610000E-18	-7.610000E-18
UC1	-56.000000E-12	-56.000000E-12

PVAG	9.534150E-03	
KETA	-9.762332E-03	7.291800E-03
ETA0	6.182294E-03	.243084
ETAB	269.257900E-06	-.020463
K3B	3.222249	5.987855
DVT2	-.302613	-.114714
DSUB	.045455	.997855
MOBMOD	1	1
AGS	.359392	.084443
DVT1W	0	0
DVT2W	0	0
PRWG	.15	.233163
PRWB	-.124343	-.051475
PDIBLCB	-.022086	-1.000000E-03
DWG	-15.000000E-09	-47.227750E-09
DWB	2.371290E-09	-16.212000E-09
B0	127.264200E-12	1.473225E-06
B1	4.171173E-09	5.000000E-06
LINT	2.800000E-09	33.490790E-09
DLC	2.800000E-09	33.490790E-09
DWC	0	0
CF	0	0
NOIA	100.000000E+18	9.900001E+18
NOIB	50.000000E+03	2.400000E+03
NOIC	-1.400000E-12	1.400000E-12
LKETA	879.276400E-06	-3.261413E-03
WKETA	3.502570E-03	1.257100E-03
PVTH0	-6.690647E-03	6.913576E-03
PRDSW	-8.4	10.49393
PK2	1.959318E-03	1.392595E-03
VTM	.025864	.025864
VERSION	3.1	3.1
PBSWG	.851594	.8
MJSWG	.268491	.278699
CJSWG	329.000000E-12	250.000000E-12

WARNING(ORPSIM-15235): Mosfet M\_M1, model N25: Pd = 0 is less than W

WARNING(ORPSIM-15235): Mosfet M\_M1, model N25: Ps = 0 is less than W

WARNING(ORPSIM-15236): Parameter XW in model N25 is invalid - Ignored

WARNING(ORPSIM-15235): Mosfet M\_M2, model P25: Pd = 0 is less than W

WARNING(ORPSIM-15235): Mosfet M\_M2, model P25: Ps = 0 is less than W

WARNING(ORPSIM-15236): Parameter XW in model P25 is invalid - Ignored

•  
 \*\*\*\* 10/14/16 20:01:24 \*\*\*\*\* PSpice 16.6.0 (October 2012) \*\*\*\*\* ID# 0 \*\*\*\*\*

\*\* Profile: "SCHEMATIC1-DC-bias" [ \\gaia.ecs.csus.edu\jadhavs\eee\_230\CS\_amp\cs\_amp-pspicefiles\schematic1\dc-bias.sim ]

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

\*\*\*\*\*

NODE	VOLTAGE	NODE	VOLTAGE	NODE	VOLTAGE	NODE	VOLTAGE
( VG1)	.6936	( VG2)	1.8064	( VO1)	1.2549	( VO2)	-9.1511
( VDDA)	2.5000	( VSSA)	0.0000				

VOLTAGE SOURCE CURRENTS  
NAME CURRENT

V Vi1	0.000E+00
V VDDA	-2.421E-04
V_VSSA	2.421E-04

TOTAL POWER DISSIPATION 6.05E-04 WATTS

●  
\*\*\*\* 10/14/16 20:01:24 \*\*\*\*\* PSpice 16.6.0 (October 2012) \*\*\*\*\* ID# 0 \*\*\*\*\*

\*\* Profile: "SCHEMATIC1-DC-bias" [ \\gaia.ecs.csus.edu\jadhavs\eee\_230\CS\_amp\cs\_amp-pspicefiles\schematic1\dc-bias.sim ]

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

\*\*\*\*\*

\*\*\*\* VOLTAGE-CONTROLLED VOLTAGE SOURCES

NAME            E Ei2  
V-SOURCE       6.936E-01  
I-SOURCE       0.000E+00

\*\*\*\* MOSFETS

NAME	M M1	M M2
MODEL	N25	P25
ID	1.26E-04	-1.16E-04
VGS	6.94E-01	-6.94E-01
VDS	1.25E+00	-1.17E+01
VBS	0.00E+00	0.00E+00
VTH	4.64E-01	-3.56E-01
VDSAT	1.76E-01	-2.63E-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	8.81E-04	5.06E-04
GDS	3.13E-05	9.68E-06
GMB	1.88E-04	1.31E-04
CBD	0.00E+00	0.00E+00
CBS	0.00E+00	0.00E+00
CGSOV	2.29E-15	2.80E-15
CGDOV	2.29E-15	2.80E-15
CGBOV	2.50E-19	2.50E-19
Derivatives of gate (dQg/dVxy) and bulk (dQb/dVxy) charges		
DQGDVGB	1.07E-14	1.02E-14
DQGDVDB	-2.20E-15	-2.74E-15
DQGDVSB	-8.03E-15	-6.86E-15
DQDDVGB	-4.71E-15	-4.61E-15
DQDDVDB	2.25E-15	2.77E-15
DQDDVSB	3.03E-15	2.33E-15
DQBDVGB	-1.27E-15	-9.79E-16
DQBDVDB	-1.73E-17	-1.22E-17
DQBDVSB	-3.22E-16	-5.95E-16

JOB CONCLUDED

•  
\*\*\*\* 10/14/16 20:01:24 \*\*\*\*\* PSpice 16.6.0 (October 2012) \*\*\*\*\* ID# 0 \*\*\*\*\*

\*\* Profile: "SCHEMATIC1-DC-bias" [ \\gaia.ecs.csus.edu\jadhavs\eee\_230\CS\_amp\cs\_amp-pspicefiles\schematic1\dc-bias.s  
m ]

\*\*\*\* JOB STATISTICS SUMMARY

\*\*\*\*\*

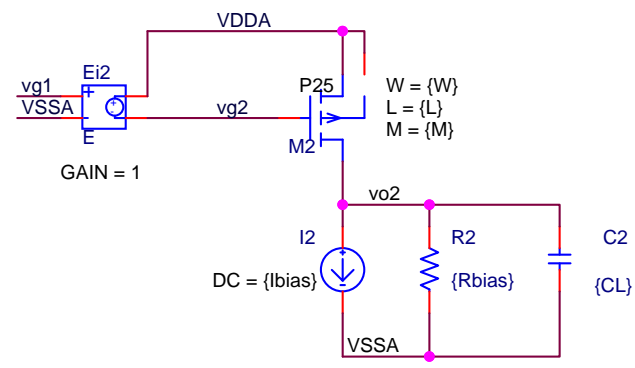
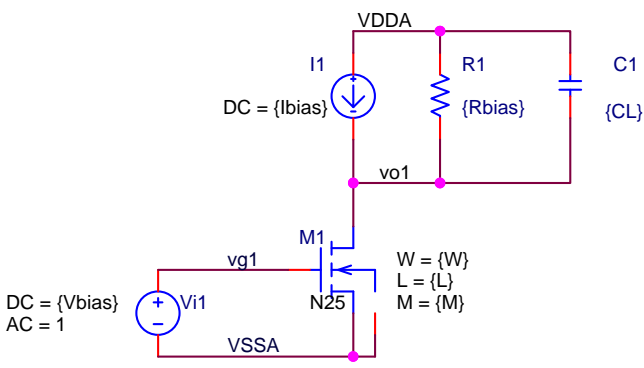
• Total job time (using Solver 1) = .05

## 4.PMOS

$R_{bias}=1000k\Omega$  and

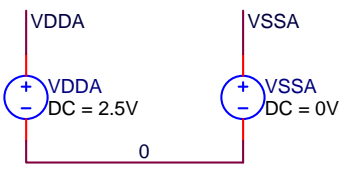
$I_{bias} = 125\mu A$



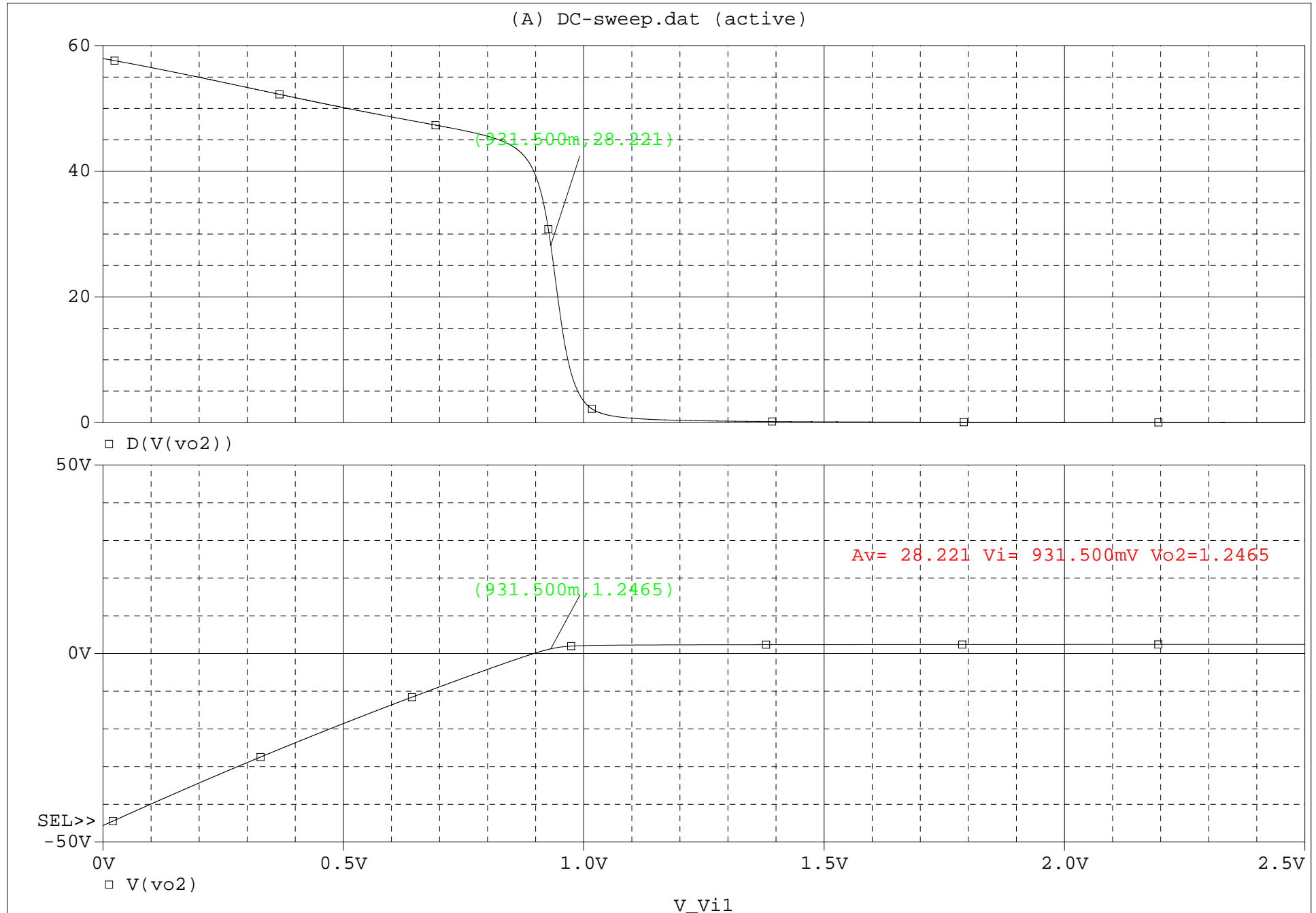


PARAMETERS:

W = 2.5u  
L = 0.25u  
M = 2  
  
Vbias = 1.5  
  
Rbias = 1000k  
Ibias = 125u  
CL = 100fF



Author = sriharsha s jadhav		
Title Common-source amplifier with current source load		
Size A	Document Number EEE 230 project-1	Rev A1
Date:	Friday, October 14, 2016	Sheet 1 of 1



D

D

C

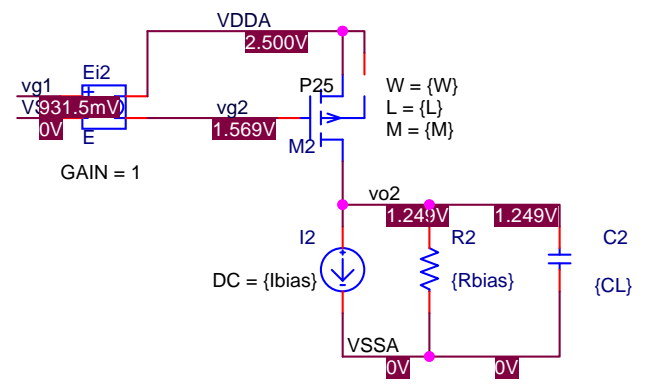
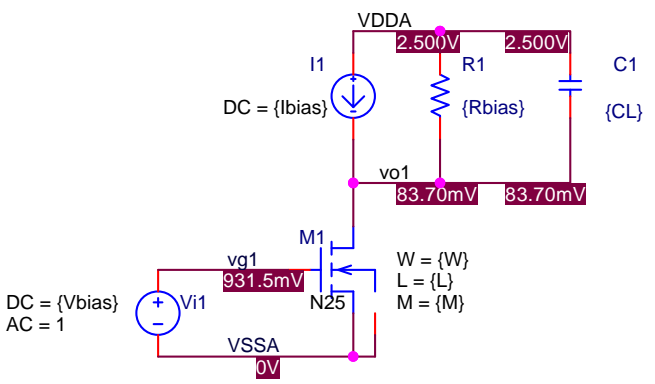
C

B

B

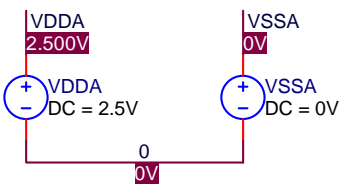
A

A

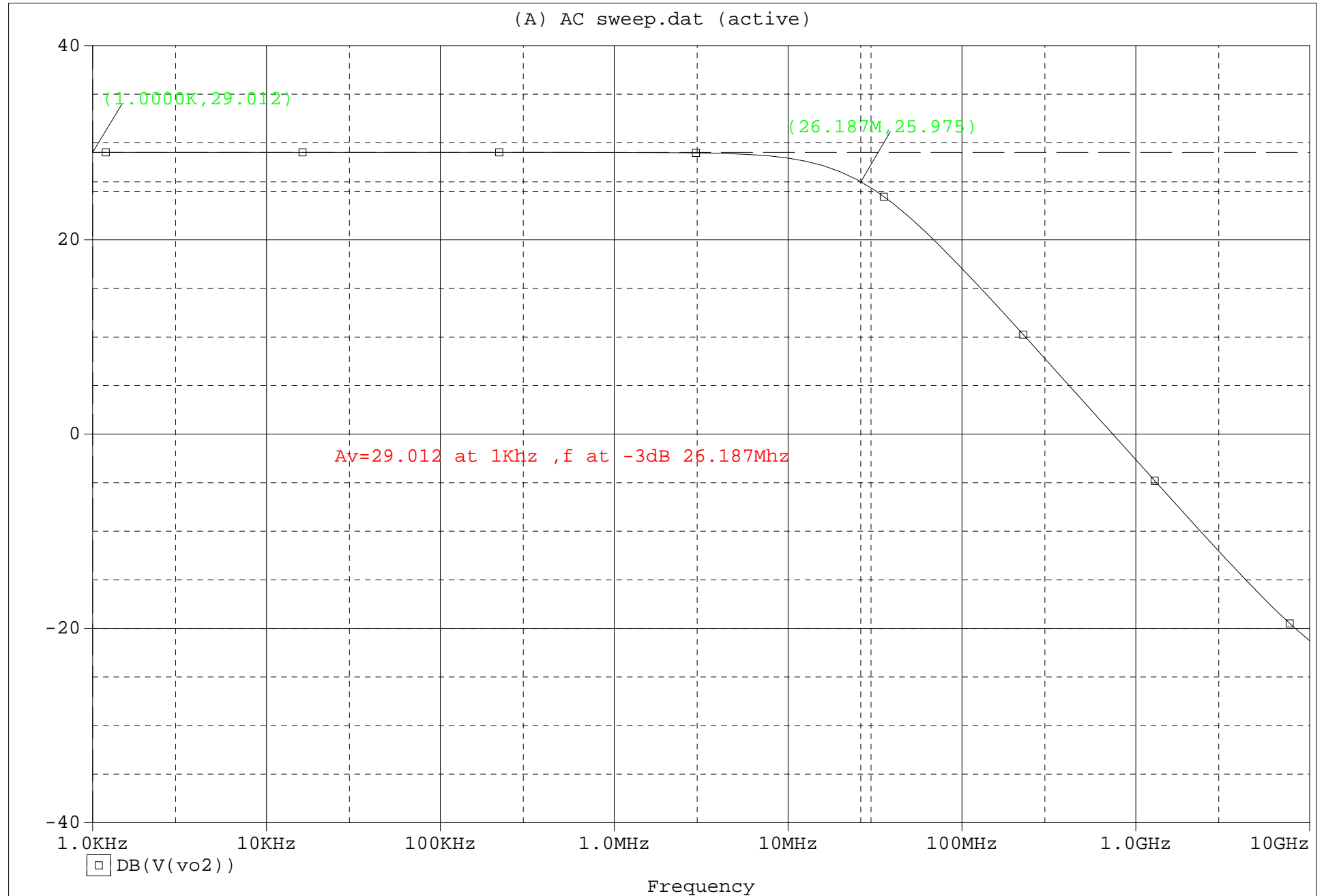


PARAMETERS:

W = 2.5u  
L = 0.25u  
M = 2  
  
Vbias = 931.500m  
  
Rbias = 1000k  
Ibias = 125u  
CL = 100fF



Author = sriharsha s jadhav		
Title Common-source amplifier with current source load		
Size A	Document Number EEE 230 project-1	Rev A1
Date:	Friday, October 14, 2016	Sheet 1 of 1



A1: (26.187M,25.975) A2: (1.0000K,29.012) DIFF(A): (26.186M,-3.0369)

\*\*\*\* 10/14/16 19:26:05 \*\*\*\* PSpice 16.6.0 (October 2012) \*\*\*\* ID# 0 \*\*\*\*

\*\* Profile: "SCHEMATIC1-DC-bias" [ \\gaia.ecs.csus.edu\jadhavs\eee\_230\CS\_amp\cs\_amp-pspicefiles\schematic1\dc-bias.sim ]

\*\*\*\* CIRCUIT DESCRIPTION

\*\*\*\*\*

\*\* Creating circuit file "DC-bias.cir"

\*\* WARNING: THIS AUTOMATICALLY GENERATED FILE MAY BE OVERWRITTEN BY SUBSEQUENT SIMULATIONS

\*Libraries:

\* Profile Libraries :

\* Local Libraries :

.LIB ".././../cs\_amp-pspicefiles/cs\_amp.lib"

\* From [PSPICE NETLIST] section of C:\Users\jadhavs\cdssetup\OrCAD\_PSpice\16.6.0\PSpice.ini file:

.lib "nom.lib"

\*Analysis directives:

.OP

.OPTIONS ADVCONV

.PROBE64 V(alias(\*)) I(alias(\*)) W(alias(\*)) D(alias(\*)) NOISE(alias(\*))

.INC "../SCHEMATIC1.net"

\*\*\*\* INCLUDING SCHEMATIC1.net \*\*\*\*

\* source CS AMP

V Vi1 VG1 VSSA DC {Vbias} AC 1 0

E Ei2 VDDA VG2 VG1 VSSA 1

V VDDA VDDA 0 DC 2.5V

V VSSA VSSA 0 DC 0V

I I1 VDDA VO1 DC {Ibias}

R R1 VO1 VDDA {Rbias} TC=0,0

I I2 VO2 VSSA DC {Ibias}

R R2 VSSA VO2 {Rbias} TC=0,0

M M1 VO1 VG1 VSSA VSSA N25

+ L={L}

+ W={W}

+ M={M}

M M2 VO2 VG2 VDDA VDDA P25

+ L={L}

+ W={W}

```
+ M={M}
C C1          VO1 VDDA  {CL}  TC=0,0
C C2          VSSA VO2   {CL}  TC=0,0
.PARAM  w=2.5u rbias=1000k l=0.25u m=2 vbias=931.500m cl=100ff ibias=125u
```

```
**** RESUMING DC-bias.cir ****
.END
```

WARNING(ORPSIM-15235): Mosfet M\_M1, model N25: Pd = 0 is less than W

WARNING(ORPSIM-15235): Mosfet M\_M1, model N25: Ps = 0 is less than W

WARNING(ORPSIM-15236): Parameter XW in model N25 is invalid - Ignored

WARNING(ORPSIM-15235): Mosfet M\_M2, model P25: Pd = 0 is less than W

WARNING(ORPSIM-15235): Mosfet M\_M2, model P25: Ps = 0 is less than W

WARNING(ORPSIM-15236): Parameter XW in model P25 is invalid - Ignored

INFO(ORPSIM-15454): Model N25: Using BSIM VERSION 3.1 or lower

INFO(ORPSIM-15454): Model P25: Using BSIM VERSION 3.1 or lower

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\*\*\*\* MOSFET MODEL PARAMETERS

\*\*\*\*\*

	N25	P25
	NMOS	PMOS
T Measured	27	27
T Current	27	27
LEVEL	7	7
L	100.000000E-06	100.000000E-06
W	100.000000E-06	100.000000E-06
VTO	.355168	-.547882
KP	357.221800E-06	357.221800E-06
GAMMA	0	0
LAMBDA	0	0
RSH	3.8	2.9

IS	1.000000E-15	1.000000E-15
JS	100.000000E-06	100.000000E-06
PB	.99	.961669
PBSW	.981431	.8
CJ	1.556442E-03	1.870360E-03
CJSW	421.795200E-12	311.598500E-12
MJ	.422704	.475679
MJSW	.19742	.268452
CGSO	457.000000E-12	559.000000E-12
CGDO	457.000000E-12	559.000000E-12
CGBO	1.000000E-12	1.000000E-12
TOX	5.800000E-09	5.800000E-09
XJ	100.000000E-09	100.000000E-09
UCRIT	10.000000E+03	10.000000E+03
DELTA	.01	.01
DIOMOD	2	2
K1	.488168	.645808
K2	-1.465714E-06	-1.621568E-03
LETA	0	0
WETA	0	0
U0	305.8067	100
XPART	.5	.5
VTH0	.355168	-.547882
K3	1.000000E-03	.096322
W0	100.000000E-09	1.000000E-06
NLX	192.736100E-09	14.689740E-09
DVT0	.575129	2.726151
DVT1	.566083	.74709
UA	-1.152667E-09	875.490400E-12
UB	2.428080E-18	1.000000E-21
UC	41.273400E-12	-100.000000E-12
VSAT	128.759100E+03	129.251900E+03
RDSW	175	839.1661
VOFF	-.109017	-.129264
NFACTOR	1.531998	.936195
PCLM	1.620562	1.397517
PDIBL1	.959482	4.013259E-03
PDIBL2	2.748496E-03	5.534487E-06
DROUT	1	.059113
PSCBE1	683.743800E+06	5.132455E+09
PSCBE2	231.977200E-06	1.189024E-09
A0	1.795768	.903978
A1	456.914600E-06	.03521
A2	.531924	.3
NPEAK	235.490000E+15	415.890000E+15
LDD	0	0
LITL	41.713310E-09	41.713310E-09
UA1	4.310000E-09	4.310000E-09
UB1	-7.610000E-18	-7.610000E-18
UC1	-56.000000E-12	-56.000000E-12

PVAG	9.534150E-03	
KETA	-9.762332E-03	7.291800E-03
ETA0	6.182294E-03	.243084
ETAB	269.257900E-06	-.020463
K3B	3.222249	5.987855
DVT2	-.302613	-.114714
DSUB	.045455	.997855
MOBMOD	1	1
AGS	.359392	.084443
DVT1W	0	0
DVT2W	0	0
PRWG	.15	.233163
PRWB	-.124343	-.051475
PDIBLCB	-.022086	-1.000000E-03
DWG	-15.000000E-09	-47.227750E-09
DWB	2.371290E-09	-16.212000E-09
B0	127.264200E-12	1.473225E-06
B1	4.171173E-09	5.000000E-06
LINT	2.800000E-09	33.490790E-09
DLC	2.800000E-09	33.490790E-09
DWC	0	0
CF	0	0
NOIA	100.000000E+18	9.900001E+18
NOIB	50.000000E+03	2.400000E+03
NOIC	-1.400000E-12	1.400000E-12
LKETA	879.276400E-06	-3.261413E-03
WKETA	3.502570E-03	1.257100E-03
PVTH0	-6.690647E-03	6.913576E-03
PRDSW	-8.4	10.49393
PK2	1.959318E-03	1.392595E-03
VTM	.025864	.025864
VERSION	3.1	3.1
PBSWG	.851594	.8
MJSWG	.268491	.278699
CJSWG	329.000000E-12	250.000000E-12

WARNING(ORPSIM-15235): Mosfet M\_M1, model N25: Pd = 0 is less than W

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

\*\*\*\*\*

NODE	VOLTAGE	NODE	VOLTAGE	NODE	VOLTAGE	NODE	VOLTAGE
( VG1)	.9315	( VG2)	1.5685	( VO1)	.0837	( VO2)	1.2493
( VDDA)	2.5000	( VSSA)	0.0000				

VOLTAGE SOURCE CURRENTS  
NAME CURRENT

V Vi1	0.000E+00
V VDDA	-2.537E-04
V_VSSA	2.537E-04

TOTAL POWER DISSIPATION 6.34E-04 WATTS

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

\*\*\*\*\*

\*\*\*\* VOLTAGE-CONTROLLED VOLTAGE SOURCES

NAME            E Ei2  
V-SOURCE       9.315E-01  
I-SOURCE       0.000E+00

\*\*\*\* MOSFETS

NAME	M M1	M M2
MODEL	N25	P25
ID	1.27E-04	-1.26E-04
VGS	9.32E-01	-9.32E-01
VDS	8.37E-02	-1.25E+00
VBS	0.00E+00	0.00E+00
VTH	4.80E-01	-4.92E-01
VDSAT	2.72E-01	-3.23E-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	3.04E-04	4.76E-04
GDS	1.29E-03	1.59E-05
GMB	6.82E-05	1.29E-04
CBD	0.00E+00	0.00E+00
CBS	0.00E+00	0.00E+00
CGSOV	2.29E-15	2.80E-15
CGDOV	2.29E-15	2.80E-15
CGBOV	2.50E-19	2.50E-19
Derivatives of gate (dQg/dVxy) and bulk (dQb/dVxy) charges		
DQGDVGB	1.17E-14	1.02E-14
DQGDVDB	-4.77E-15	-2.74E-15
DQGDVSB	-6.75E-15	-6.93E-15
DQDDVGB	-5.79E-15	-4.61E-15
DQDDVDB	4.86E-15	2.77E-15
DQDDVSB	1.73E-15	2.35E-15
DQBDVGB	-1.67E-16	-9.73E-16
DQBDVDB	-2.67E-15	-1.27E-17
DQBDVSB	1.00E-15	-5.74E-16

JOB CONCLUDED

•  
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m ]

\*\*\*\* JOB STATISTICS SUMMARY

\*\*\*\*\*

• Total job time (using Solver 1) = .39

## 5. Answers to the questions:

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?

Answer:

Sl no	Circuit	Rbias value in $K\Omega$	Ibias value in $\mu A$	DC gain	AC gain in dB	AC gain
1	NMOS	10	0	-6.688	16.503	6.6857
2	PMOS	10	0	4.1006	12.257	4.100624
3	NMOS	1000	125	-27.284	28.718	27.2834
4	PMOS	1000	125	28.221	29.021	28.2520

*Table 1: Gain DC and AC*

Observations:

From the table 1 we infer that the DC gain is approximately equal to AC gain.

The reason for DC and AC gain to be equal is that in AC sweep we are using the DC bias voltage obtained in DC sweep to run the AC sweep. So, both the gains that are obtained are equal.

2. Compare the low frequency gain obtained with each circuit. Explain why one is higher

SL no	circuit	Rbias in $K\Omega$	Ibias in $\mu A$	Low frequency gain in dB
1	NMOS	10	0	16.503
2	PMOS	10	0	12.257
3	NMOS	1000	125	28.718
4	PMOS	1000	125	29.021

*Table 2: low frequency gains*

Observations:

Table 2 shows an increment in the values of the low frequency gains.

The change is a result of the increased values of the Rbias and Ibias. Due to the voltage drop across the increased load there is an increased output voltage.

3. Compare the -3dB frequency obtained with each circuit. Explain why one is higher.

SL no	circuit	Rbias in K $\Omega$	Ibias in $\mu$ A	-3dB frequency in MHz
1	NMOS	10	0	201.8
2	PMOS	10	0	179.571
3	NMOS	1000	125	50.841
4	PMOS	1000	125	26.187

*Table 3: -3dB frequency of the circuits.*

Observations:

From table 3 we see a decrease in frequency for -3dB even though the transistor parameters like W, L and M are kept constant.

This reduction in the frequency can be attributed to the increase in the values of resistance i.e. Rbias and current Ibias.

We know that power P

$$P=(I_{bias})^2R$$

The decrement of power to half power will be faster due to the increment in P