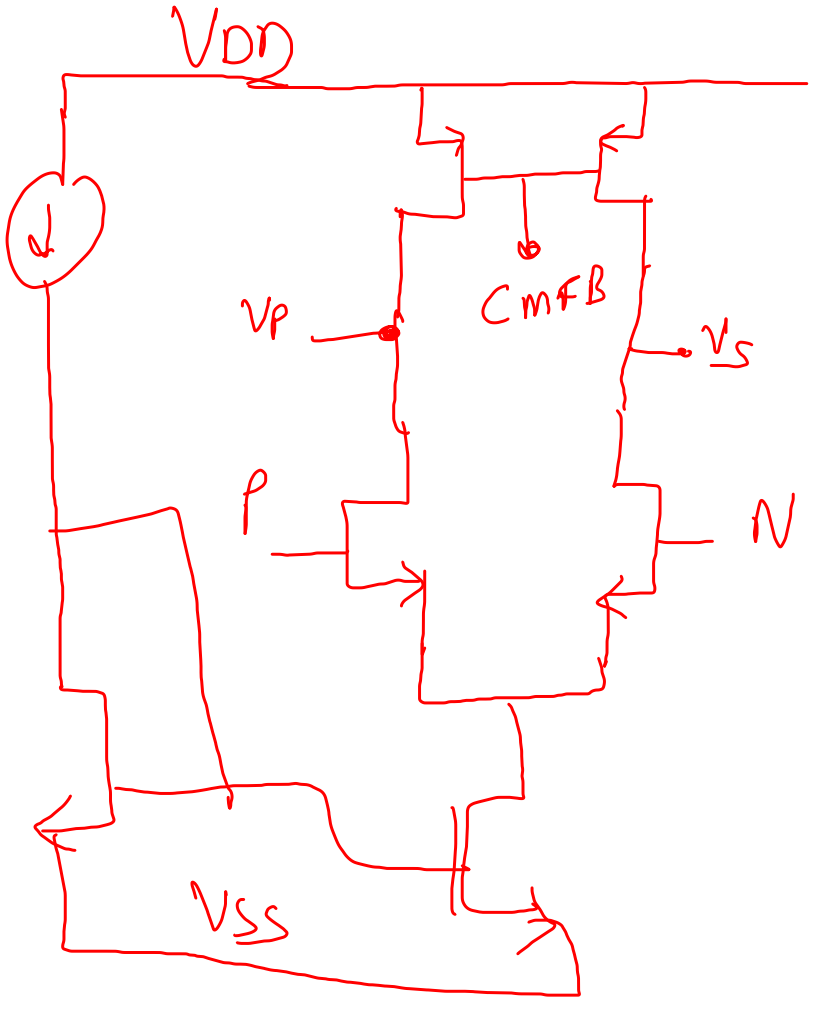
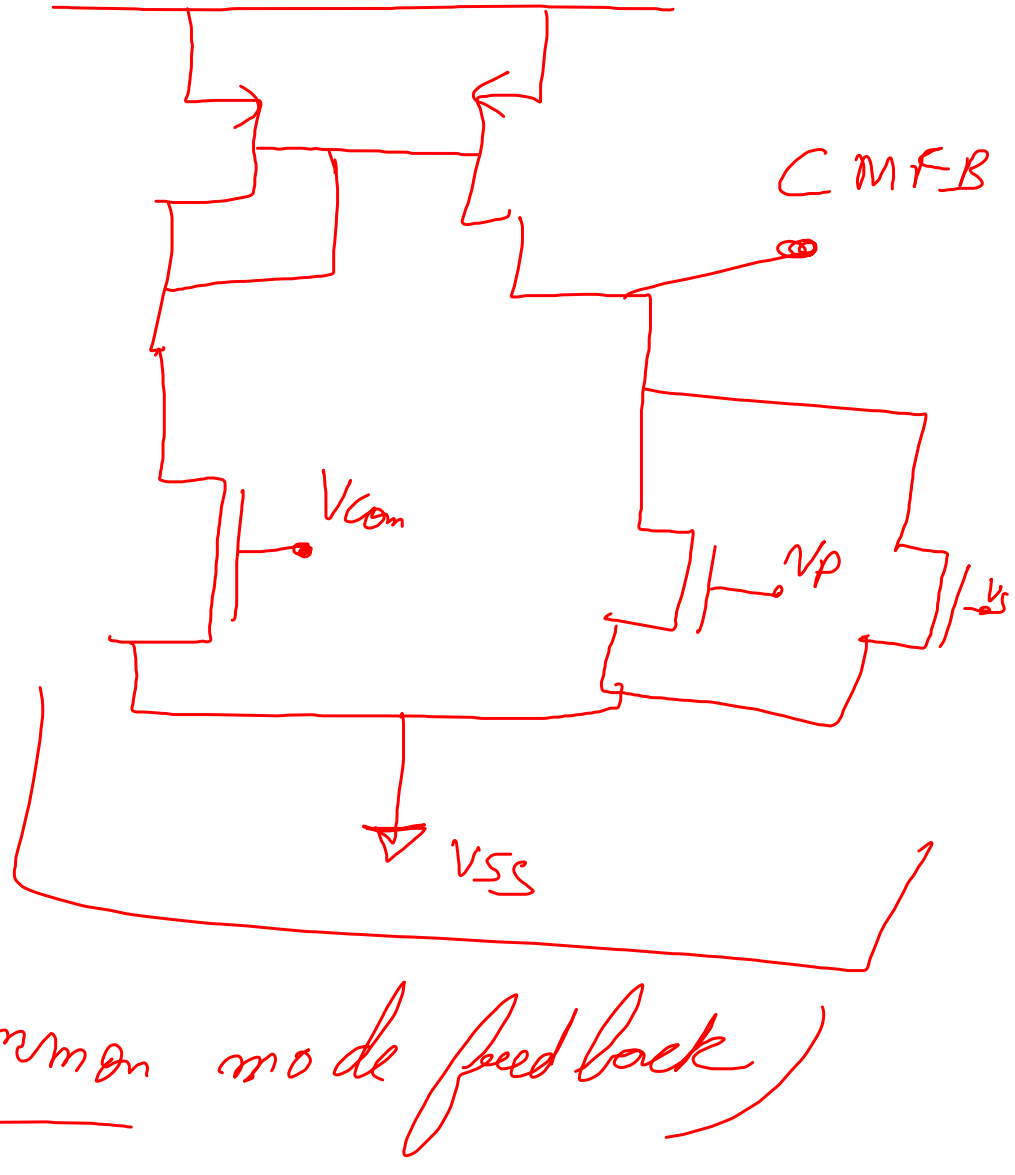


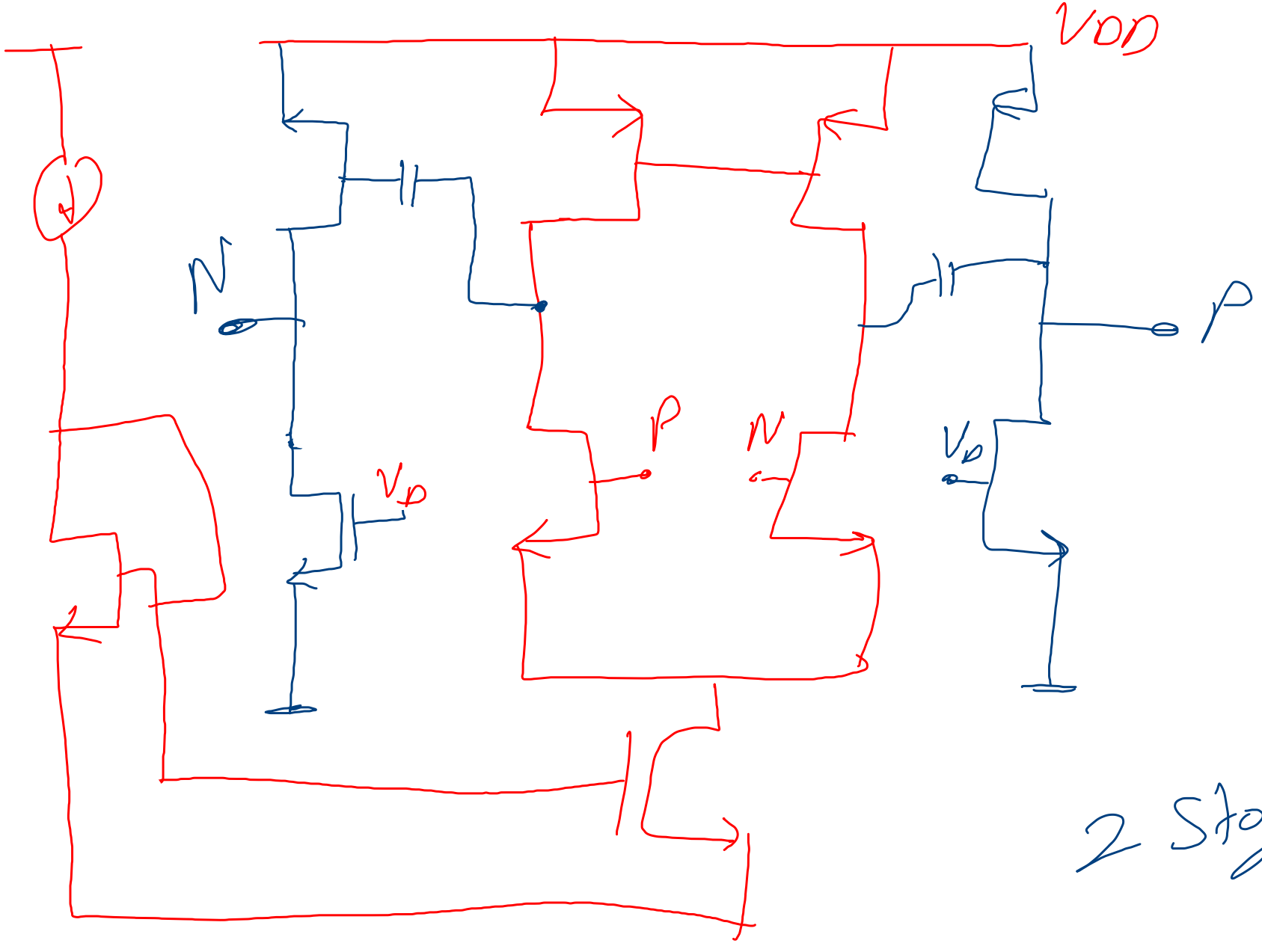


(Common mode feedback)

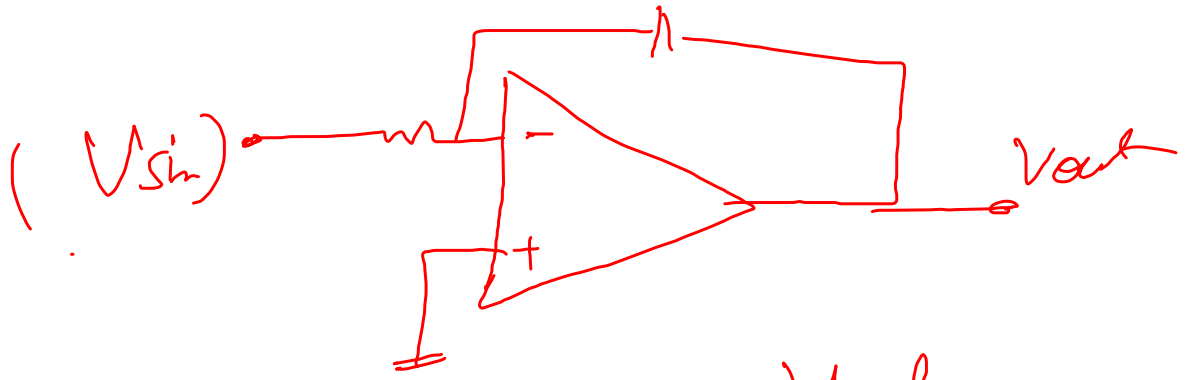
① Convert Single stage to differential mode. using CMFB

② Then using miller compensation technique apply 2-stage amplifier

③ then take a resistor divider ckt for common-mode feedback.



2 Stage with miller

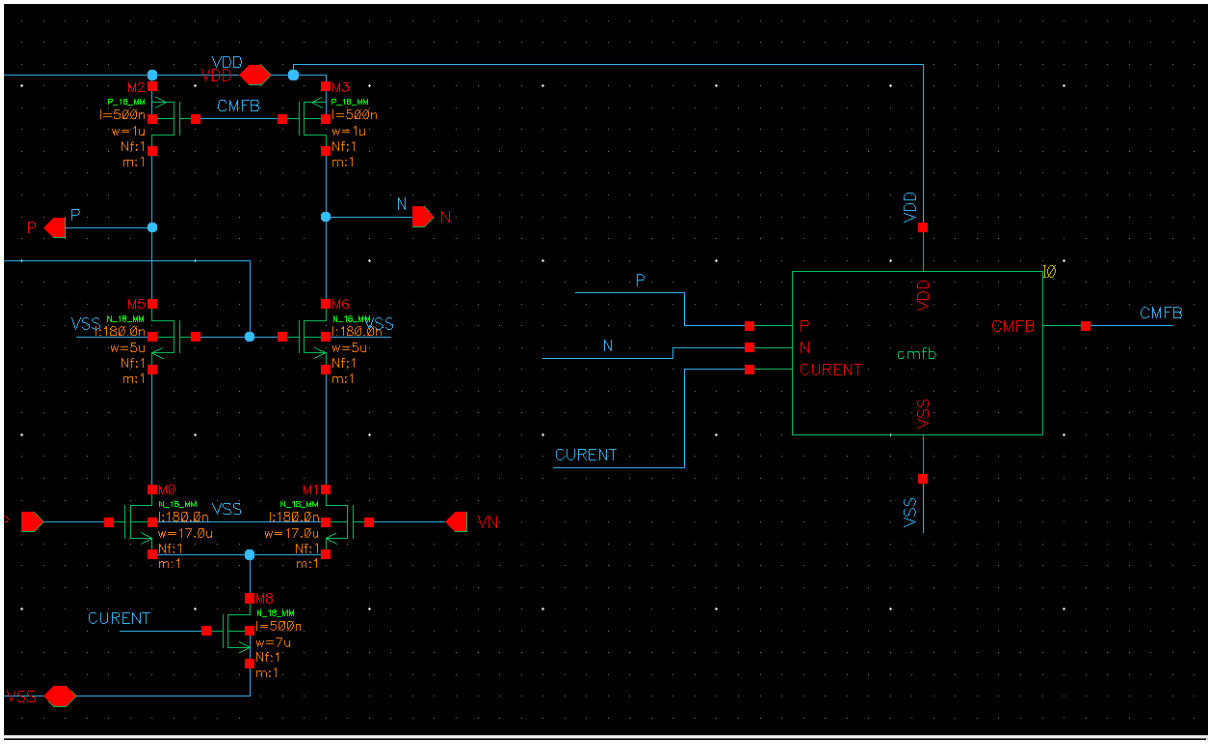


$$Vout = -\frac{1}{RC}\int(V\sin\omega t)$$

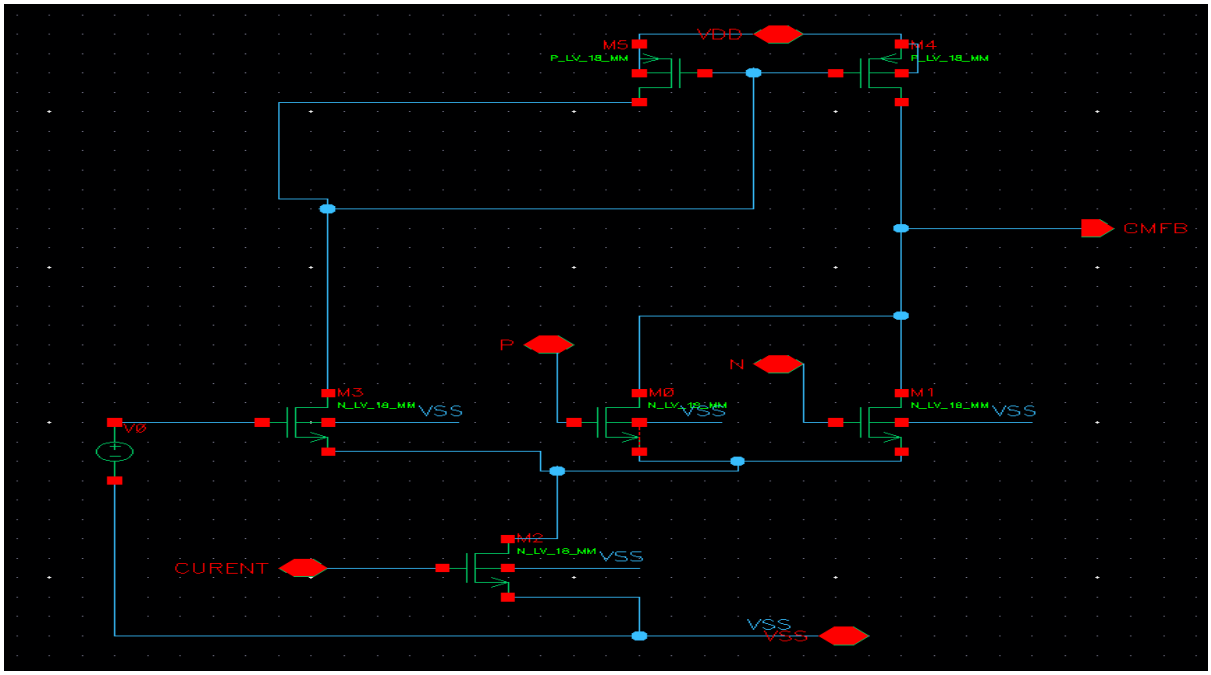
in fully differential method

$$= -\frac{1}{RC}\int V\sin\omega t = \left(\frac{V\cos\omega t}{RC\times\omega}\right)$$

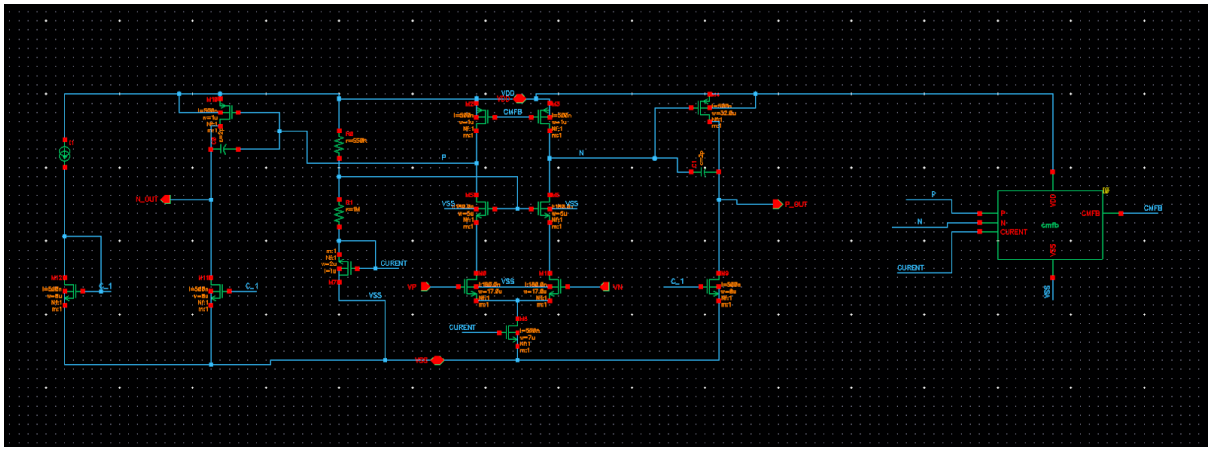
Single stage OTA WITH common mode feedback (CMFB)



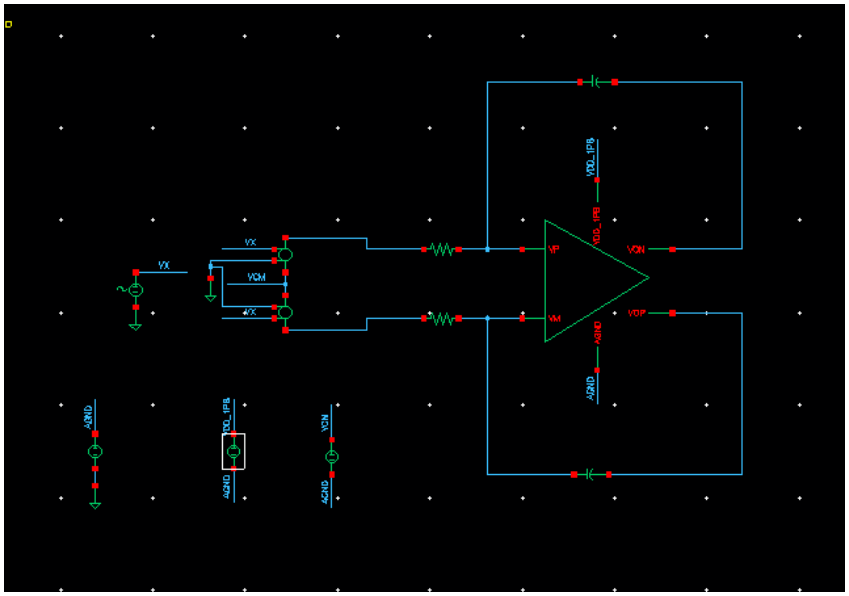
Circuit for (CMFB)



2 stage amplifier



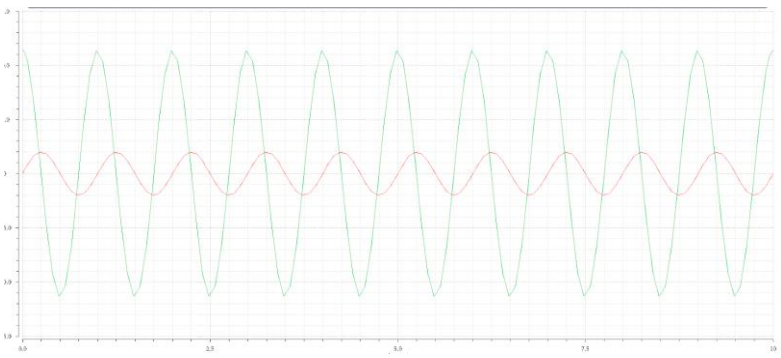
2 stage with parameters given in question



2 stage output

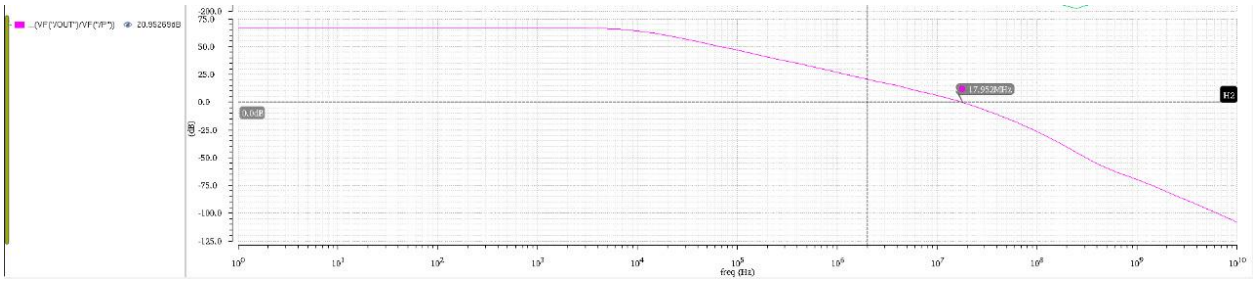
Input 10mv with 1M HZ (sin)

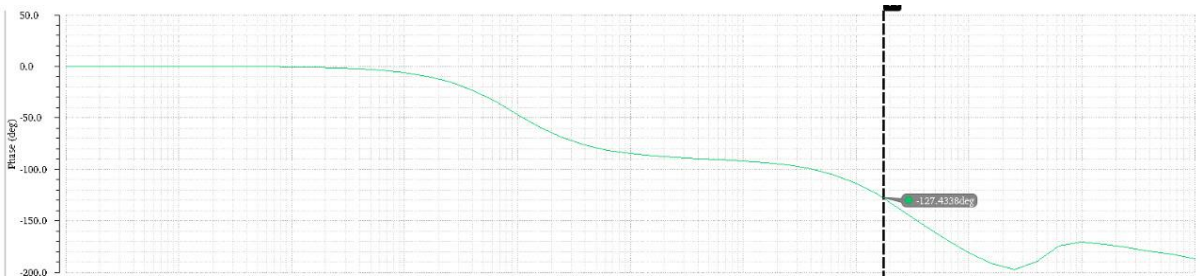
Output cos 160mv with 1M HZ(cos)



Gain and Phase margin plot

So gain is 67.23dB for this with phase margin of 53 degree and Unity gain



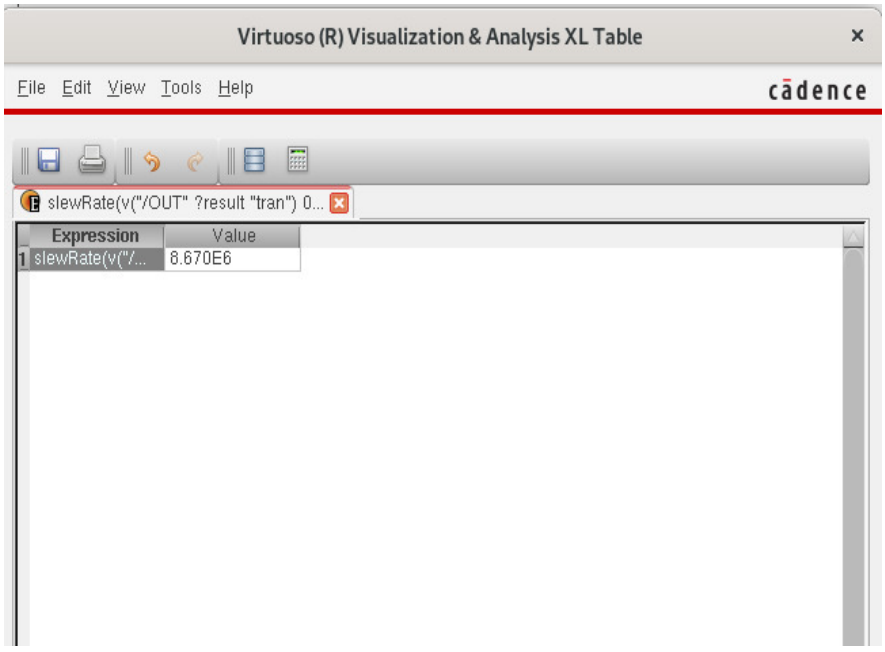


Total Noise calculated is

Device	Param	Noise Contribution	% Of Total
/M1	fn	0.00164795	47.51
/M0	fn	0.00164062	47.30
/M3	fn	8.38505e-05	2.42
/M2	fn	8.3427e-05	2.41
/M1	id	5.32333e-06	0.15
/M0	id	5.29967e-06	0.15
/M3	id	8.97469e-07	0.03
/M2	id	8.92936e-07	0.03
/M5	fn	2.42637e-07	0.01
/M4	fn	2.41558e-07	0.01
/M7	fn	2.84038e-08	0.00
/M6	fn	2.82603e-08	0.00
/M5	id	7.84301e-10	0.00
/M4	id	7.80815e-10	0.00
/M1	rs	5.97298e-10	0.00
/M0	rs	5.94643e-10	0.00
/M7	id	1.10354e-10	0.00
/M6	id	1.09796e-10	0.00
/M3	rs	3.78855e-11	0.00
/M2	rs	3.76942e-11	0.00

/M8	fn	1.03822e-11	0.00
/M9	fn	2.3769e-12	0.00
/M9	id	2.18131e-12	0.00
/M8	id	1.68813e-13	0.00
/M5	rs	8.61884e-14	0.00
/M4	rs	8.58054e-14	0.00
/M1	rd	8.53549e-14	0.00
/M0	rd	8.49755e-14	0.00
/M7	rs	1.13944e-14	0.00
/M6	rs	1.13369e-14	0.00
/M3	rd	5.57521e-15	0.00
/M2	rd	5.54704e-15	0.00
/M9	rs	7.1066e-17	0.00
/M9	rd	5.24717e-17	0.00
/M5	rd	4.36968e-17	0.00
/M4	rd	4.35024e-17	0.00
/M7	rd	9.38938e-18	0.00
/M6	rd	9.34194e-18	0.00
/M8	rs	6.93635e-18	0.00
/M8	rd	6.17996e-22	0.00
Integrated Noise Summary (in V^2) Sorted By Noise Contributors			
Total Summarized Noise = 0.0034688			
Total Input Referred Noise = 7.56386e-10			
The above noise summary info is for noise data			

Slew rate



Slew rate is 8.67E6 (V/s)

DC operating points for

Source

DC operation points in table for source

signal OP("/V5" "??")	signal OP("/V4" "??")	signal OP("/V10" "??")	signal OP("/V1" "??")	signal OP("/V6" "??")	signal OP("/V3" "??")	signal OP("/V0" "??")	signal OP("/I5" "??")
i 0	i 0	i 0	i 0	i 0	i -0	i -40.48512u	i 20u
pwr 0	pwr 0	pwr 0	pwr 0	pwr 0	pwr -0	pwr -72.873215u	pwr 28.118759u
v 100m	v 900m	v 500m	v 0	v 500m	v 10m	v 1.8	v 1.405938

Operating points for the transistor in 2 stage

DC operation points in table for mosfet

signal OP("/M8" "??")	signal OP("/M0" "??")	signal OP("/M4" "??")	signal OP("/M2" "??")	signal OP("/M6" "??")	signal OP("/M9" "??")	signal OP("/M7" "??")	signal OP("/M3" "??")	signal OP("/M1" "??")	signal OP("/M5" "??")	signal OP("/C0" "??")	signal OP("/C1" "??")
beff 20.302713	beff 1.9320107m	beff 1.9632637m	beff 34.537545u	beff 131.49723u	beff 994.21028m	beff 131.49724u	beff 34.537545u	beff 1.9320107m	beff 1.9632637m	cap 2p	cap 2p
betaeff 17.7838m	betaeff 1.5414003m	betaeff 1.535164m	betaeff 38.596582u	betaeff 141.95031u	betaeff 89.295248m	betaeff 141.95031u	betaeff 38.596582u	betaeff 1.5414003m	betaeff 1.535164m		
fug 239.93393M	fug 627.31035M	fug 636.42508M	fug 49.224494M	fug 431.05342M	fug 31.39254M	fug 431.05348M	fug 49.224494M	fug 627.31035M	fug 636.42494M		
gbd 0	gbd 0	gbd 0	gbd 0	gbd 0	gbd 0	gbd 0	gbd 0	gbd 0	gbd 0		

gbs 3.291 6086 n	gbs 0	gbs 0	gbs 26.39 7284 p	gbs 26.62 6759 p	gbs 2.183 5416 n	gbs 26.62 6759 p	gbs 26.39 7284 p	gbs 0	gbs 0
gds 4.929 9058 u	gds 2.043 1925 u	gds 3.779 4728 u	gds 396.2 3793 n	gds 1.755 531u	gds 2.467 7082 m	gds 1.755 525u	gds 396.2 3789 n	gds 2.043 1924 u	gds 3.779 4831 u
gm 428.0 8276 u	gm 140.4 2947 u	gm 140.3 2877 u	gm 23.93 7259 u	gm 45.10 6832 u	gm 332.6 6005 u	gm 45.10 6837 u	gm 23.93 7259 u	gm 140.4 2947 u	gm 140.3 2874 u
gmb 89.27 7278 u	gmb 28.44 6505 u	gmb 23.75 6101 u	gmb 8.330 0695 u	gmb 14.29 5062 u	gmb 71.48 4779 u	gmb 14.29 5064 u	gmb 8.330 0695 u	gmb 28.44 6505 u	gmb 23.75 6096 u
gmbs 89.27 7278 u	gmbs 28.44 6505 u	gmbs 23.75 6101 u	gmbs 8.330 0695 u	gmbs 14.29 5062 u	gmbs 71.48 4779 u	gmbs 14.29 5064 u	gmbs 8.330 0695 u	gmbs 28.44 6505 u	gmbs 23.75 6096 u
gmov erid 21.40 4138	gmov erid 13.71 0406	gmov erid 13.69 306	gmov erid 2.337 039	gmov erid 4.403 863	gmov erid 16.23 9107	gmov erid 4.403 8635	gmov erid 2.337 039	gmov erid 13.71 0406	gmov erid 13.69 306
i1 20u	i1 10.24 2547 u	i1 10.24 8167 u	i1 - 10.24 2559 u	i1 - 10.24 256u	i1 20.48 512u	i1 - 10.24 256u	i1 - 10.24 2559 u	i1 10.24 2547 u	i1 10.24 8166 u
i3 -20u	i3 - 10.24 2547 u	i3 - 10.24 8167 u	i3 10.24 2559 u	i3 10.24 256u	i3 - 20.48 5119 u	i3 10.24 256u	i3 10.24 2559 u	i3 - 10.24 2547 u	i3 - 10.24 8166 u
i4 - 9.735 2183f	i4 - 2.214 7459f	i4 - 2.195 1751f	i4 594.2 0836 a	i4 575.2 3892 a	i4 - 30.72 9917 f	i4 575.2 3892 a	i4 594.2 0836 a	i4 - 2.214 7459f	i4 - 2.195 1751f
ib NaN	ib NaN	ib NaN	ib NaN	ib NaN	ib NaN	ib NaN	ib NaN	ib NaN	ib NaN
id 20u	id 10.24 2547 u	id 10.24 8167 u	id - 10.24 2559 u	id - 10.24 256u	id 20.48 512u	id - 10.24 256u	id - 10.24 2559 u	id 10.24 2547 u	id 10.24 8166 u

idb 7.453 0363f	idb 1.107 3729f	idb 1.097 5875f	idb 406.7 4783 a	idb 348.3 3075 a	idb 30.41 9789 f	idb 348.3 3075 a	idb 406.7 4783 a	idb 1.107 3729f	idb 1.097 5875f
ide 20u	ueff 34.90 6736 m	ide 10.24 8168 u	ide - 10.24 2561 u	ide - 10.24 2561 u	ide 20.48 512u	ide - 10.24 2561 u	ide - 10.24 2561 u	ide 10.24 2547 u	ide 10.24 8166 u
ids 20u	ids 10.24 2547 u	ids 10.24 8167 u	ids - 10.24 2559 u	ids - 10.24 256u	ids 20.48 5119 u	ids - 10.24 256u	ids - 10.24 2559 u	ids 10.24 2547 u	ids 10.24 8166 u
is -20u	is - 10.24 2547 u	is - 10.24 8167 u	is 10.24 2559 u	is 10.24 256u	is - 20.48 5119 u	is 10.24 256u	is 10.24 2559 u	is - 10.24 2547 u	is - 10.24 8166 u
isb 2.282 182f	isb 1.107 3729f	isb 1.097 5875f	isb 187.4 6053 a	isb 226.9 0817 a	isb 310.1 2876 a	isb 226.9 0817 a	isb 187.4 6053 a	isb 1.107 3729f	isb 1.097 5875f
ise 20u	ise 10.24 2547 u	ise 10.24 8168 u	ise - 10.24 2559 u	ise - 10.24 256u	ise 20.48 512u	ise - 10.24 256u	ise - 10.24 2559 u	ise 10.24 2547 u	ise 10.24 8166 u
isub 0	isub 0	isub 0	isub -0	isub -0	isub 0	isub -0	isub -0	isub 0	isub 0
pwr 7.881 2407 u	pwr 3.431 7335 u	pwr 2.222 2136 u	pwr 8.266 5886 u	pwr 4.437 9297 u	pwr 158.7 069n	pwr 4.437 9329 u	pwr 8.266 5887 u	pwr 3.431 7335 u	pwr 2.222 2099 u
regio n 2	regio n 2	regio n 2	regio n 2	regio n 2	regio n 2	regio n 2	regio n 2	regio n 2	regio n 2
ron 19.70 3103 K	ron 32.71 1288 K	ron 21.15 8915 K	ron 78.79 6943 K	ron 42.30 224K	ron 378.1 9763	ron 42.30 227K	ron 78.79 6944 K	ron 32.71 1288 K	ron 21.15 8886 K
rout 202.8 4363 K	rout 489.4 3015 K	rout 264.5 8717 K	rout 2.523 7362 M	rout 569.6 2822 K	rout 405.2 343	rout 569.6 3017 K	rout 2.523 7364 M	rout 489.4 3016 K	rout 264.5 8645 K
self_ gain	self_ gain	self_ gain	self_ gain	self_ gain	self_ gain	self_ gain	self_ gain	self_ gain	self_ gain

86.833862	68.730419	37.129192	60.411328	25.694124	134.80527m	25.694215	60.411333	68.73042	37.129084
type 0	type 0	type 0	type 1	type 1	type 0	type 1	type 1	type 0	type 0
ueff 34.865931m	ueff 34.906736m	ueff 35.105997m	ueff 5.7181809m	ueff 6.2124729m	ueff 34.784537m	ueff 6.2124729m	ueff 5.7181809m	ueff 34.906736m	ueff 35.105997m
vbs 0	vbs -7.747 4236m	vbs -342.7 9432m	vbs 0	vbs 0	vbs 0	vbs 0	vbs 0	vbs -7.747 4236m	vbs -342.7 9432m
vdb 394.06204m	vdb 342.7 9432m	vdb 559.6 3442m	vdb -807.0 8234m	vdb -433.2 8324m	vdb 7.747 4236m	vdb -433.2 8355m	vdb -807.0 8236m	vdb 342.7 9432m	vdb 559.6 3409m
vds 394.06204m	vds 335.0 4689m	vds 216.8 401m	vds -807.0 8234m	vds -433.2 8324m	vds 7.747 4236m	vds -433.2 8355m	vds -807.0 8236m	vds 335.0 469m	vds 216.8 3977m
vdsat 64.105226m	vdsat 119.6 9808m	vdsat 123.4 1071m	vdsat -656.5 5699m	vdsat -357.8 6091m	vdsat 66.56 5876m	vdsat -357.8 609m	vdsat -656.5 5699m	vdsat 119.6 9808m	vdsat 123.4 1071m
vdss 64.105226m	vdss 119.6 9808m	vdss 123.4 1071m	vdss -656.5 5699m	vdss -357.8 6091m	vdss 66.56 5876m	vdss -357.8 609m	vdss -656.5 5699m	vdss 119.6 9808m	vdss 123.4 1071m
vearly 4.0568727	vearly 5.0130115	vearly 2.7115338	vearly 25.849521	vearly 5.8344519	vearly 8.3012731m	vearly 5.8344718	vearly 25.849523	vearly 5.0130116	vearly 2.7115259
vfbeff -934.22806m	vfbeff -938.75343m	vfbeff -935.99979m	vfbeff -993.65101m	vfbeff -967.0875m	vfbeff -942.20662m	vfbeff -967.0875m	vfbeff -993.65101m	vfbeff -938.75343m	vfbeff -935.99979m

vgb 394.06204 m	vgb 500m	vgb 900m	vgb -1.2403656	vgb -892.91766 m	vgb 394.06204 m	vgb -892.91764 m	vgb -1.2403656	vgb 500m	vgb 900m
vgd 0	vgd 157.20568 m	vgd 340.36558 m	vgd -433.28324 m	vgd -459.63442 m	vgd 386.31462 m	vgd -459.63409 m	vgd -433.28323 m	vgd 157.20568 m	vgd 340.36591 m
vgs 394.06204 m	vgs 492.25258 m	vgs 557.20568 m	vgs -1.2403656	vgs -892.91766 m	vgs 394.06204 m	vgs -892.91764 m	vgs -1.2403656	vgs 492.25258 m	vgs 557.20568 m
vgsteff 33.769836 m	vgsteff 108.26443 m	vgsteff 107.3869m	vgsteff 770.10308 m	vgsteff 394.41728 m	vgsteff 36.387144 m	vgsteff 394.41727 m	vgsteff 770.10308 m	vgsteff 108.26443 m	vgsteff 107.3869m
vgt 1.403631m	vgt 102.97083 m	vgt 102.17598 m	vgt -770.14684 m	vgt -394.69441 m	vgt 6.4194102 m	vgt -394.6944m	vgt -770.14684 m	vgt 102.97083 m	vgt 102.17597 m
vsat_marg 329.95682 m	vsat_marg 215.34882 m	vsat_marg 93.429384 m	vsat_marg -150.52536 m	vsat_marg -75.422334 m	vsat_marg -58.818452 m	vsat_marg -75.422655 m	vsat_marg -150.52537 m	vsat_marg 215.34882 m	vsat_marg 93.429063 m
vth 392.65841 m	vth 389.28174 m	vth 455.02971 m	vth -470.21875 m	vth -498.22325 m	vth 387.64263 m	vth -498.22325 m	vth -470.21875 m	vth 389.28174 m	vth 455.02971 m