VARIABLE GAIN AMPLIFIER

Design of a stable VGA with high GBW

Group 12

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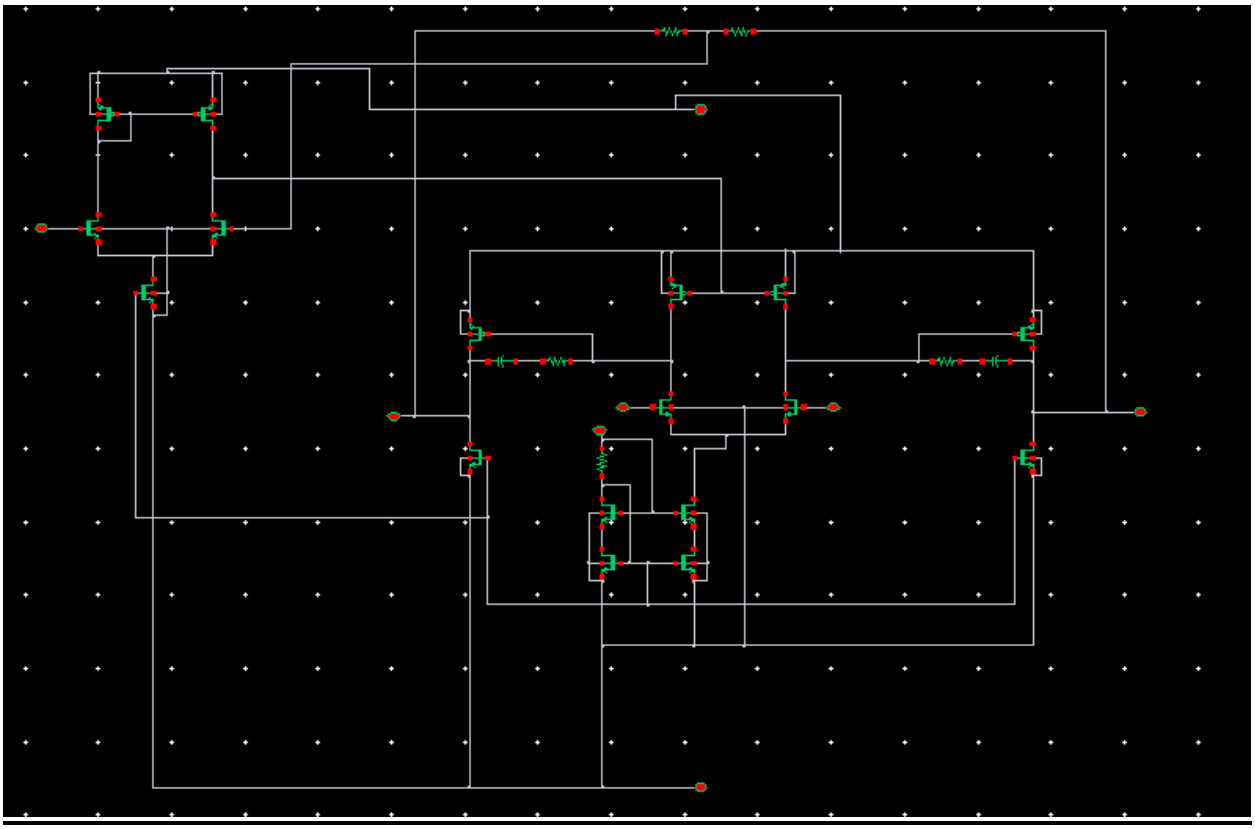
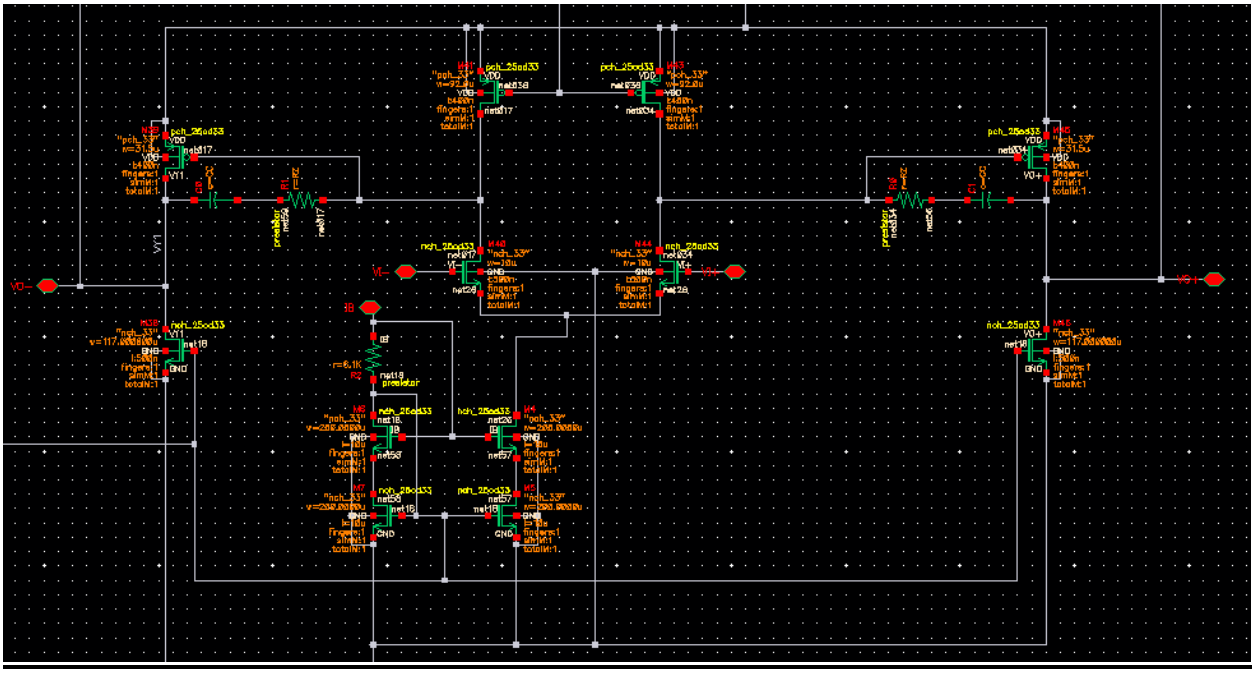
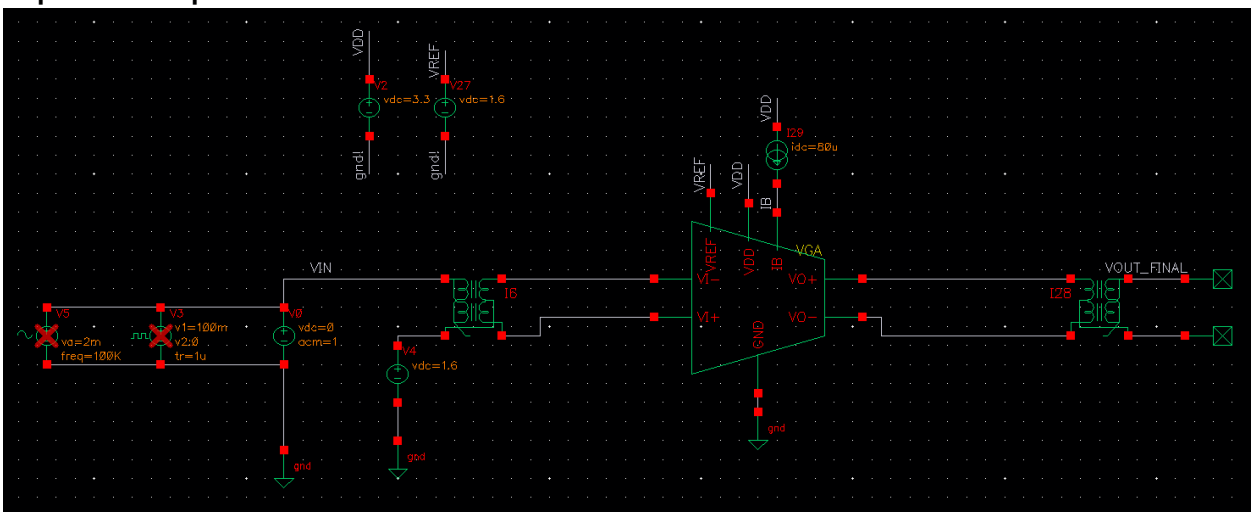
Complete Design :



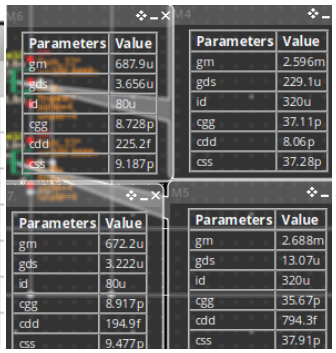
The Diff OTA:



Open Loop Simulation



Test	Output	Nominal
AIC_Tasks2:OPENLOOP:1	VOUT	
AIC_Tasks2:OPENLOOP:1	AOL	1.058k
AIC_Tasks2:OPENLOOP:1	AOL_dB	60.49
AIC_Tasks2:OPENLOOP:1	BW_OL	661.2k
AIC_Tasks2:OPENLOOP:1	GBW_OL	701.4M
AIC_Tasks2:OPENLOOP:1	UGF	1.651G
AIC_Tasks2:OPENLOOP:1	PM	-111.5

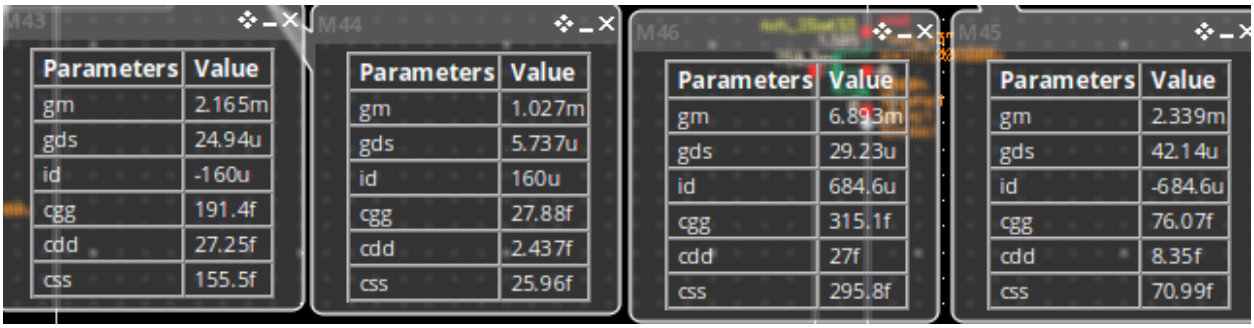


Parameters	Value
gm	687.9u
gds	3.656u
id	80u
cgg	8.728p
cdd	225.2f
css	9.187p

Parameters	Value
gm	2.596m
gds	229.1u
id	320u
cgg	37.11p
cdd	8.06p
css	37.28p

Parameters	Value
gm	672.2u
gds	3.222u
id	80u
cgg	8.917p
cdd	194.9f
css	9.477p

Parameters	Value
gm	2.688m
gds	13.07u
id	320u
cgg	35.67p
cdd	794.3f
css	37.91p



M43

Parameters	Value
gm	2.165m
gds	24.94u
id	-160u
cgg	191.4f
cdd	27.25f
css	155.5f

M44

Parameters	Value
gm	1.027m
gds	5.737u
id	160u
cgg	27.88f
cdd	2.437f
css	25.96f

M46

Parameters	Value
gm	6.893m
gds	29.23u
id	684.6u
cgg	315.1f
cdd	27f
css	295.8f

M45

Parameters	Value
gm	2.339m
gds	42.14u
id	-684.6u
cgg	76.07f
cdd	8.35f
css	70.99f

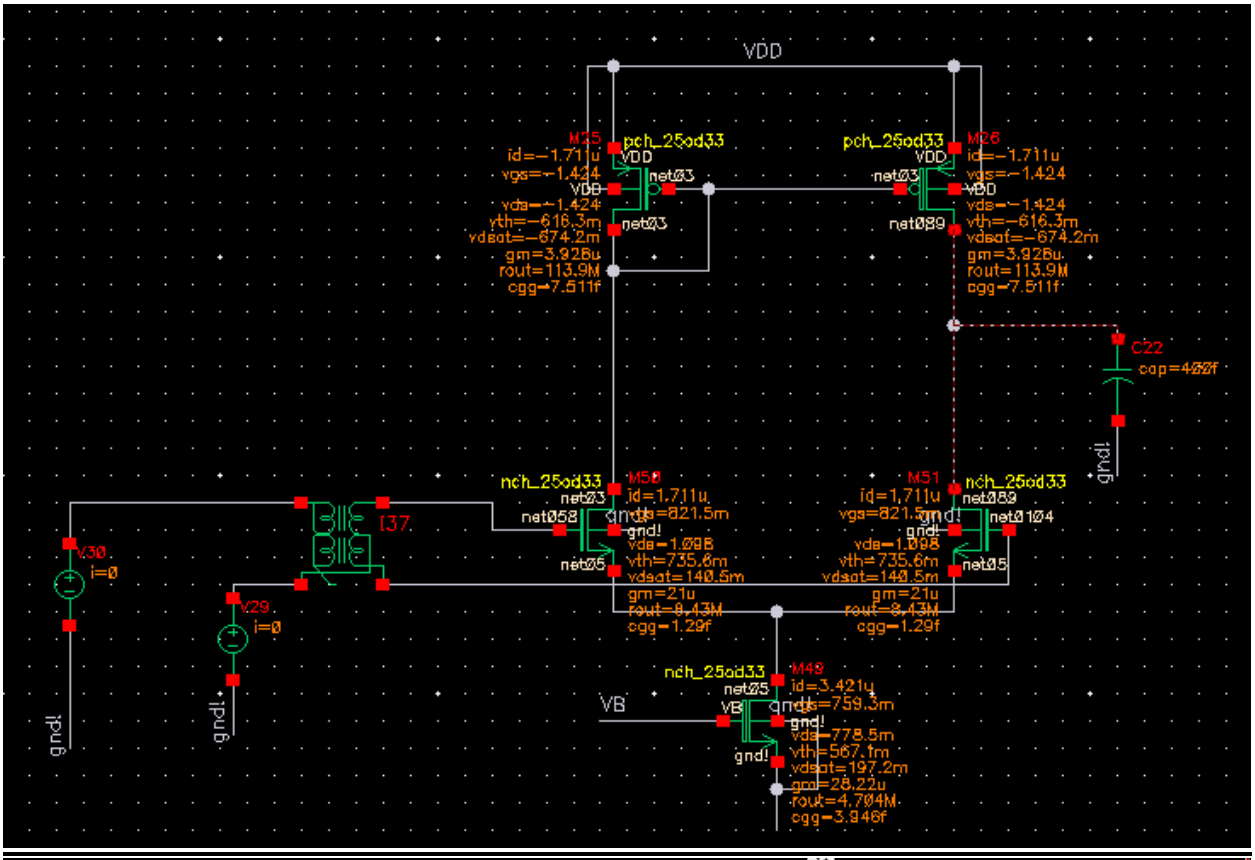
Hand analysis:

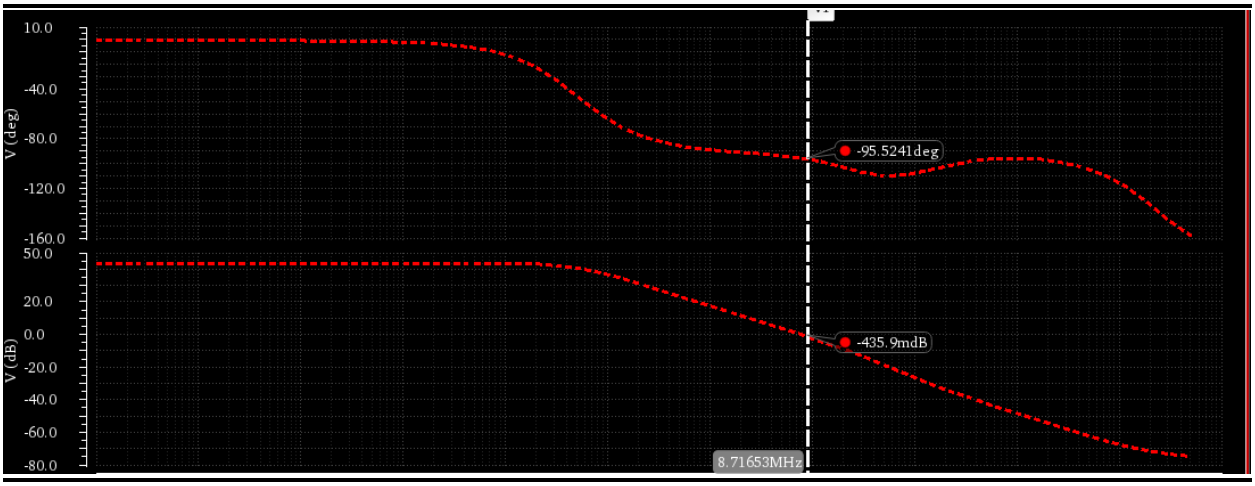
$$A_{OL} = g_{m1}(r_{o1} \backslash\backslash r_{o2}) * \ g_{m3}(r_{o3} \backslash\backslash r_{o4}) = 1066 = 60.55\ dB$$

$$BW_{OL} = \frac{1}{2\pi R_{out1}(gm3R_{out2}Cc + C_2)} = 699\ KHz$$

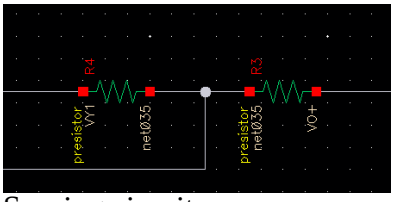
Numbers agree with simulationsX

CMFB Simulation

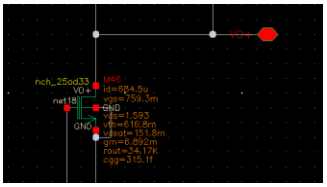




Av = 44dB , Pm = 95 deg

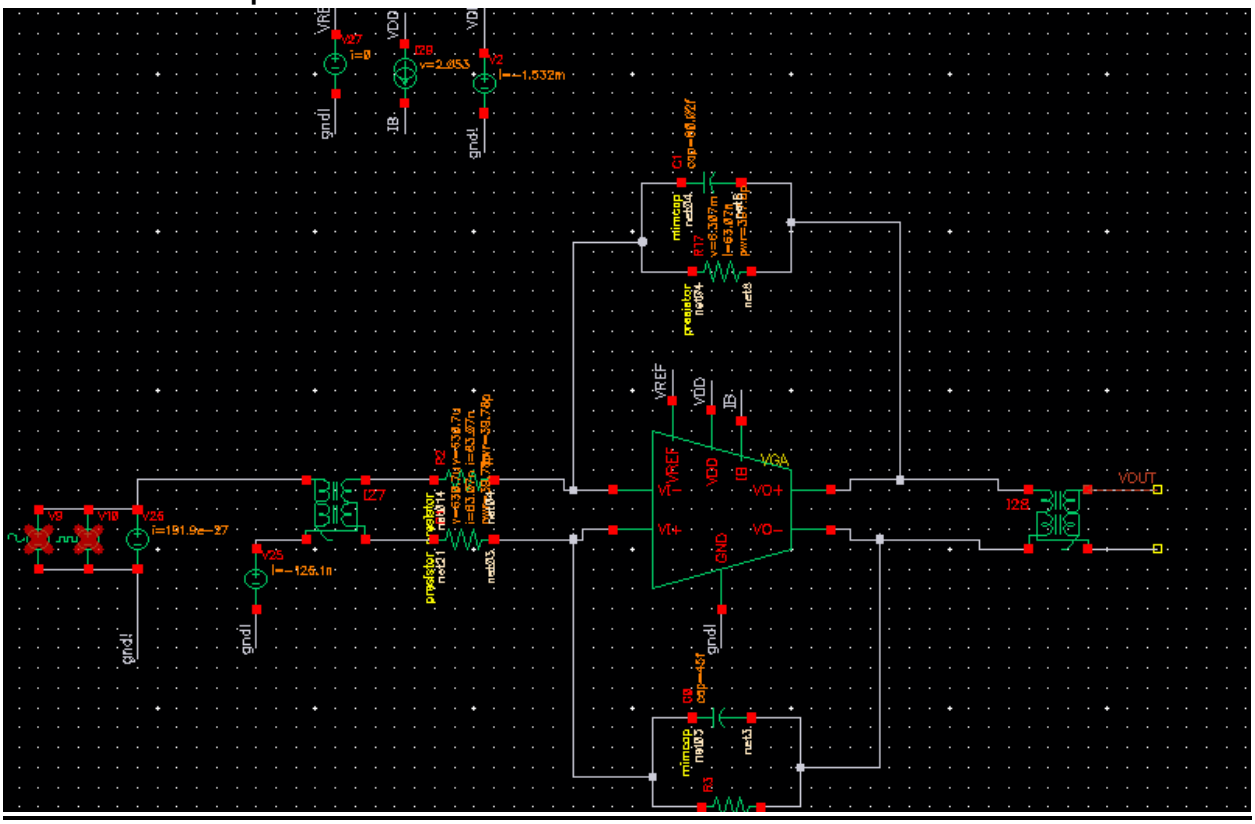


Sensing circuit



Vref =1.6DC level of output : VDS = 1.593V

Feedback Impedance Values



C2 for cutoff at 20Mhz : C2=46f cutoff freq = 22Mhz

R2=100k ohm

<u>Discussion about values of R1:</u>

We need the gain to change between these values (20dB 30dB 40dB 50dB 60dB)

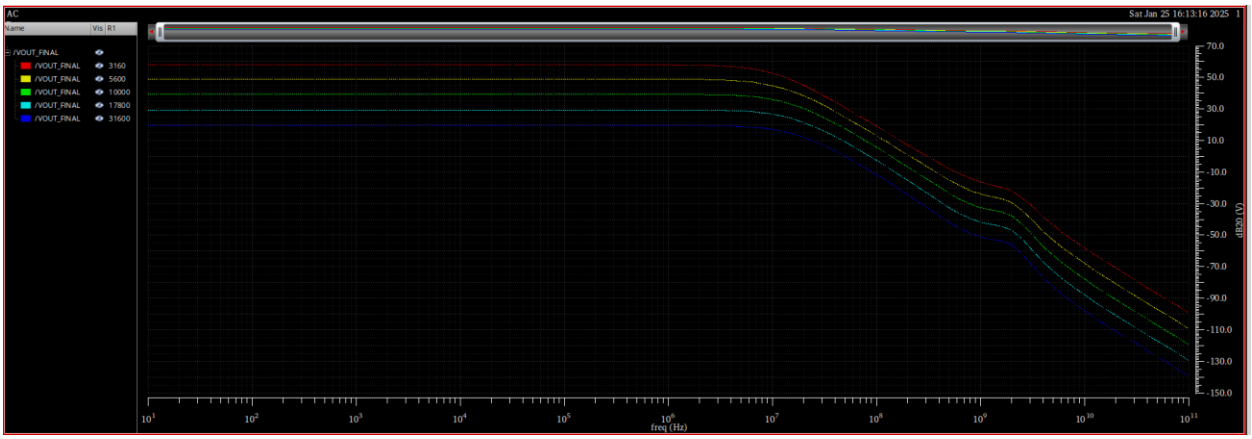
And they correspond to (10 31.6 100 316 1000)

By dividing each gain on our two amplifiers we get (3.16 5.6 10 17.77 31.6)

As we chose R2=100k ohm this would mean that the values of R1 are (31.6k 17.8k 10k 5.6k 3.16k)

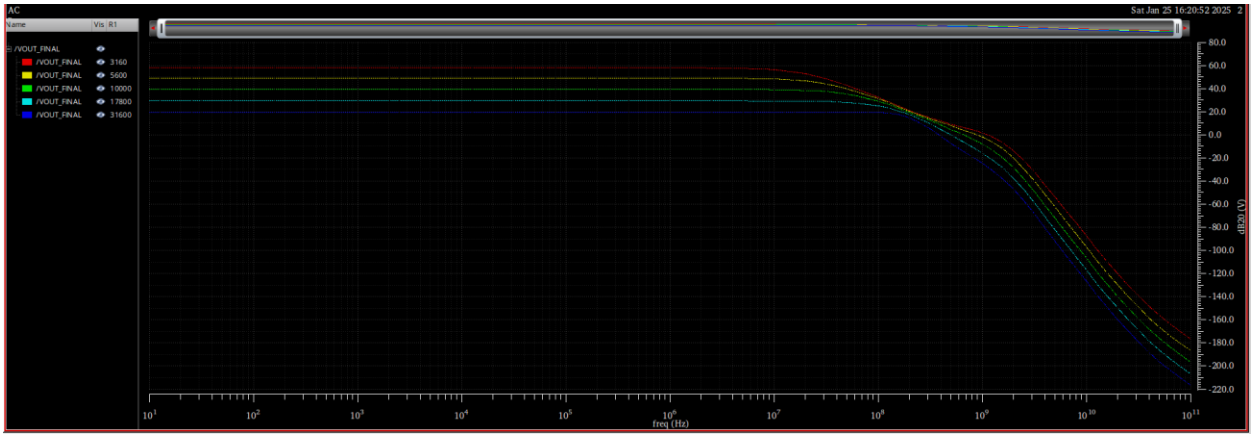
Frequency Response with and without C2

With C2



Point	Test	Output	Nominal
Parameters: R1	=3.16k		
1	AIC_Tasks2:playground:1	VOUT	
1	AIC_Tasks2:playground:1	ACL	58.4
1	AIC_Tasks2:playground:1	BWCL	6.918M
Parameters: R1	=5.6k		
2	AIC_Tasks2:playground:1	VOUT	
2	AIC_Tasks2:playground:1	ACL	49.37
2	AIC_Tasks2:playground:1	BWCL	8.273M
Parameters: R1	=10k		
3	AIC_Tasks2:playground:1	VOUT	
3	AIC_Tasks2:playground:1	ACL	39.68
3	AIC_Tasks2:playground:1	BWCL	9.535M
Parameters: R1	=17.8k		
4	AIC_Tasks2:playground:1	VOUT	
4	AIC_Tasks2:playground:1	ACL	29.82
4	AIC_Tasks2:playground:1	BWCL	10.5M
Parameters: R1	=31.6k		
5	AIC_Tasks2:playground:1	VOUT	
5	AIC_Tasks2:playground:1	ACL	19.92
5	AIC_Tasks2:playground:1	BWCL	11.13M

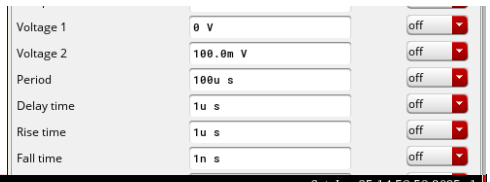
Without C2

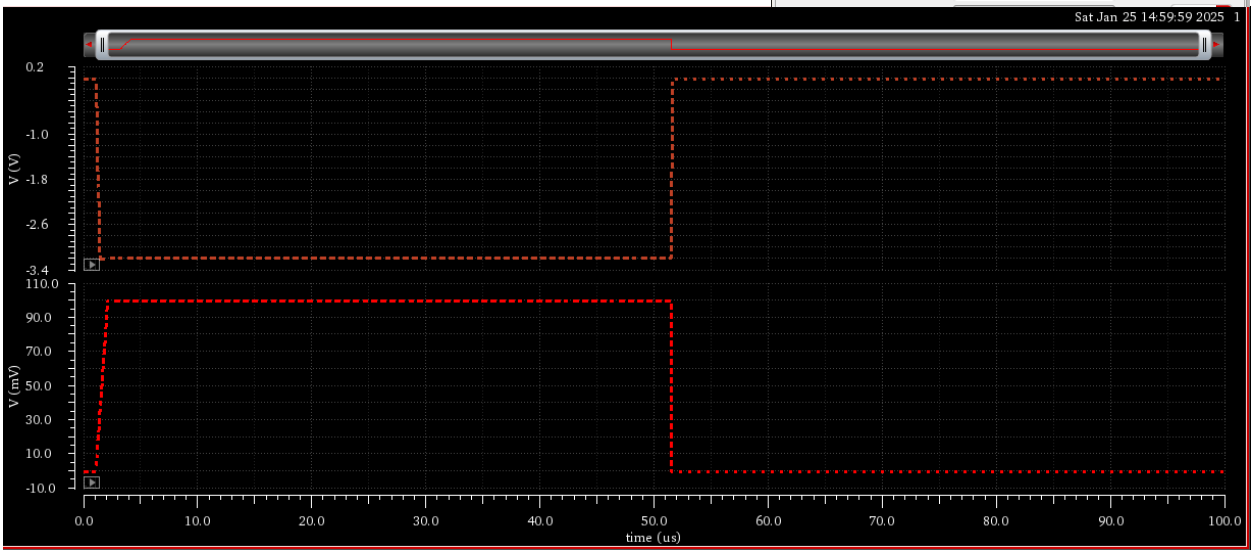


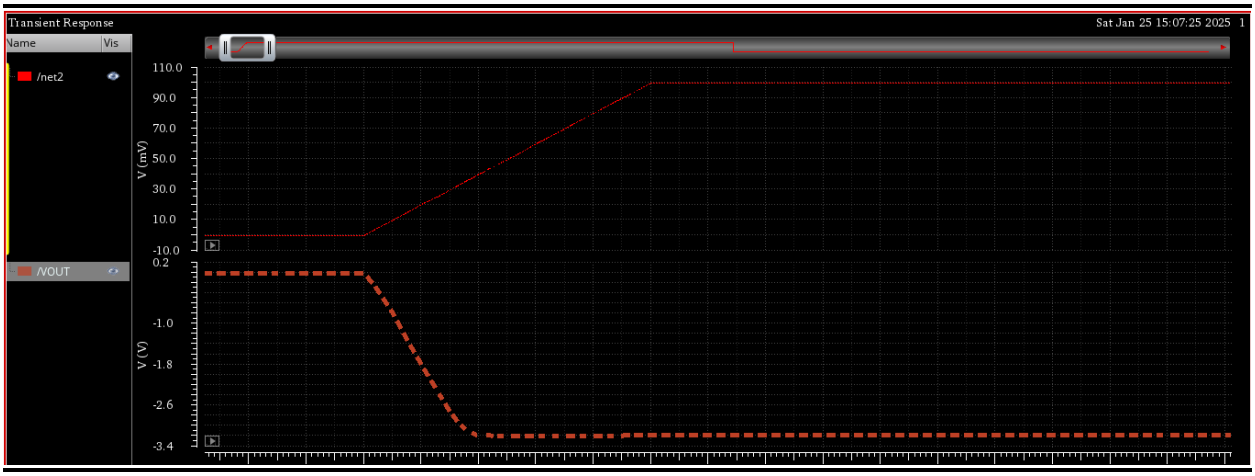
Point	Test	Output	Nominal
Parameters: R1 =3.16k			
1	AIC_Tasks2:playground:1	VOUT	
1	AIC_Tasks2:playground:1	ACL	58.4
1	AIC_Tasks2:playground:1	BWCL	14.08M
Parameters: R1 =5.6k			
2	AIC_Tasks2:playground:1	VOUT	
2	AIC_Tasks2:playground:1	ACL	49.37
2	AIC_Tasks2:playground:1	BWCL	23.39M
Parameters: R1 =10k			
3	AIC_Tasks2:playground:1	VOUT	
3	AIC_Tasks2:playground:1	ACL	39.68
3	AIC_Tasks2:playground:1	BWCL	41.6M
Parameters: R1 =17.8k			
4	AIC_Tasks2:playground:1	VOUT	
4	AIC_Tasks2:playground:1	ACL	29.82
4	AIC_Tasks2:playground:1	BWCL	81.44M
Parameters: R1 =31.6k			
5	AIC_Tasks2:playground:1	VOUT	
5	AIC_Tasks2:playground:1	ACL	19.96
5	AIC_Tasks2:playground:1	BWCL	174.7M

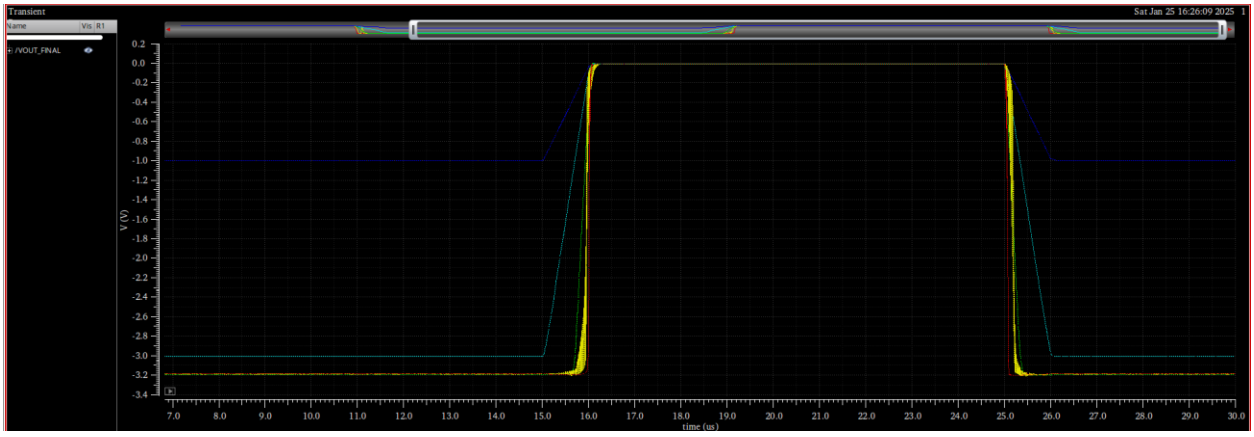
Transient Simulation

At gain = 100









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