



UiO • University of Oslo

IN5230 - Mandatory Task 3

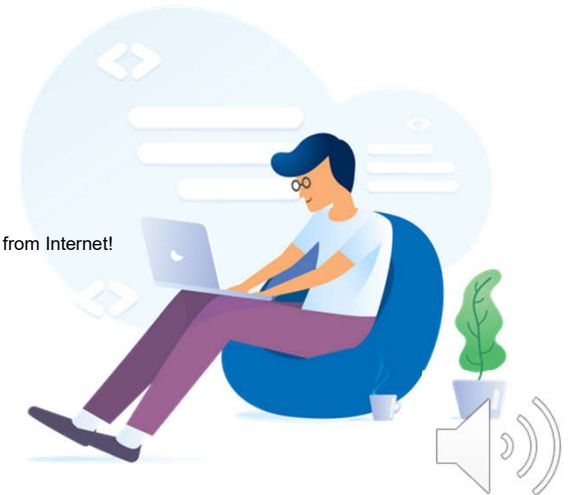
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Deadline for delivery

- November 14 @ 08:00.
- The report is being submitted individually.
- Consisting of the schematics, simulation results, text explaining, summary table and comments.
- White/light background for the plots.

Image is borrowed from Internet!



Key Syntax

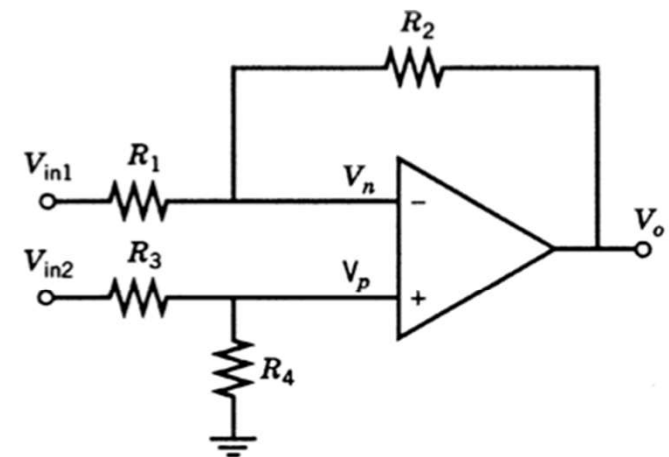
- .Noise
- .Meas
 - The output can be found in error log file.
 - Spot Noise: Noise at some frequencies.
 - Integrated Noise: Noise over some frequency ranges.



Task1: Ideal Amplifier

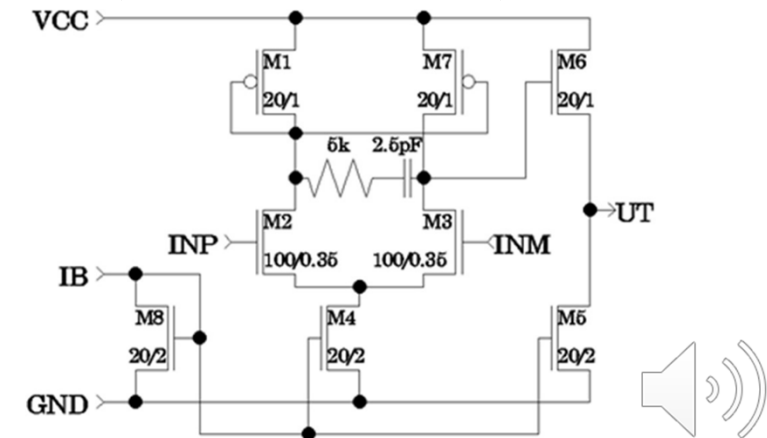
- Studying the performance of the ideal amplifier in a resistive feedback loop
- Copy the symbol from the "Educational" area
- Gain = 100k and GBW = 10Meg

$$V_o = \left(\frac{R_4}{R_3 + R_4} \right) \left(\frac{R_1 + R_2}{R_1} \right) V_{in2} - \left(\frac{R_2}{R_1} \right) V_{in1}$$



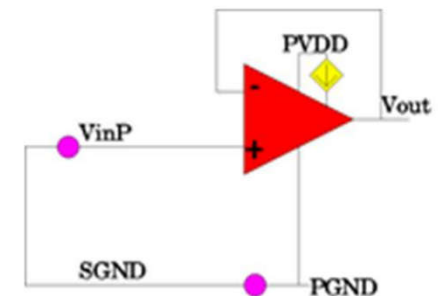
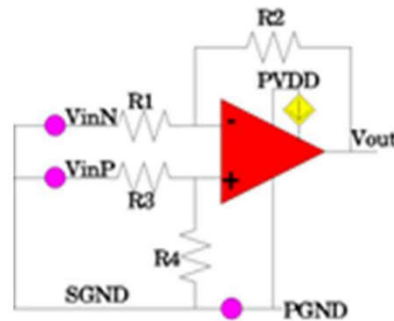
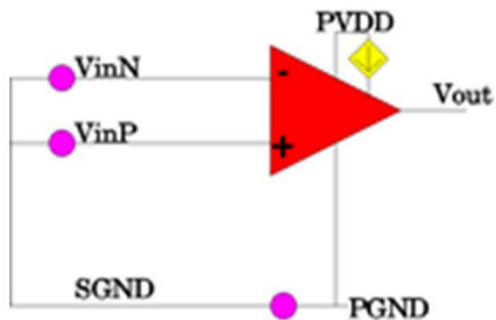
Task2: Simple CMOS Amplifier

- a) AC analysis for the open loop circuit without the feedback
- b) Perform the AC analysis for the resistive network of task 1 when you replace the ideal amplifier by this amplifier
- c) Finding the spot noise at 1Hz, 1kHz, 1MHz, and 1GHz and integrated noise for the areas of 1Hz-1kHz, 1kHz-1MHz, and 1Hz-1MHz
- d) Repeat the task 1 with this amplifier
 - a) Find the 6 strongest noise source



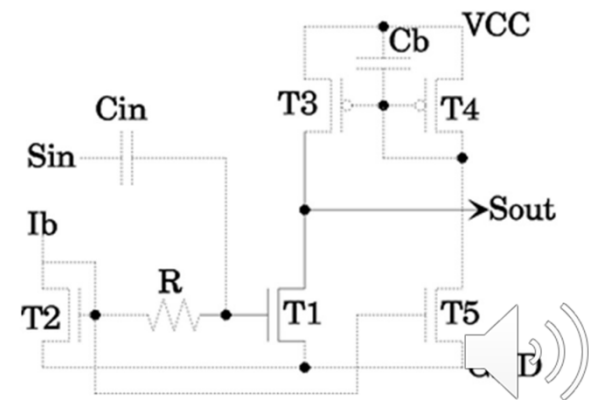
Task3: Open loop, 10x gain and closed loop

- Finding spot noise and integrated noise for three different structures



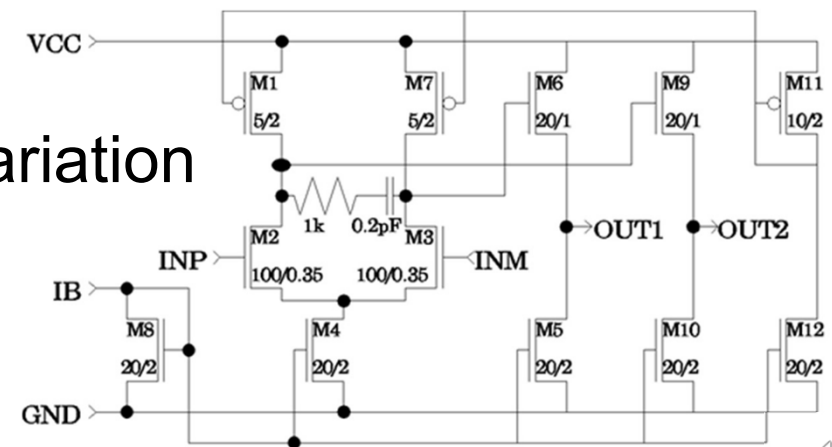
Task4: Common Source Amplifier- RF

- Finding C_{in} as the signal is not muted by more than 10% ($R = 1k$ and $f_{in} = 1MHz$, $I_b = 10\mu A$)
- Finding the range for R as its contribution on the output noise is $<10\%$.
- What is the role of C_b ?
- Doubling the W_n , L_n , W_p , L_p
- Increasing the I_b
- Replacing CMOS with Bipolar transistors

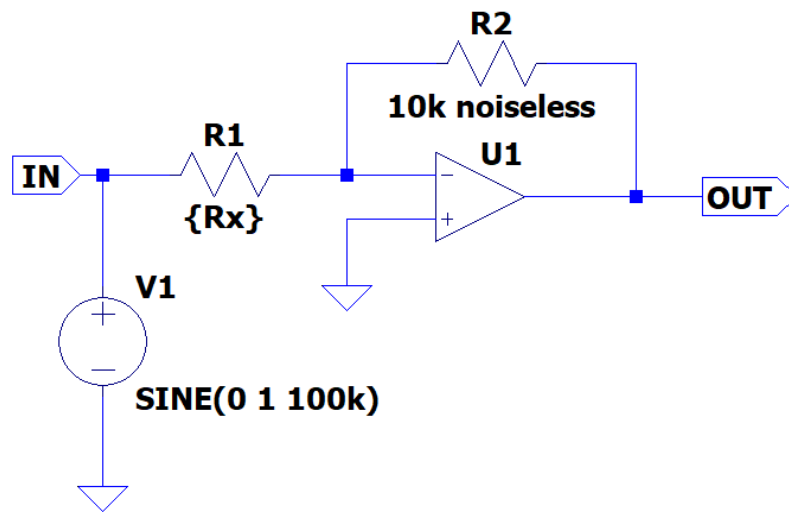


Task5: CMOS Amplifier with Differential Input and Output

- a) Finding the gain for each input, and differential input, finding the output noise and equivalent input noise
- b) Look at the effect of noise on the power supply, VCC (.AC)
 - a) M2 and M3 are identical
 - b) $W_{M2} = W_{M3} + 0.1W_{M3}$
- c) Specify the power consumption variation



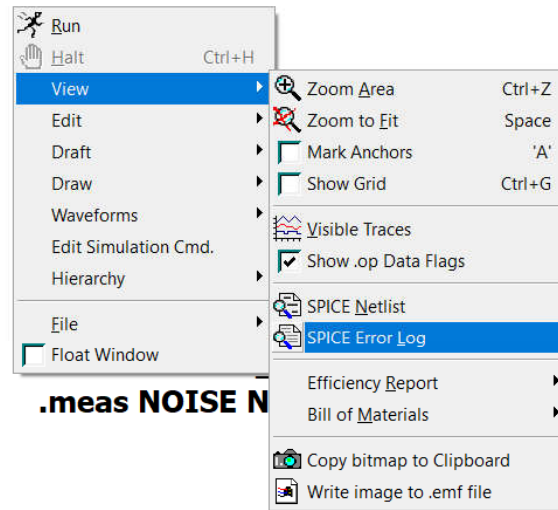
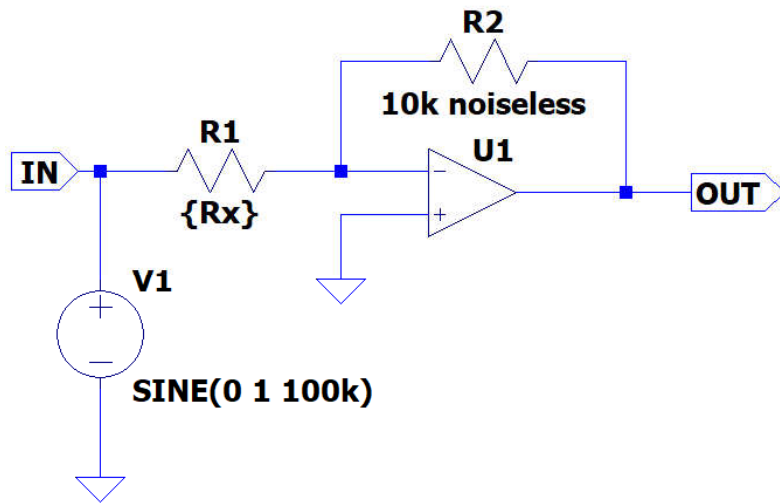
Example: How to plot .MEAS data



```
.inc opamp.sub
.noise V(OUT) V1 dec 200 1m 1G
.step dec param Rx 1 1000k 10
.MEAS noise NItot FIND V(inoise) at 10k
.MEAS noise Nr1 FIND V(r1) at 10k
.MEAS noise N_r1_onoise FIND V(r1)/V(onoise) at 10k
.meas NOISE Nr1_INTEG INTEG V(r1) TRIG at=1k TARG at=100k
```



Example: How to plot .MEAS data



.meas NOISE N

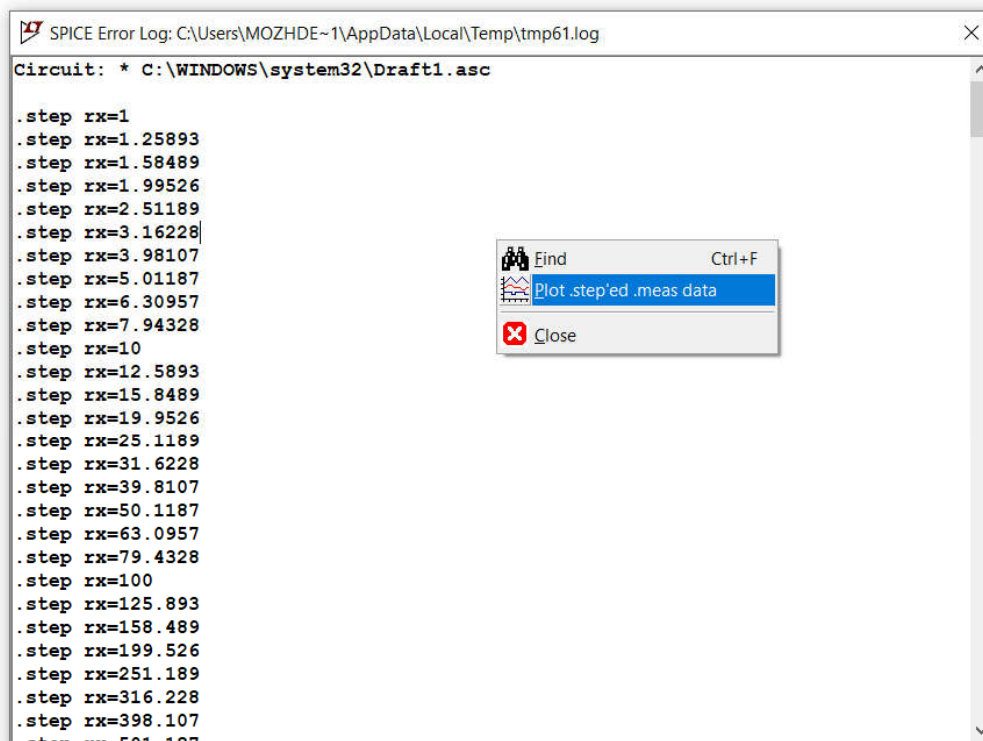
at 10k

1)/V(onoise) at 10k

r1) TRIG at=1k TARG at=100k



Example: How to plot .MEAS data



SPICE Error Log: C:\Users\MOZHDE~1\AppData\Local\Temp\tmp61.log

Circuit: * C:\WINDOWS\system32\Draft1.asc

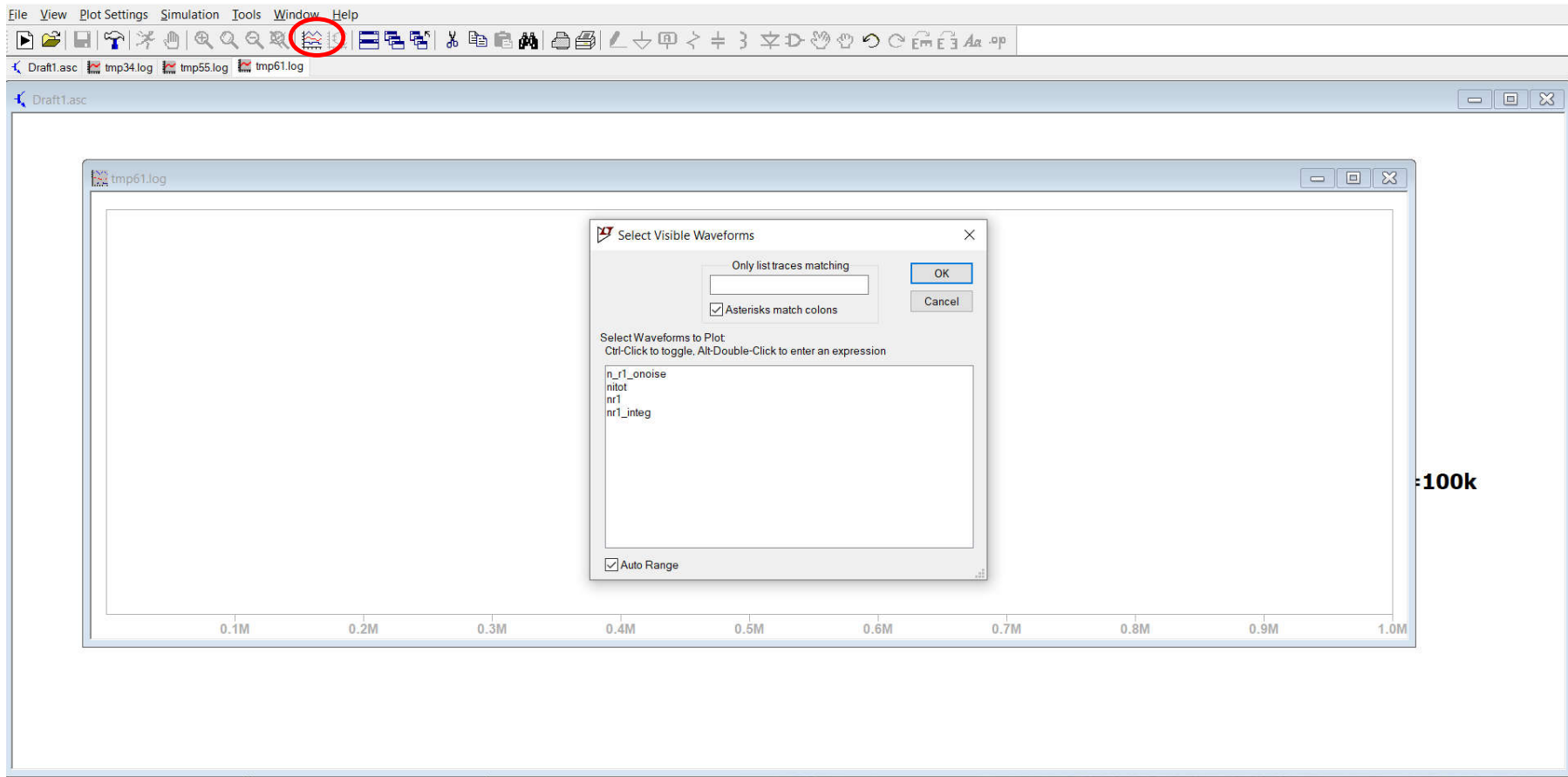
```
.step rx=1  
.step rx=1.25893  
.step rx=1.58489  
.step rx=1.99526  
.step rx=2.51189  
.step rx=3.16228  
.step rx=3.98107  
.step rx=5.01187  
.step rx=6.30957  
.step rx=7.94328  
.step rx=10  
.step rx=12.5893  
.step rx=15.8489  
.step rx=19.9526  
.step rx=25.1189  
.step rx=31.6228  
.step rx=39.8107  
.step rx=50.1187  
.step rx=63.0957  
.step rx=79.4328  
.step rx=100  
.step rx=125.893  
.step rx=158.489  
.step rx=199.526  
.step rx=251.189  
.step rx=316.228  
.step rx=398.107  
.step rx=501.187
```

Find Ctrl+F
Plot .step'ed .meas data
Close

```
p.sub  
OUT) V1 dec 200 1m 1G  
param Rx 1 1000k 10  
ise NItot FIND V(inoise) at 10k  
ise Nr1 FIND V(r1) at 10k  
ise N_r1_onoise FIND V(r1)/V(onoise) at 10k  
ISE Nr1_INTEG INTEG V(r1) TRIG at=1k TARG at=100k
```



Example: How to plot .MEAS data



Example: How to plot .MEAS data

