UiO : University of Oslo

IN5230 - Mandatory Task 3

Teaching Assistant: Mozhdeh Nematzadeh (mozhdehn@ifi.uio.no)

Deadline for delivery

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

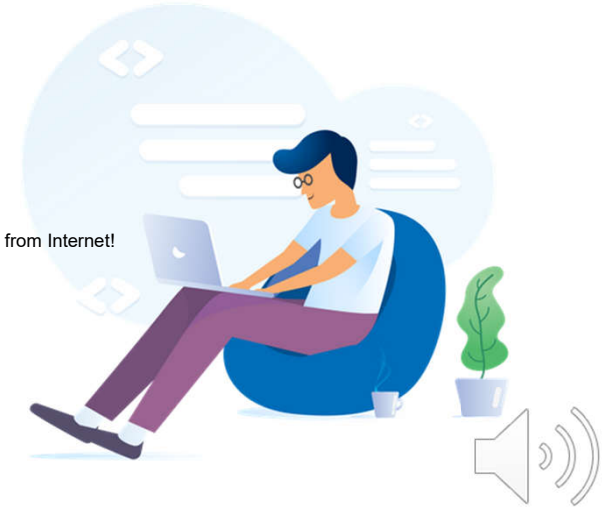


Image is borrowed from Internet!

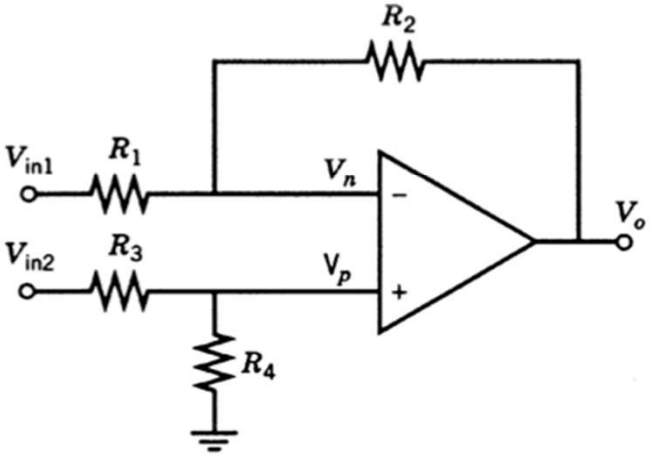
The Object

- Running .Noise simulation in LTspice.
- Spot Noise: Noise at some frequencies.
- Integrated Noise: Noise over some frequency ranges.

Task1: Ideal Amplifier

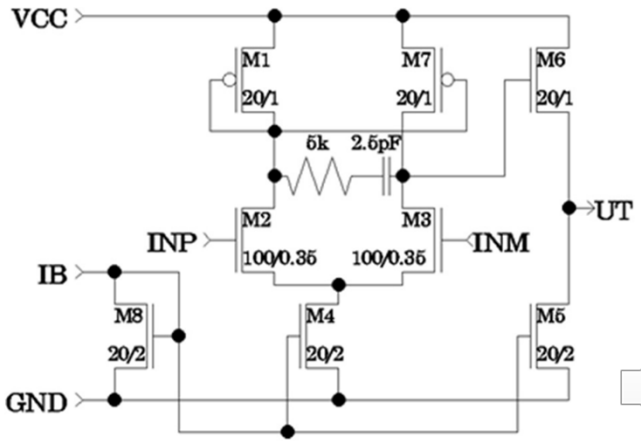
- Studying the performance of the ideal amplifier in a resistive feedback loop
- Copy the symbol from the "Educational" area
- Gain = 100k and GBW = 10Meg

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



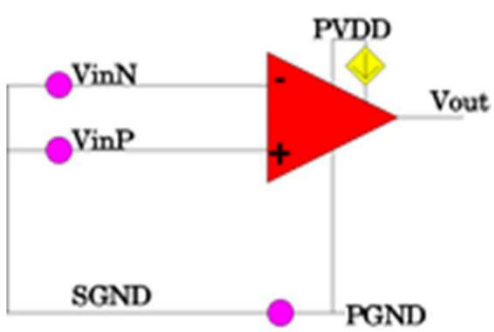
Task2: Simple CMOS Amplifier

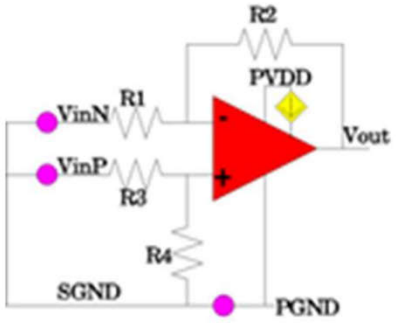
a) AC analysis for the open loop circuit without the feedback
b) Perform the AC analysis for the resistive network of task 1 when you replace the ideal amplifier by this amplifier
c) Finding the spot noise at 1Hz, 1kHz, 1MHz, and 1GHz and integrated noise for the areas of 1Hz-1kHz, 1kHz-1MHz, and 1Hz-1MHz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



Task3: Open loop, 10x gain and closed loop

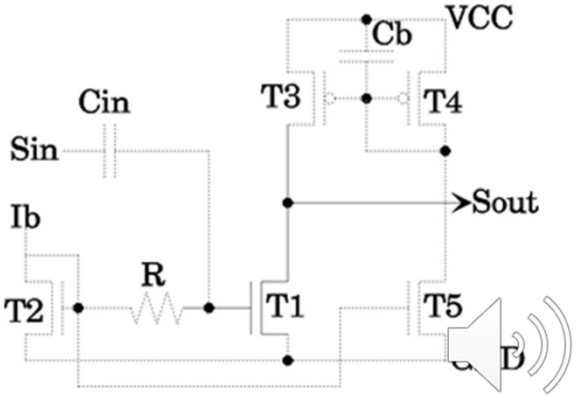
- Fining spot noise and integrated noise for three different structures





Task4: Common Source Amplifier- RF

a) Finding Cin as the signal is not muted by more than 10% (R = 1k and fin = 1MHz, Ib = 10uA)
b) Finding the range for R as its contribution on the output noise is <10%.
c) What is the role of Cb?
d) Doubling the Wn, Ln, Wp, Lp
e) Increasing the Ib
f) Replacing CMOS with Bipolar transistors

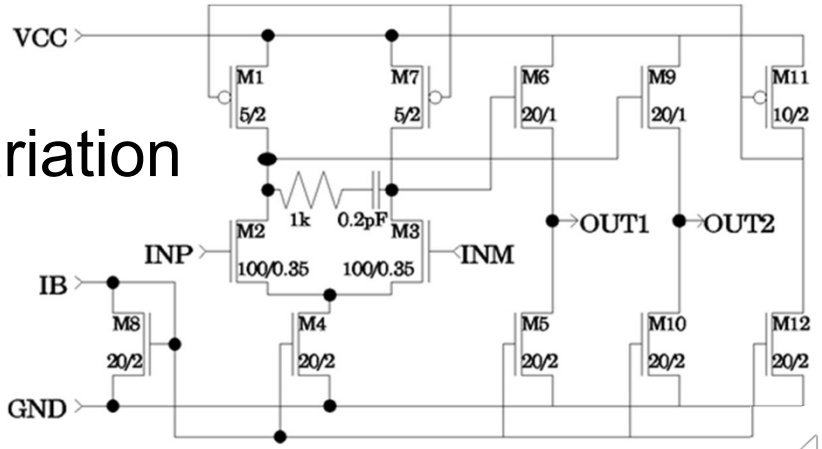


Task5: CMOS Amplifier with Differential Input and Output

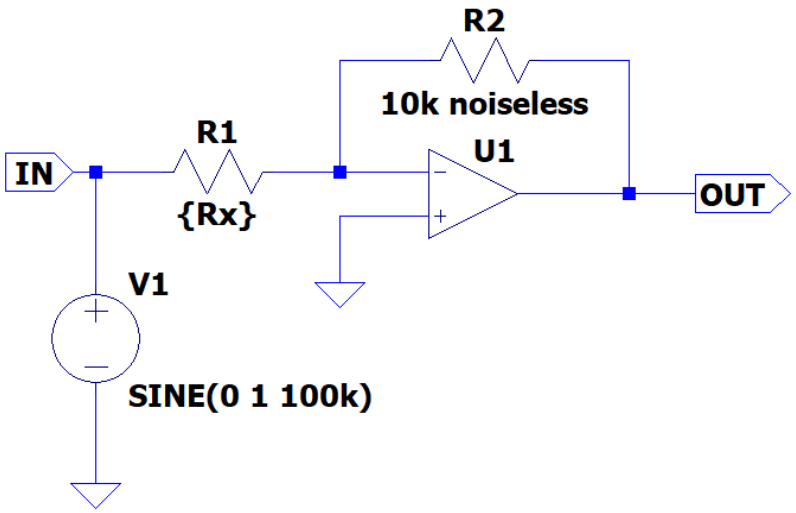
a) Finding the gain for each input, and differential input, finding the output noise and equivalent input noise

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

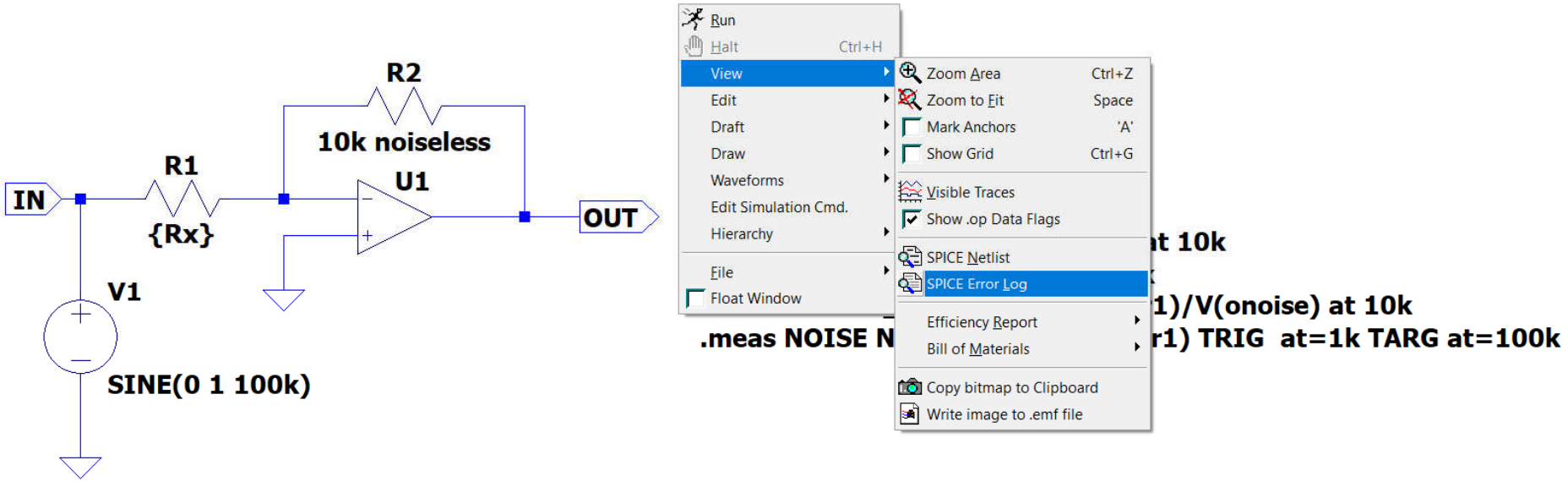


Example: How to plot .MEAS data

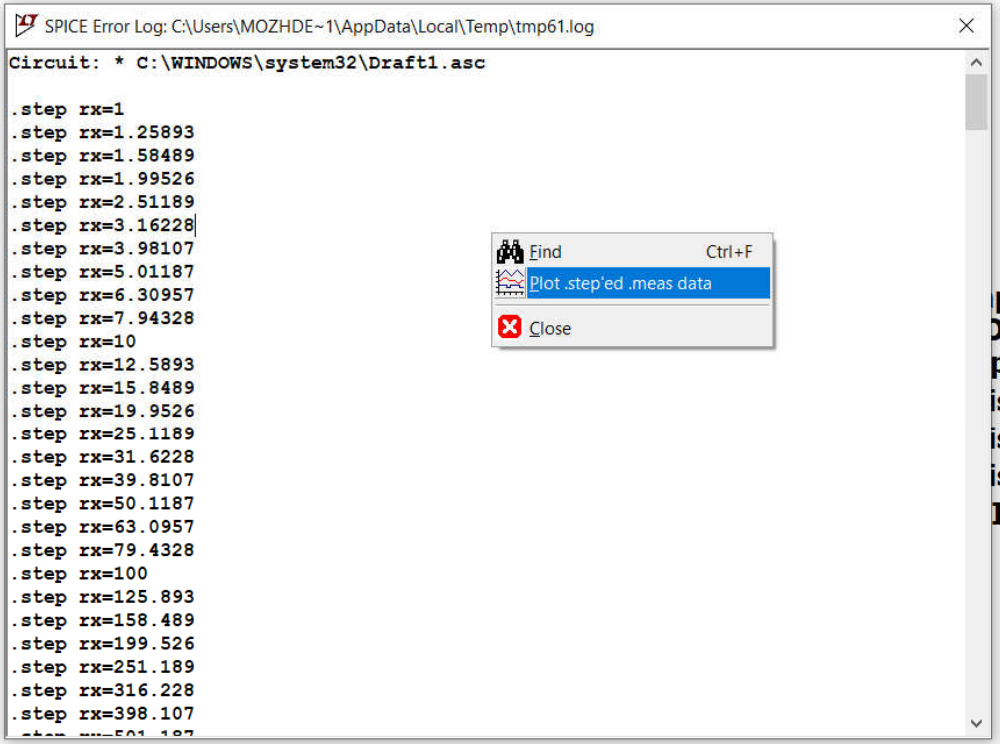



```
.inc opamp.sub
.noise V(OUT) V1 dec 200 1m 1G
.step dec param Rx 1 1000k 10
.MEAS noise NItot FIND V(inoise) at 10k
.MEAS noise Nr1 FIND V(r1) at 10k
.MEAS noise N_r1_onoise FIND V(r1)/V(onoise) at 10k
.meas NOISE Nr1_INTEG INTEG V(r1) TRIG  at=1k TARG at=100k
```

Example: How to plot .MEAS data

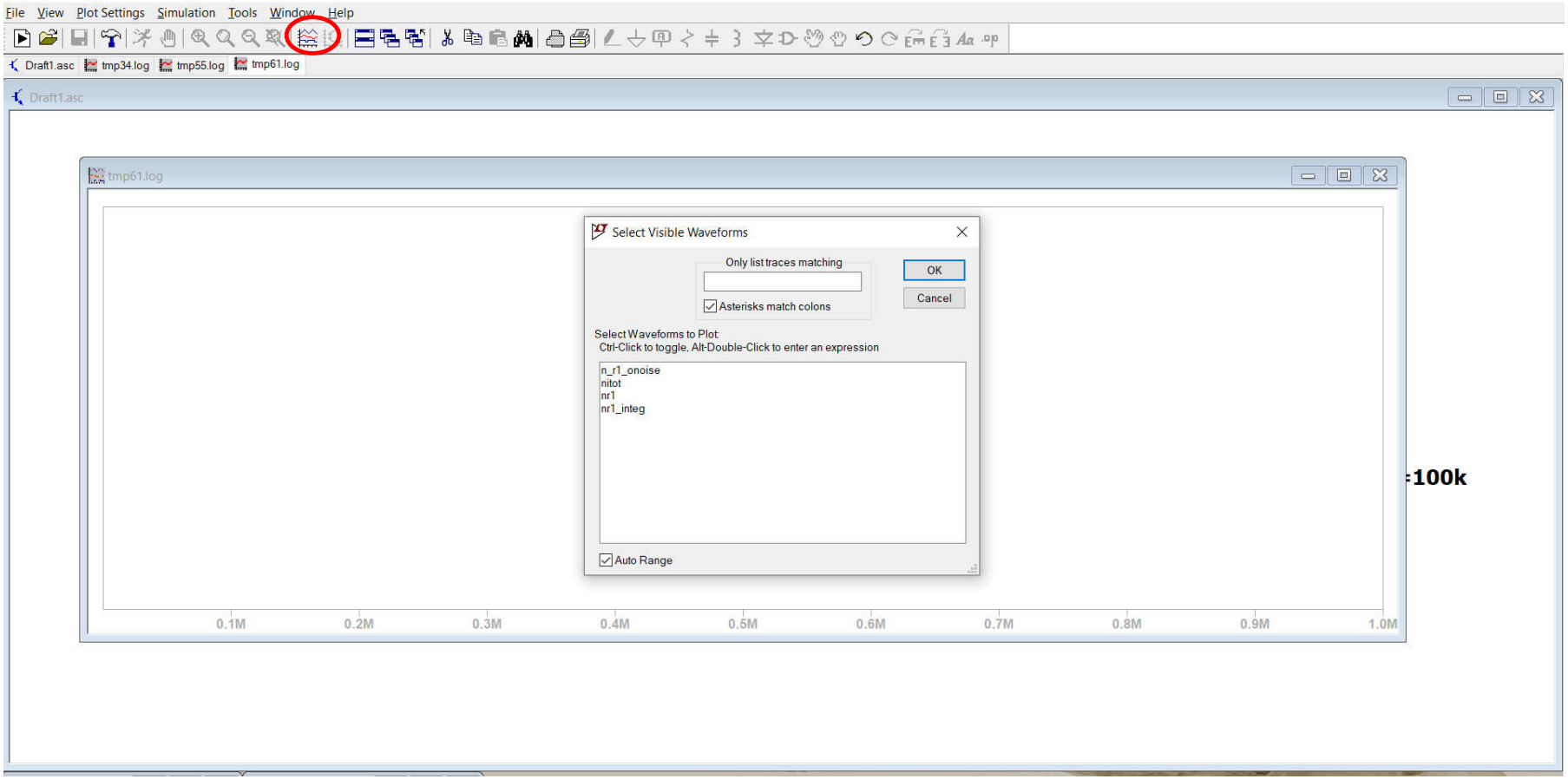


Example: How to plot .MEAS data

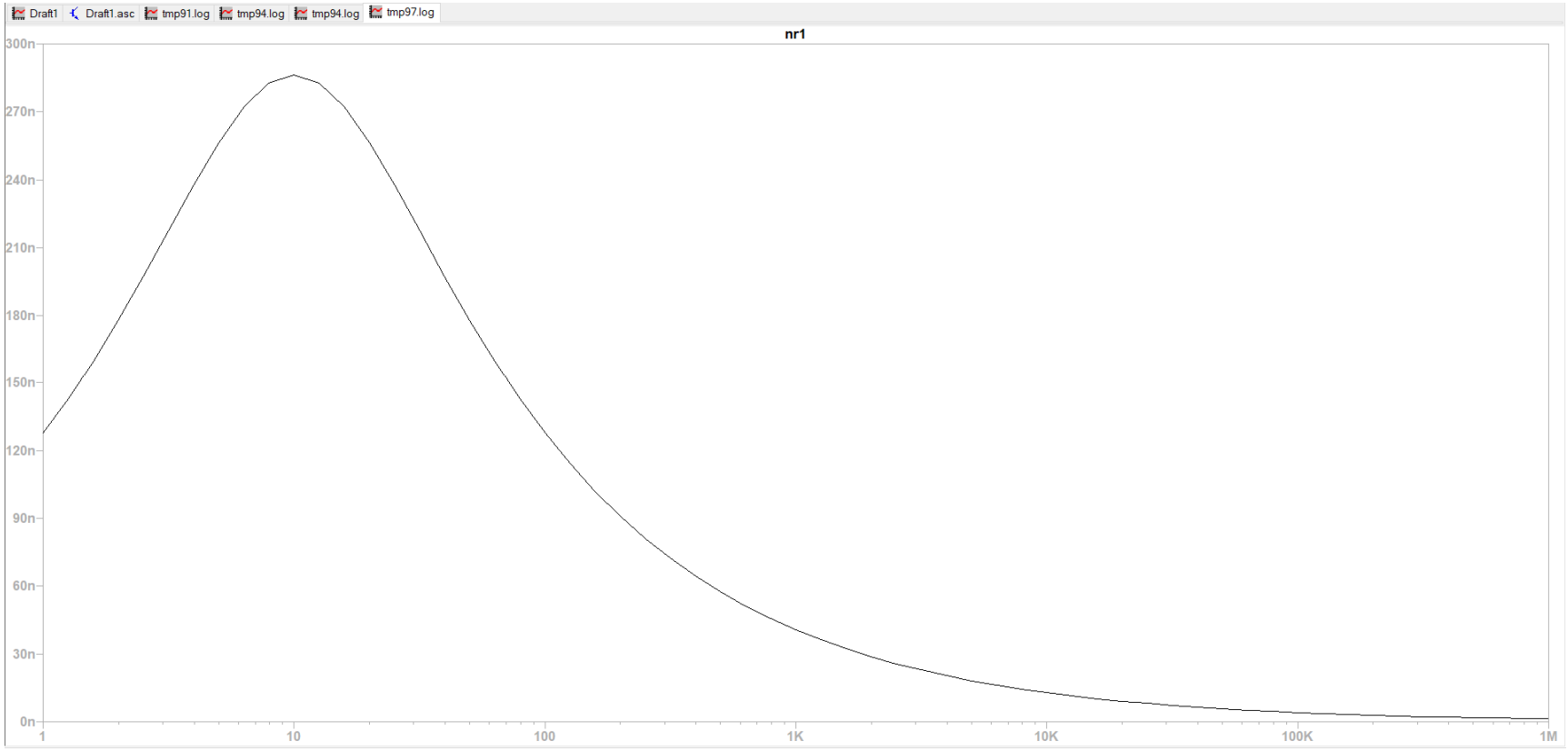


p.sub
UT) V1 dec 200 1m 1G
param Rx 1 1000k 10
ise NItot FIND V(inoise) at 10k
ise Nr1 FIND V(r1) at 10k
ise N_r1_onoise FIND V(r1)/V(onoise) at 10k
ISE Nr1_INTEG INTEG V(r1) TRIG at=1k TARG at=100k

Example: How to plot .MEAS data



Example: How to plot .MEAS data



R1 (ohm)