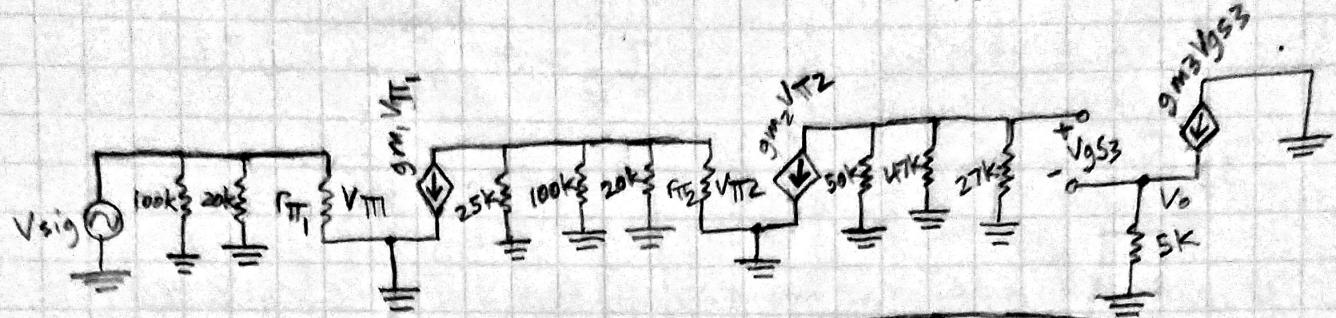


Simulation Hybrid PI Model

$$V_T = 1.2 \quad k_n(\frac{W}{L}) = 0.7 \text{ mA/V}^2$$

$$\lambda = 0.004 \text{ V}^{-1}$$



$$V_o = \frac{g_{m3} V_{gs3}}{5k}$$

$$g_{m3} = \sqrt{0.7 \text{ mA}(z)(593.3 \mu\text{A})} = .83 \mu\text{A}$$

$$V_{gs3} = V_{g3} - V_{s3}$$

$$V_{g3} = \frac{-g_{m2} V_{\pi2} (50k || 47k)}{50k + 47k + 27k} \quad (\pi2)$$

$$V_{s3} = V_o \quad (50k + 47k + 27k)$$

$$V_{\pi2} = \frac{-g_{m1} V_{\pi1} (25k || 100k || 20k)}{25k + 100k + 20k + \pi2} \quad (\pi2)$$

$$V_{\pi1} = V_{sig}$$

$$V_{\pi2} = -g_{m1}(V_{sig}) 10k \quad 145k + \pi2$$

$$V_{g3} = \frac{-g_{m2} (-g_{m1}(V_{sig})) 6.54T}{-179G + 124k(\pi2)}$$

$$V_{gs3} = \frac{-g_{m2} (-g_{m1}(V_{sig})) 6.54T}{-179G + 124k(\pi2)} - V_o$$

$$V_o = \frac{(g_{m2})(g_{m1})(V_{sig})(.166n)(6.54T)}{-179G + 124k(\pi2)} - V_o$$

$$\frac{V_o}{V_{sig}} = \frac{(g_{m2})(g_{m1})(1085.64)}{.358G + 248k(\pi2)}$$

$$R_{in} = 20k || 100k || \pi1$$

$$R_{out} = 5k || \frac{1}{g_{m3}} = 4979.3 \Omega$$

We still don't have gm values for the BJTs, I couldn't find any info on it.

From previous project and sim, we know $V_{C2} = 12.64V$ and $I_{C2} = 47.2 \mu\text{A}$. So we can find g_{m3} by solving Mosfet.

$$V_i = \frac{15(27) - 15(47)}{27k + 47k} = -4.05V$$

$$I_D = \frac{1}{2} (0.7 \text{ mA}) (V_{GS} - 1.2)^2$$

$$V_G = 12.64V - 47.2 \mu\text{A}(50k) + 4.05V = 5.473V$$

$$V_S = -15 + 5k(I_D)$$

$$I_D = \frac{1}{2} (0.7 \text{ mA}) (5.473 + 15 - 5kI_D - 1.2)^2$$

$$2857.14I_D = (19.273 - 5kI_D)^2$$

$$2857.14I_D = 371.45 - 192730I_D + 25M^2$$

$$0 = 25M^2 - 195587.14I_D + 371.45$$

$$I_D = \frac{195587.14 \pm \sqrt{195587.14^2 - 4(25M)(371.45)}}{2(25M)}$$

$$V_S = 595.3 \mu\text{A}(5k)$$

$$= 2.97V = 4.5 \mu\text{A}, \boxed{595.3 \mu\text{A}} \checkmark$$

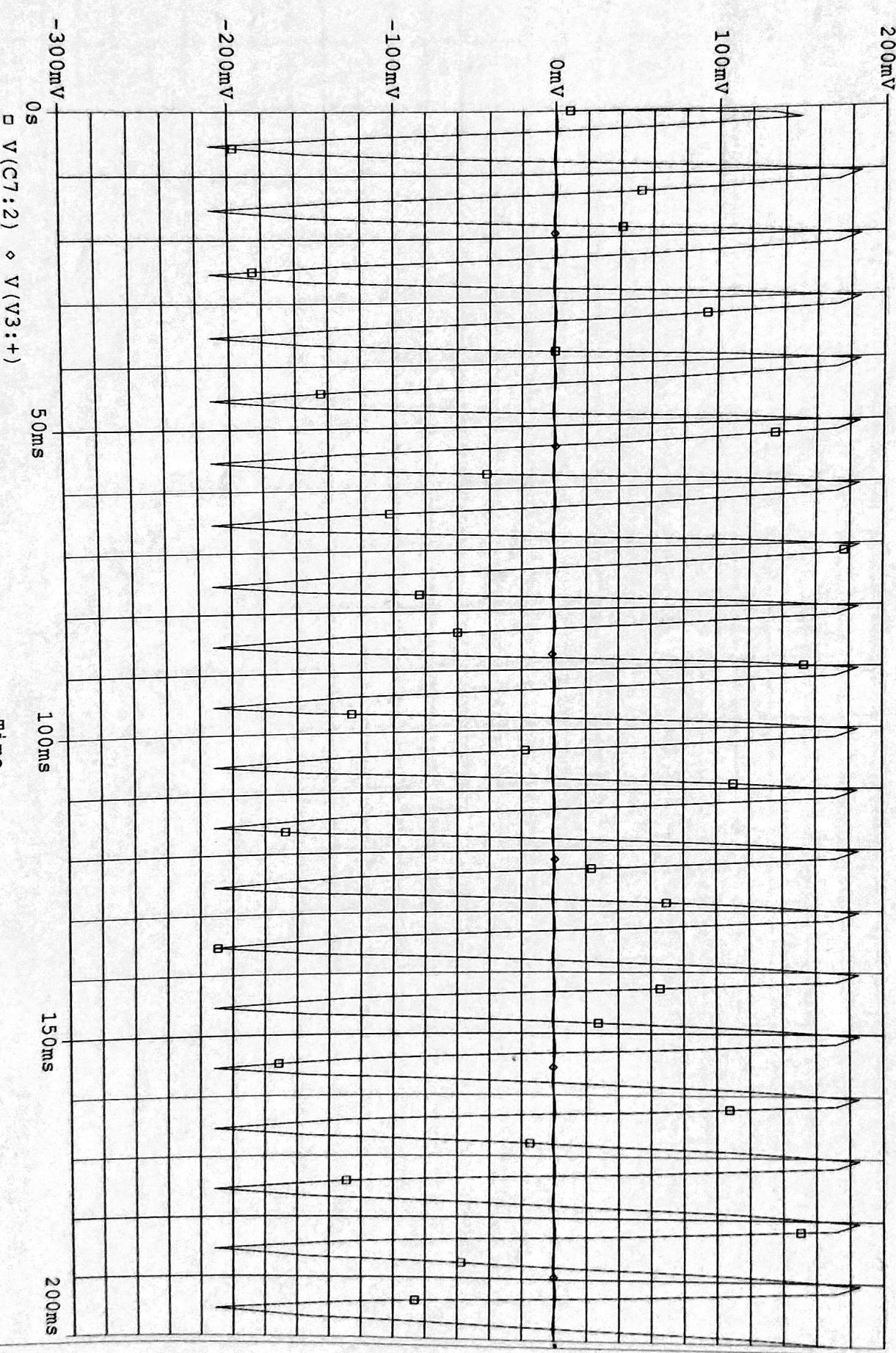
$$V_D = 15 - 595.3 \mu\text{A}(15k) \quad V_{DS} > |V_{GS}| + |V_{th}| \quad V_{GS} > V_T$$

$$= 6.07V$$

100 Hz

** Profile: "SCHEMATIC1-Lab4sim" [C:\OrCAD\OrCAD_16.6_Lite\lab4-pspicefiles\schematic1\lab4sim.sim]
Date/Time run: 04/07/16 20:47:43
Temperature: 27.0

(A) Lab4sim (active)



Date: April 07, 2016

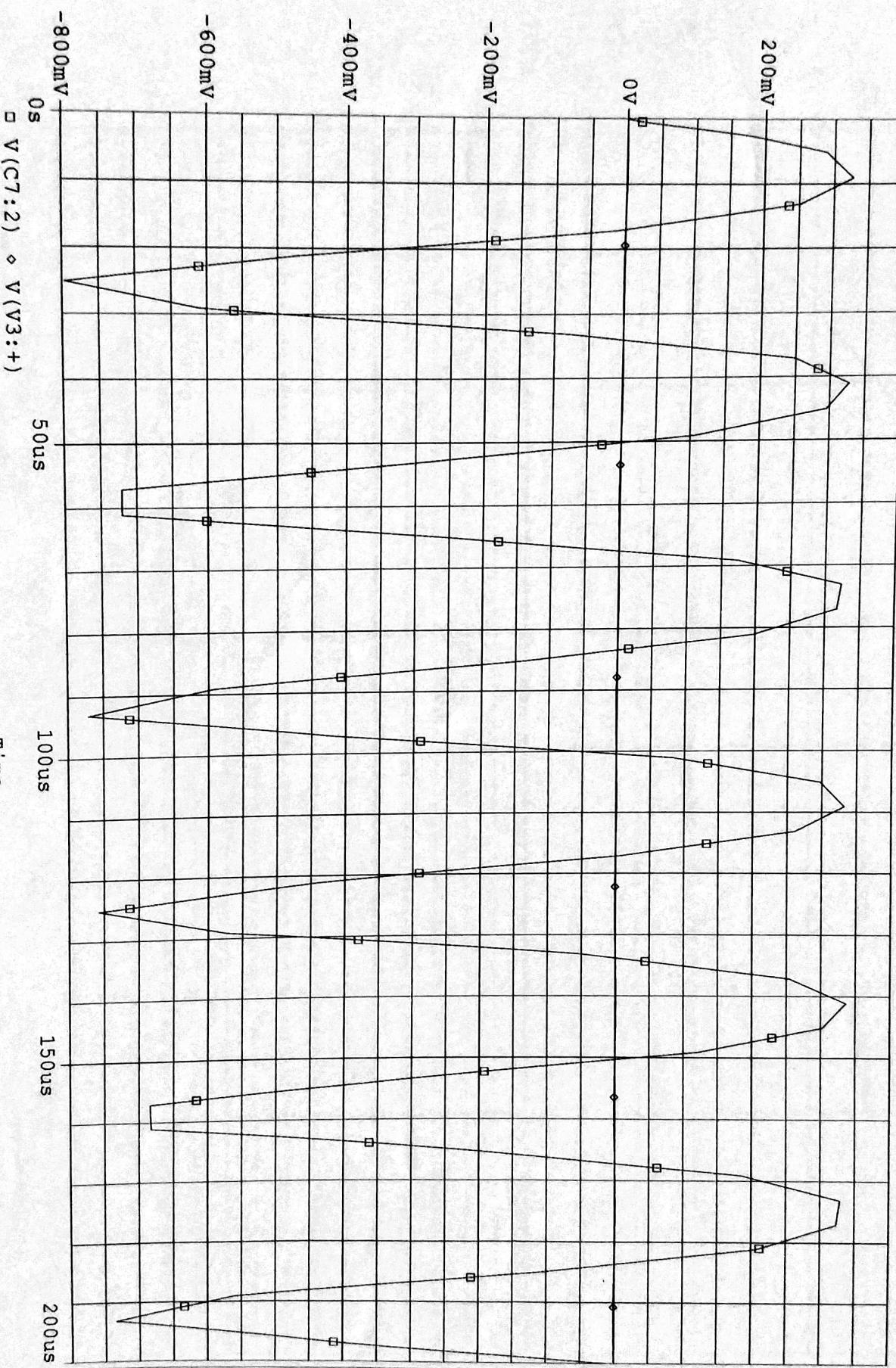
Page 1

Time: 20:48:01

30K Hz

** Profile: "SCHEMATIC1-Lab4sim" [C:\ORCAD\ORCAD_16.6_Lite\lab4-pspicefiles\schematic1\lab4sim.sim]
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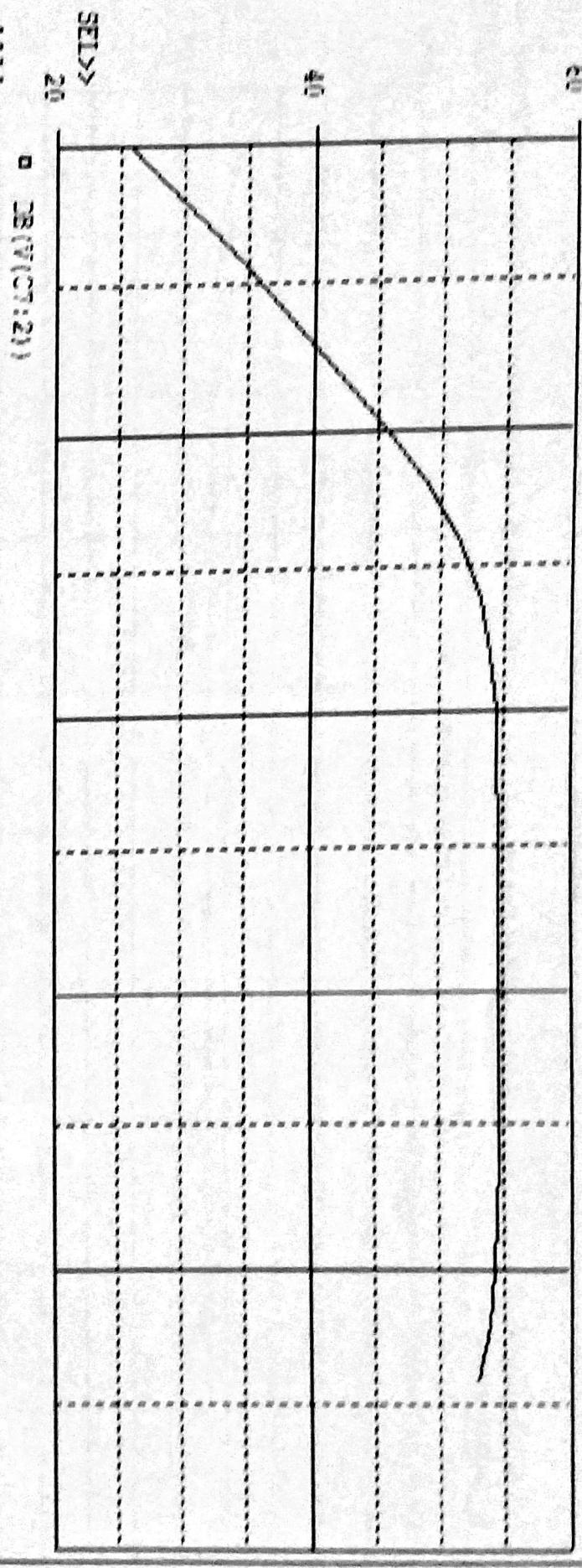
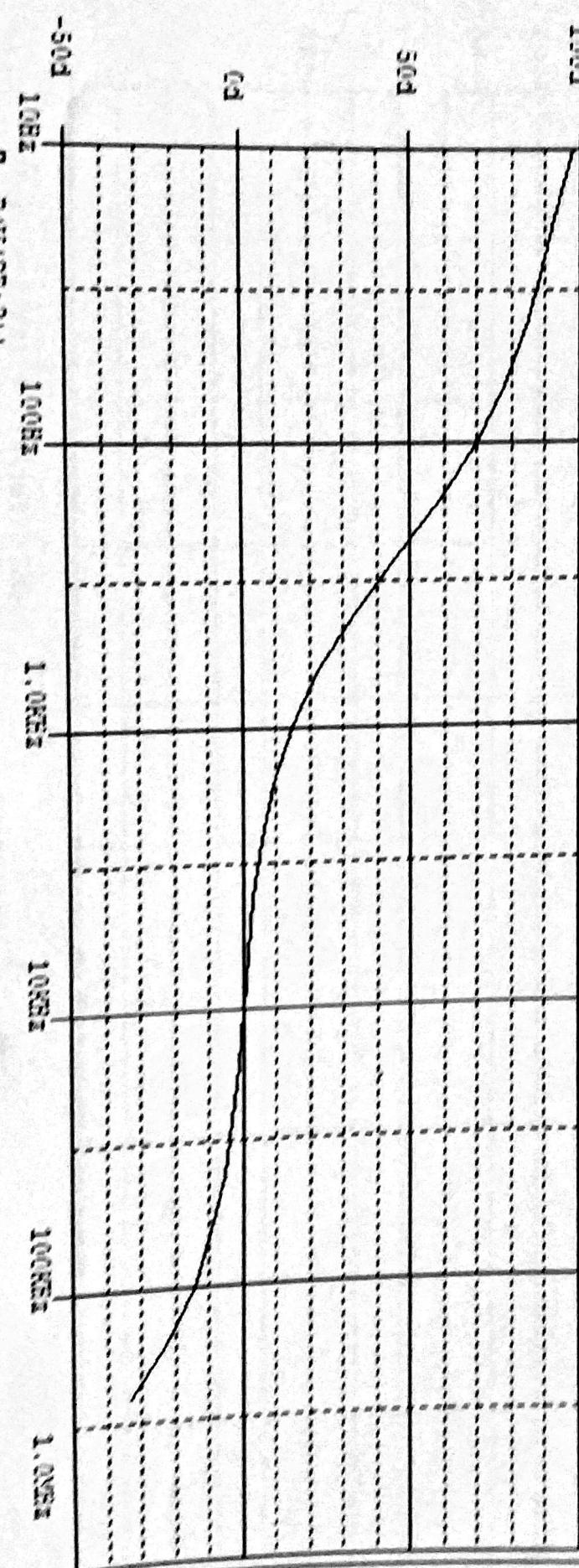
(A) Lab4sim (active)



Date: April 07, 2016

Page 1

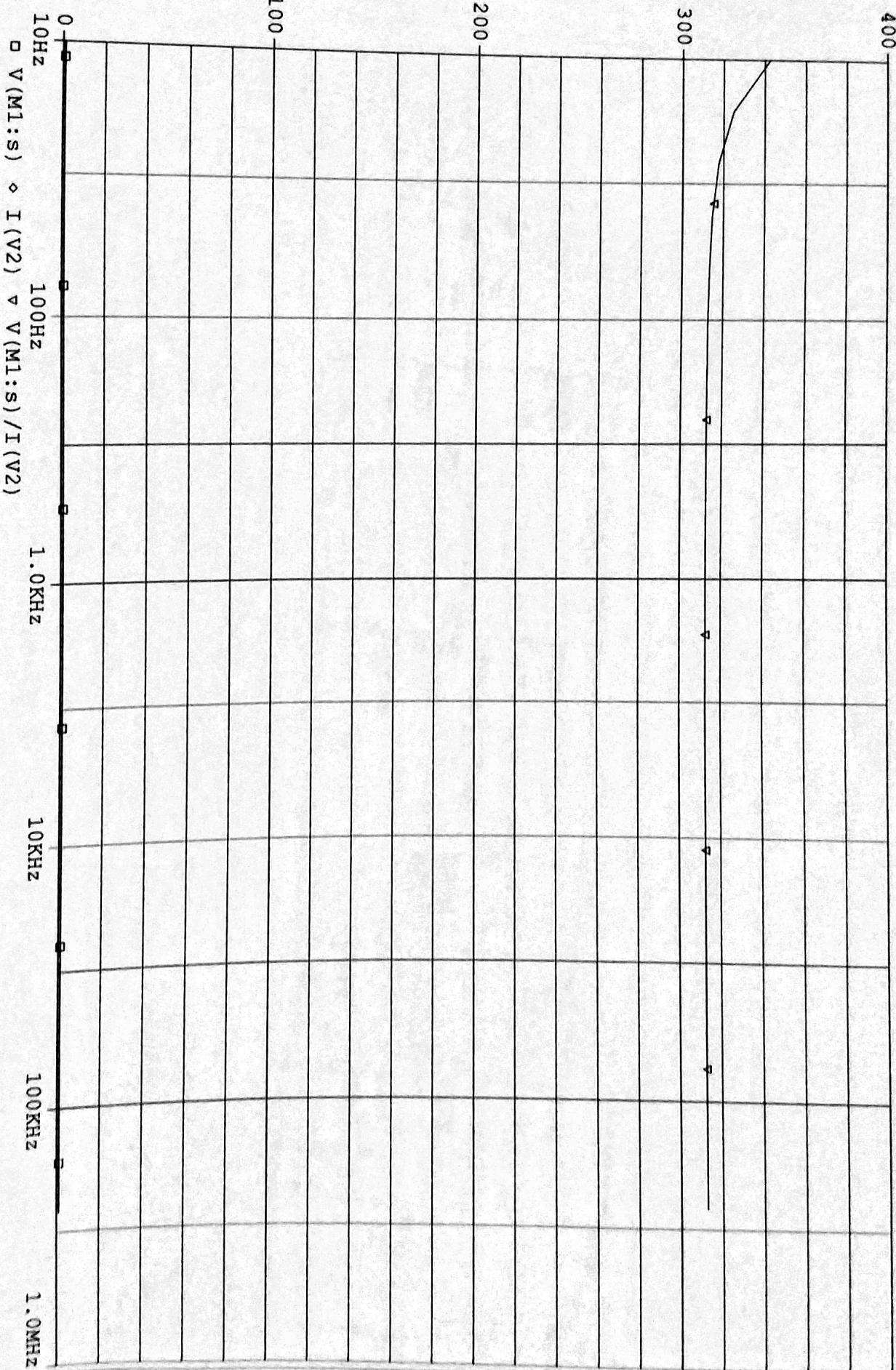
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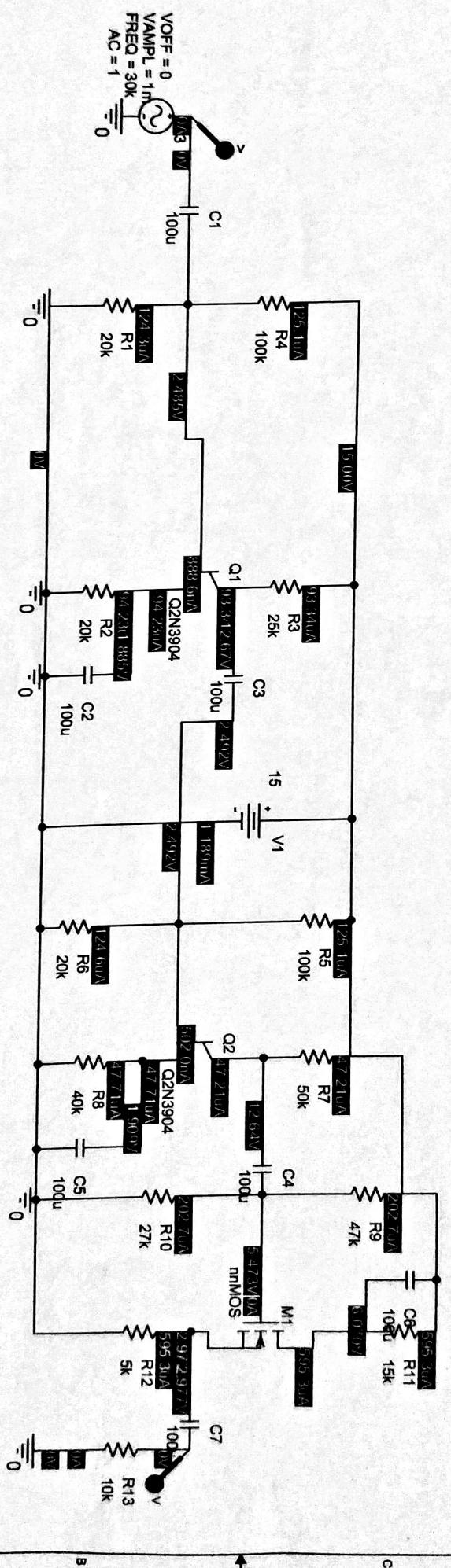


Impedance Vs Frequency

** Profile: "SCHEMATIC1-Lab4sim" [C:\orCAD\orCAD_16.6_Lite\lab4-pspicefiles\schematic1\lab4sim.sim]
Date/Time run: 04/09/16 19:05:11
Temperature: 27.0

(A) Lab4sim (active)





Saturation!

$$V_{DS} = 6.07V - 2.977V = 3.093$$

$$\sqrt{65} = 5.473 \sqrt{2.977} = 2.496$$

$$V_t = 1.2$$

$$3.093 > 1.246 \quad \checkmark$$

$$3.2496 > 1.2 \quad \checkmark$$