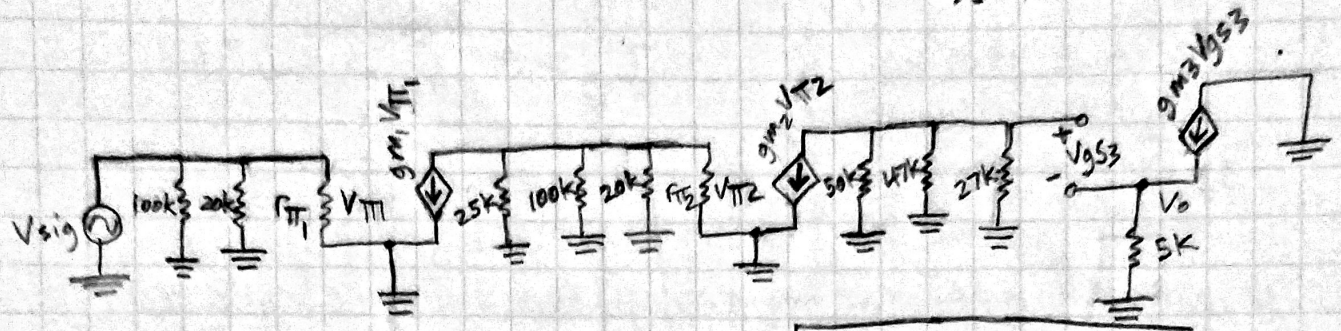
Simulation Hybrid PI Model

$V_t = 1.2 \quad k_n'\left(\frac{W}{L}\right) = 0.7\,mA/V^2$

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



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

$g_{m3} = \sqrt{0.7mA(2)(593.3\mu A)} = .83\mu$

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

$V_{g3} = \frac{-g_{m2} V_{\pi 2} (50k \| 47k)}{50k + 47k + 27k} \quad (27k)$

$V_{s3} = V_o$

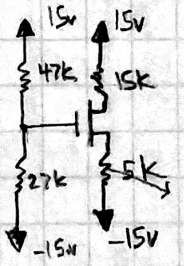
$V_{\pi 2} = \frac{-g_{m1} V_{\pi 1} (25k \| 100k \| 10k \| 20k)}{25k + 100k + 20k + r_{\pi 2}} \quad (r_{\pi 2})$

We still dont have gm values for the BJT's, I couldnt find any info on it.

$V_{\pi 1} = V_{sig}$

$V_{\pi 2} = \frac{-g_{m1}(V_{sig})\,10k}{145k + r_{\pi 2}}$

From previous project and sim, we know $V_{C2} = 12.64V$ and $I_{C2} = 47.21\mu A$ So we can find g_{m3} by solving Mosfet.



$V_1 = \frac{15(27k) - 15(47k)}{27k + 47k} = -4.05V$

$V_{g3} = \frac{-g_{m2}(-g_{m1}(V_{sig}))\,6.54T}{.179G + 124k(r_{\pi 2})}$

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

$V_{gs3} = \frac{-g_{m2}(-g_{m1}(V_{sig}))\,6.54T}{.179G + 124k(r_{\pi 2})} - V_o$

$V_G = 12.64V - 47.21\mu A(50k) + 4.05$

$= 5.473V$

$V_o = \frac{(g_{m2})(g_{m1})(V_{sig})(.166n)(6.54T)}{.179G + 124k(r_{\pi 2})} - V_o$

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

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

$\frac{V_o}{V_{sig}} = \frac{(g_{m2})(g_{m1})(1085.64)}{.358G + 248k(r_{\pi 2})}$

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

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

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

$I_D = \frac{195587.14 \pm \sqrt{-195587^2 - 4(25M)(371.45)}}{2(25M)}$

$R_{in} = 20k \| 100k \| r_{\pi 1}$

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

$V_S = 595.3\mu A(5k)$

$= 2.97V \quad = 4.5mA, \boxed{595.3\mu A}$ ✓

$V_D = 15 - 595.3\mu A(15k)$

$= 6.07V$

$|V_{DS}| > |V_{GS} - V_t| \quad V_{GS} > V_t$

100 Hz

** Profile: "SCHEMATIC1-Lab4sim" [C:\OrCAD\OrCAD_16.6_Lite\lab4-pspicefiles\schematic1\lab4sim.sim]
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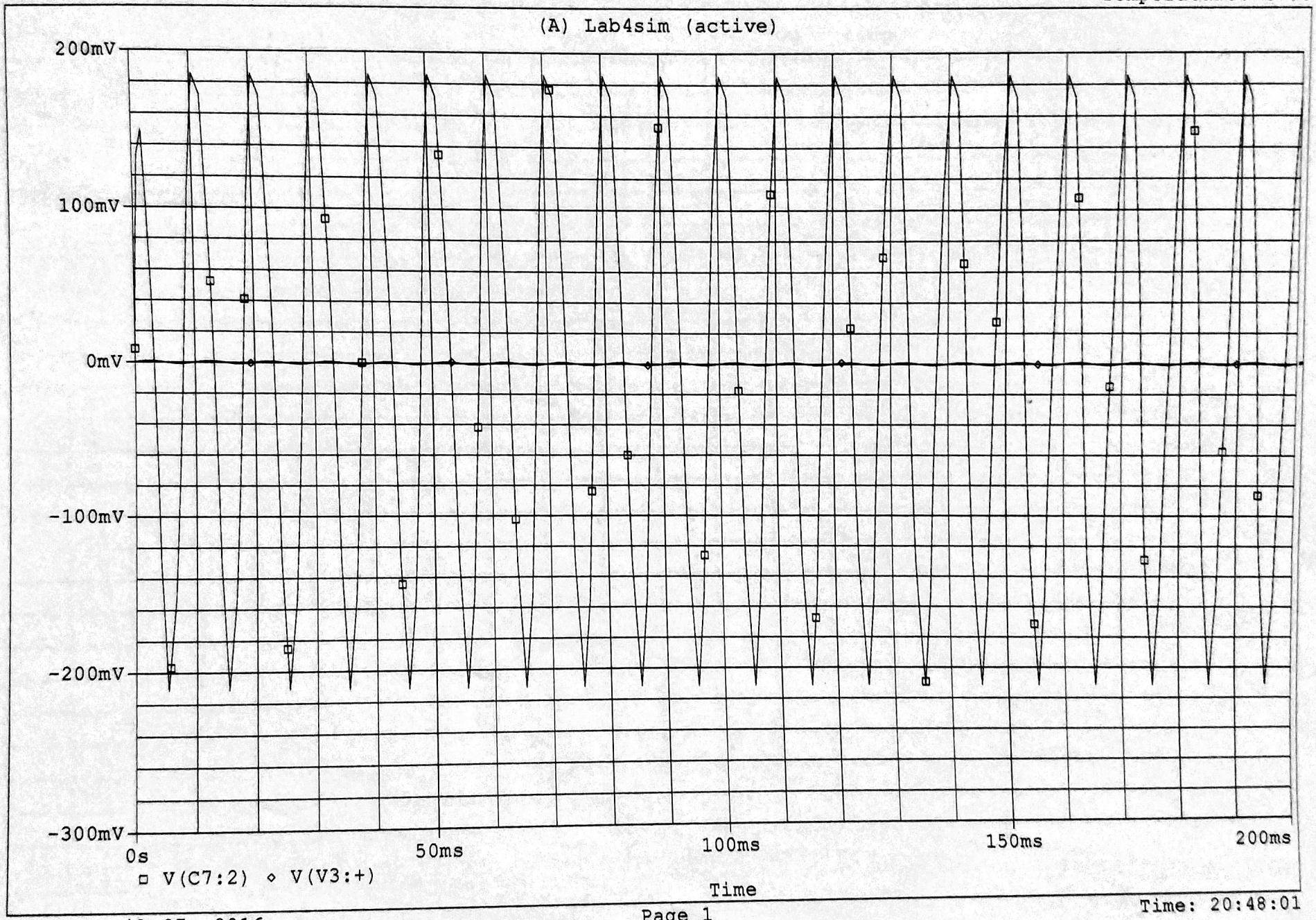

Date: April 07, 2016
Page 1
Time: 20:48:01

30K Hz

** Profile: "SCHEMATIC1-Lab4sim" [C:\OrCAD\OrCAD_16.6_Lite\lab4-pspicefiles\schematic1\lab4sim.sim]
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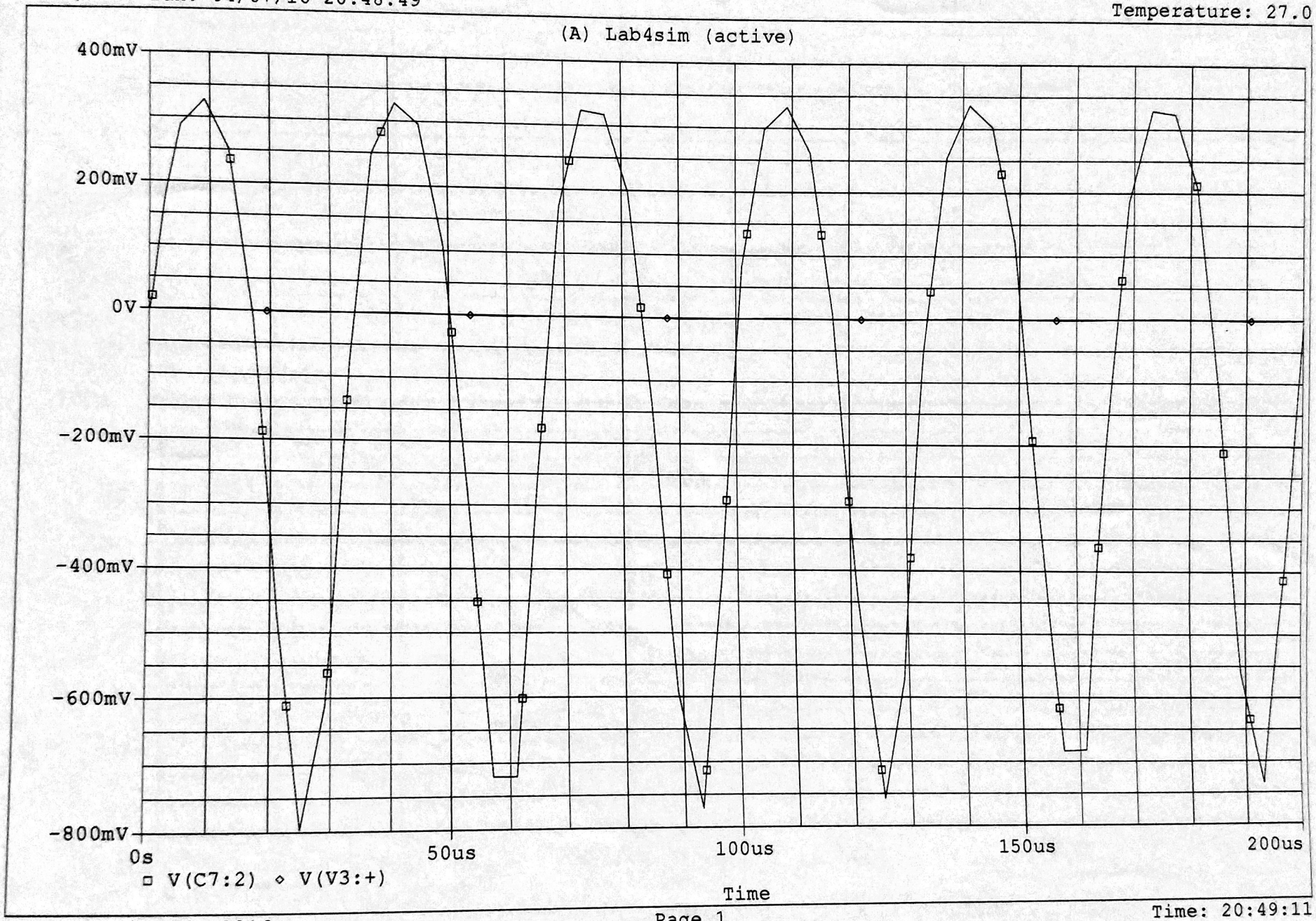

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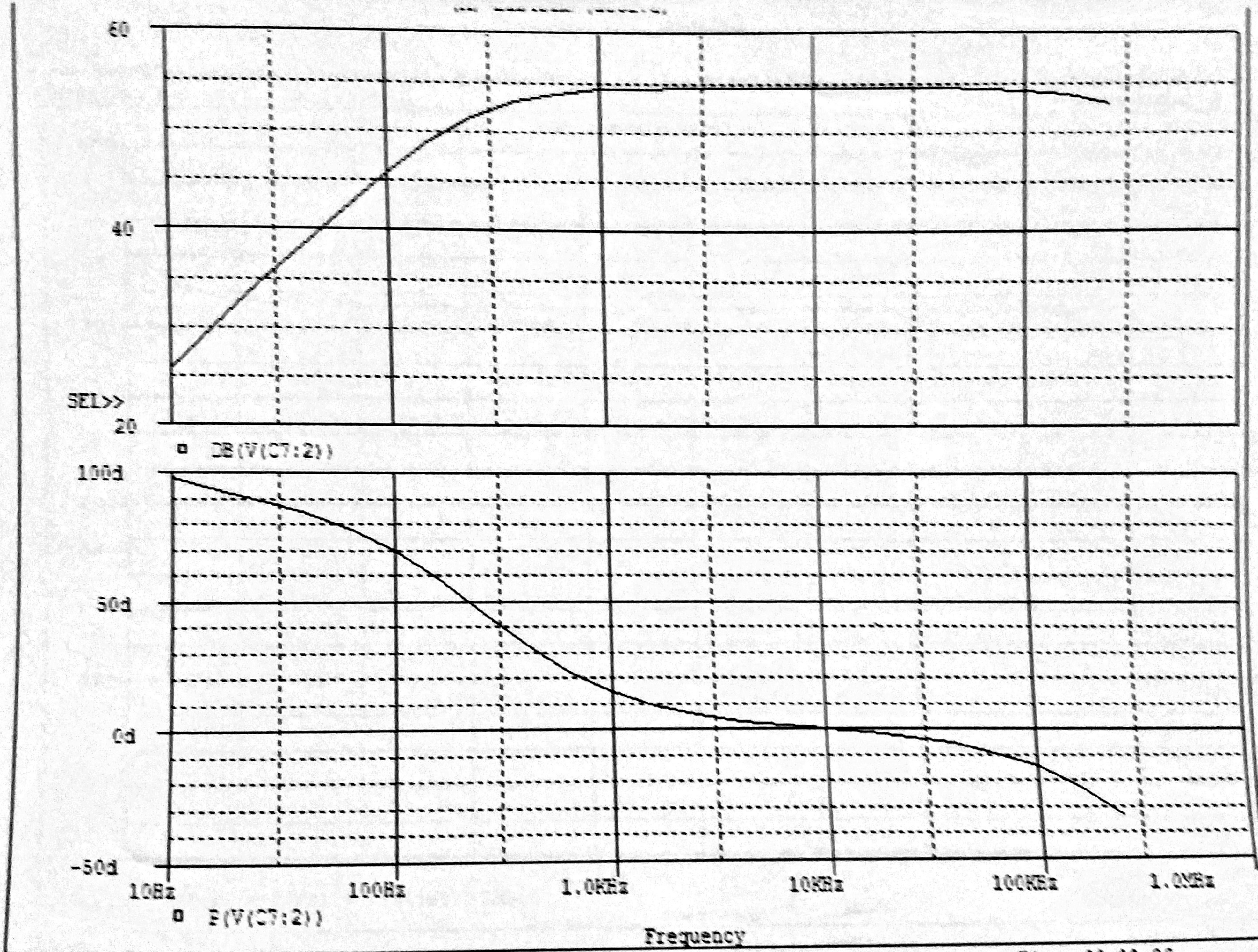
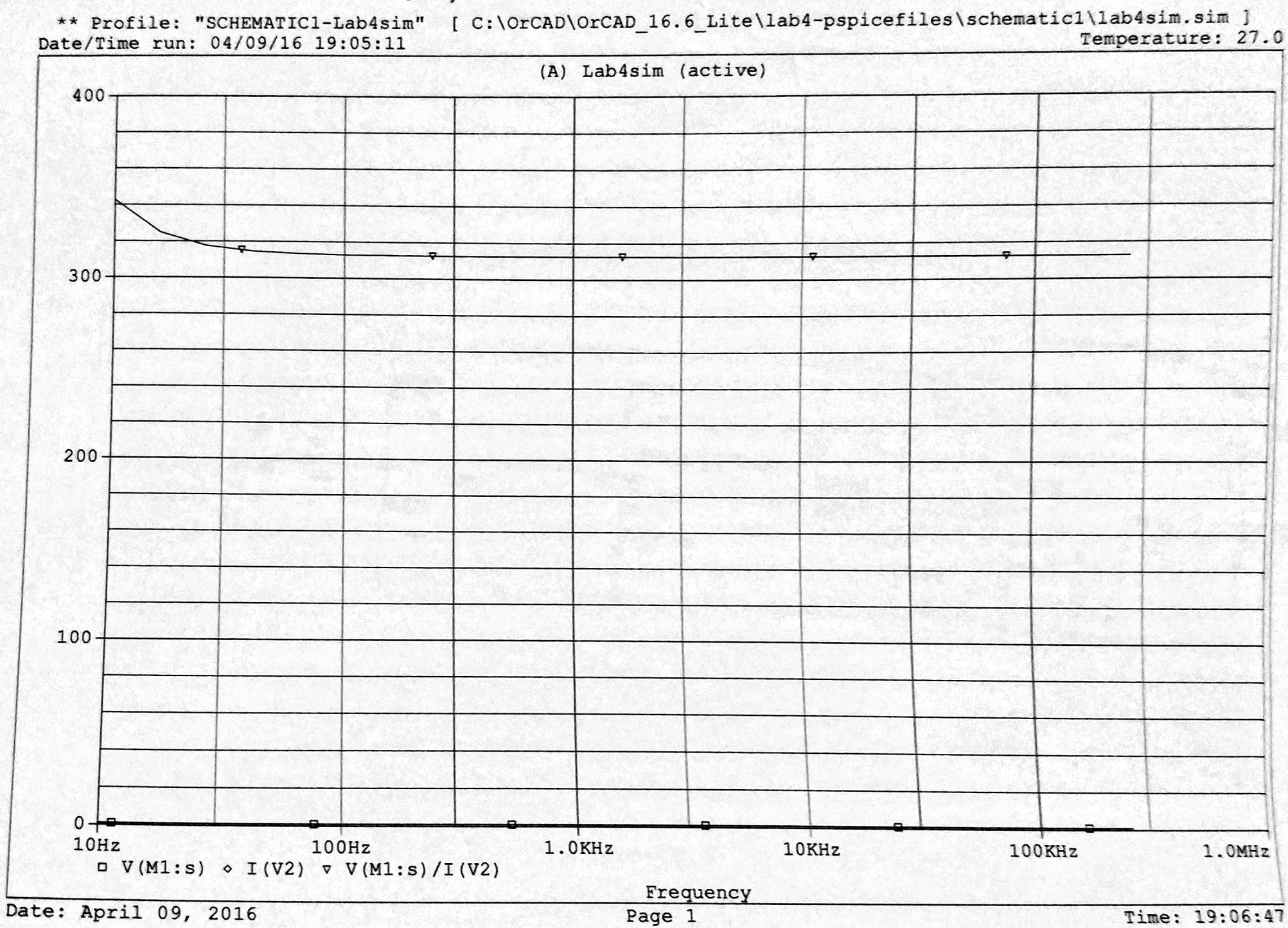
Page 1
Time: 20:49:11

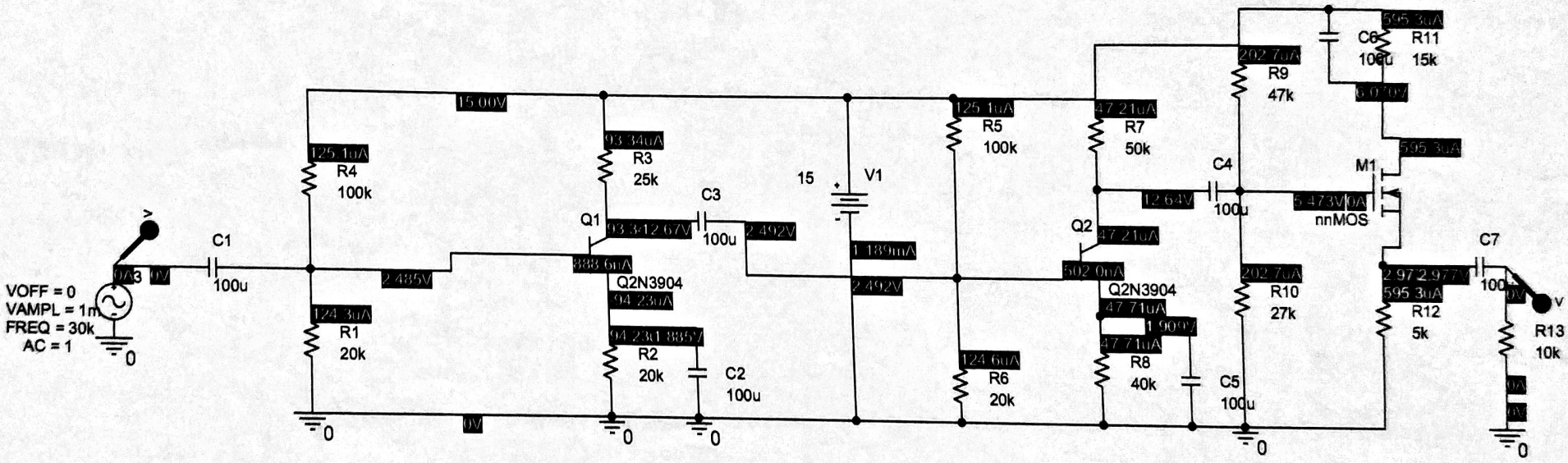


Date: April 08, 2016

Time: 11:11:36

Impedance Vs Frequency





Saturation!

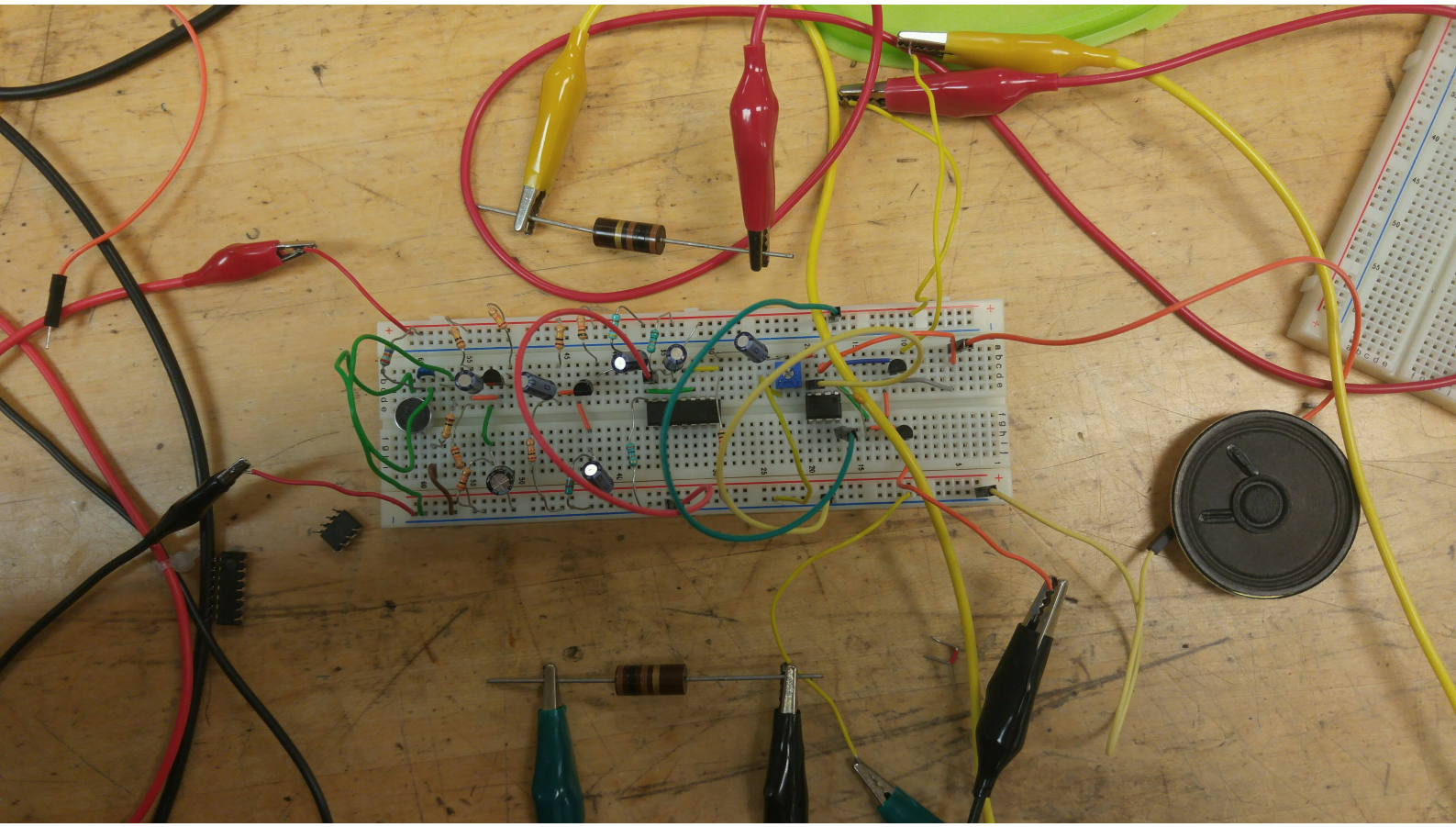
$V_{DS} = 6.07V - 2.977V = 3.093$

$V_{GS} = 5.473V - 2.977V = 2.496$

$V_t = 1.2$

$3.093 > 1.296$ ✓

$2.496 > 1.2$ ✓



- Measured Gain was actually about 76 V/V instead of 70 V/V.
- With 1 mV input at 200 Hz I get about 50 dB
- With the same input at 22 kHz I get about 55 dB
- Mid bandwidth is about 1 kHz to 50 kHz at about 55 dB