ECE 3040 Homework #9 Solutions

Note: These solutions (as are most of my solutions) are much more involved than I would request of you! This is meant to aid your understanding of the problem!

1.) Jaeger 6.12

Reading the values off the graph, V_{OH}=2.5V, and V_{OL}=~0.2V

2.) Jaeger 6.17

a.) $P_{average} = \dfrac{100W}{100x10^6\ Gates} = 1\mu W$

b.) $I = \dfrac{1\mu W}{2.5V} = 0.4\mu\ A/gate$

c.) PDP=(1 nS)(1uW)=1fJ (a very small amount of energy)

3.) Jaeger 6.38a

For M_S off, $I_{DS} = 0$ and $V_{OH} = 5V$.

For V_{OL}, $I_{DS} = \dfrac{5 - V_{OL}}{200k\Omega} = K_n\left(V_{OH} - V_{TN} - \dfrac{V_{OL}}{2}\right)V_{OL}$ | $K_n = \left(\dfrac{3}{1}\right)\left(25\dfrac{\mu A}{V^2}\right) = 75\dfrac{\mu A}{V^2}$

$5 - V_{OL} = \left(2x10^5\right)\left(75\dfrac{\mu A}{V^2}\right)\left(5 - 1 - \dfrac{V_{OL}}{2}\right)V_{OL} \rightarrow 7.5V_{OL}^2 - 61V_{OL} + 5 = 0$

$V_{OL} = 0.0828$ V | Checking: $I_{DS} = \dfrac{5 - 0.0828}{200k\Omega} = 24.6\ \mu A$ and

$I_{DS} = 75\dfrac{\mu A}{V^2}\left(5 - 1 - \dfrac{0.0828}{2}\right)0.0828 = 24.6\ \mu A$ | $P = 5V(24.6\ \mu A) = 123\ \mu W$

4.) Jaeger 6.51

For $\gamma = 0$, $V_{OH} = V_{DD} - V_{TN} = 3.3 - 1 = 2.3V$ | For V_{OL}: $I_{DSL} = I_{DSS}$

$\dfrac{K_n'}{2}\dfrac{1}{2}(3.3 - V_{OL} - 1)^2 = K_n'\left(\dfrac{4}{1}\right)\left(2.3 - 1 - \dfrac{V_{OL}}{2}\right)V_{OL} \rightarrow 9V_{OL}^2 - 25V_{OL} + 5.29 = 0$

$V_{OL} = 0.2264V$ | $I_{DD} = \dfrac{25x10^{-6}}{2}\dfrac{1}{2}(3.3 - 0.2264 - 1)^2 = 26.87\mu A$

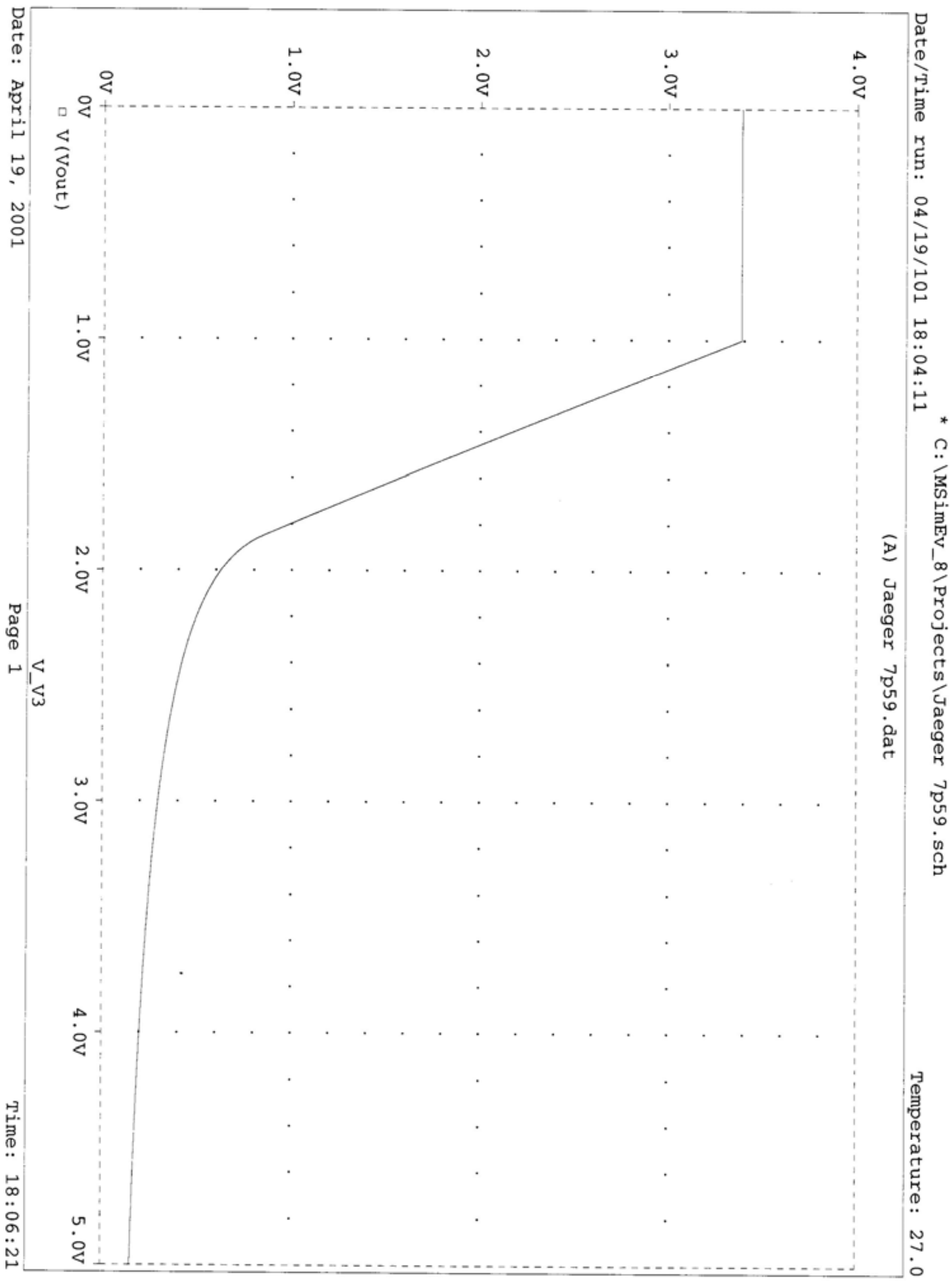
$P = (3.3V)(26.87\mu A) = 88.68\ \mu W$

Checking: $I_{DD} = 25x10^{-6}\left(\dfrac{4}{1}\right)\left(2.3 - 1 - \dfrac{0.2264}{2}\right)0.2264 = 26.87\mu A$

Extra problems not assigned: Edition 1 Jaeger 7.59 or edition 2 6.132. No comparable version in edition 3.

See the following pages are PSPICE output for a saturated enhancement load inverter. Be aware of the timing terms described below. The graphical analysis using the cursor function in PSPICE results in:

t_f=3.7 nS, t_r=152 nS, t_{PHL}=1.9 nS, t_{PHL}=16 nS and thus, t_p=0.5(t_{PHL} + t_{PHL})=9 nS



* C:\MSimEv_8\Projects\Jaeger 7p59.sch

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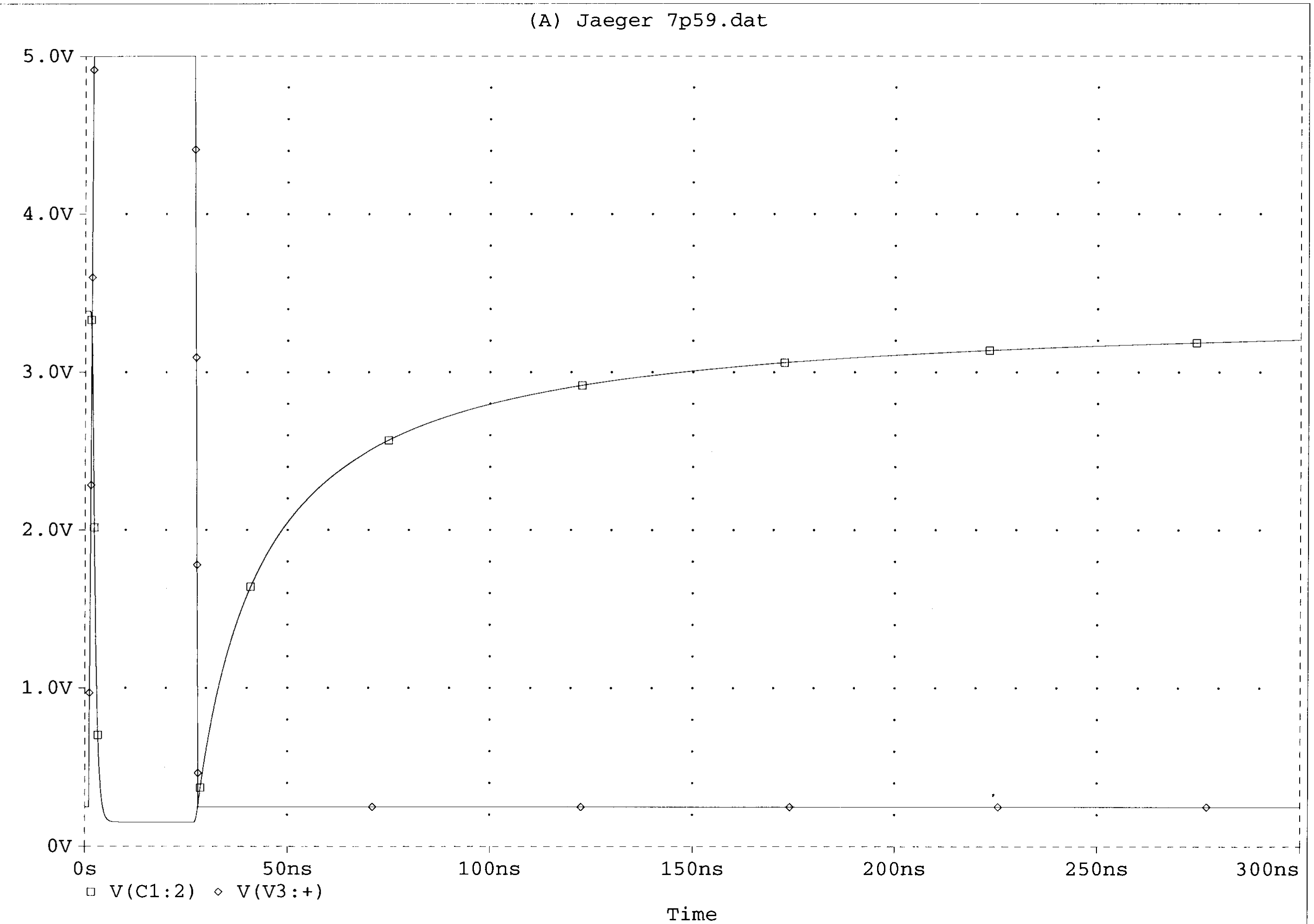
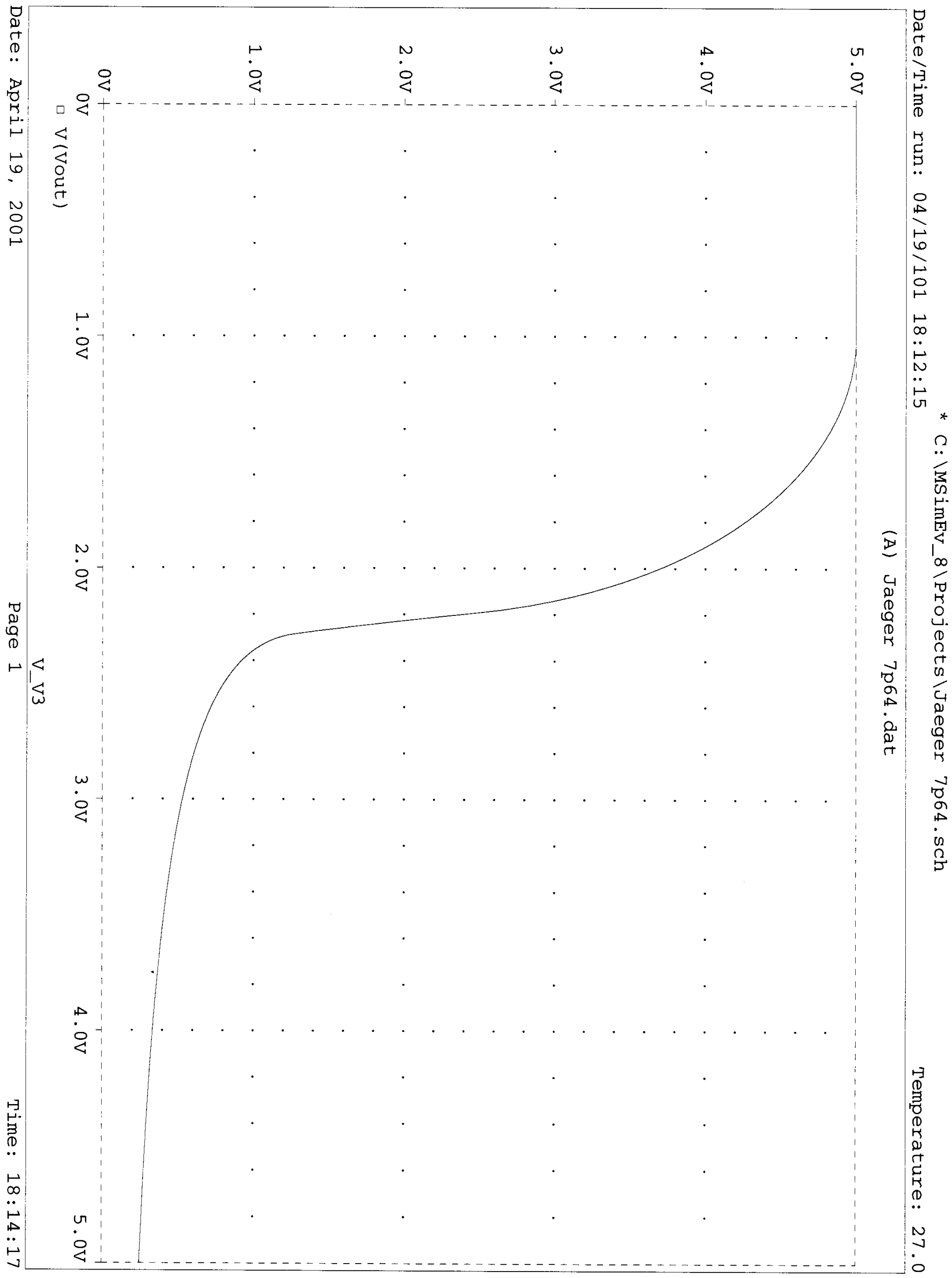


Additional problem not assigned: Edition 1 Jaeger 7.64, Edition 2 Jaeger 6.139, no comparable problem in edition 3.

See the following pages are PSPICE output for a depletion load inverter. Be aware of the timing terms described below. The graphical analysis using the cursor function in PSPICE results in:

t_f=3.3 nS, t_r=26 nS, t_{PHL}=1.4 nS, t_{PHL}=11 nS and thus, t_p=0.5(t_{PHL} + t_{PHL})=6.2 nS



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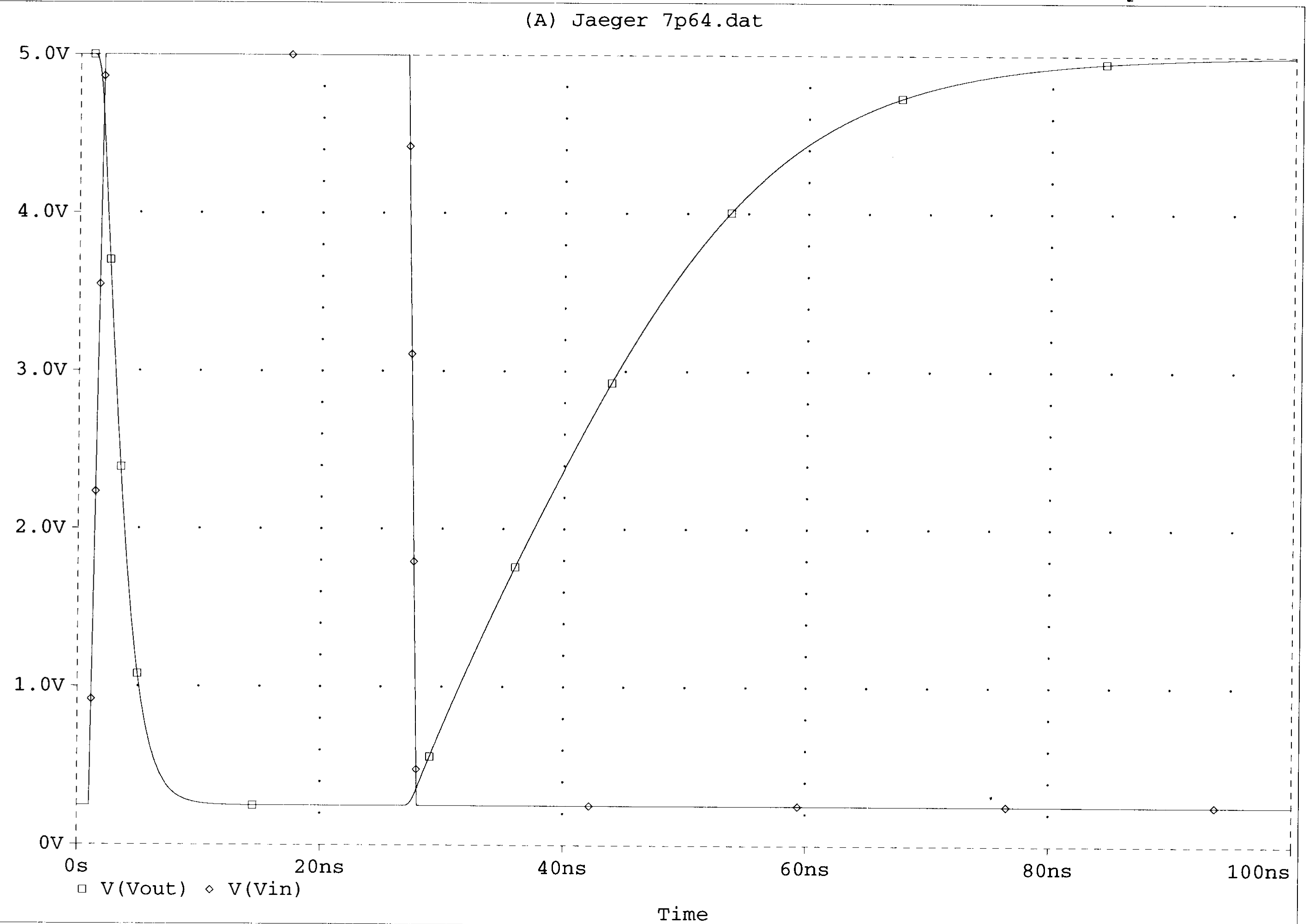

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