

File: e:/courses/spring2007/303/mcdinvertdischrg.doc

file: e:/courses/spring2007/303/invrtdischrg.mcd RWN 03/11/07

Mathcad program to calculate the discharging of a C loaded inverter when switching state

$$KP := 2 \cdot 10^{-4} \quad w := 10 \cdot 10^{-6} \quad L := W \quad VDD := 5 \quad VSS := -VDD$$

$$VTO := 1.5 \quad C := 2 \cdot 10^{-9}$$

$$ID := \left(\frac{KP}{2} \right) \cdot (VDD - VSS - VTO) \quad ID = 8.5 \cdot 10^{-4}$$

$$Ts := C \cdot \frac{VTO}{ID} \quad Ts = 3.529 \cdot 10^{-6}$$

$$vo1(t) := VDD - \left(\frac{ID}{C} \right) \cdot t \quad Vs := vo1(Ts) - VSS \quad Vs = 8.5 \quad vo1(Ts) = 3.5$$

normalize time through K and set the constant a so that $dx/dt = x(x-a)$

$$K := \left(\frac{KP}{2} \right) \cdot \left(\frac{W}{L} \right) \cdot \frac{1}{C} \quad K = 5 \cdot 10^4 \quad vo(t)$$

$$a := 2 \cdot (VDD - VSS - VTO) \quad a = 17$$

$$vo2(t) := VSS + a \cdot \left[\frac{1}{1 - \left[1 - \left(\frac{a}{Vs} \right) \right] \cdot \exp(a \cdot K \cdot (t - Ts))} \right] \quad vo2(Ts) = 3.5$$

$$vo2(5 \cdot Ts) = -5$$

$$vo(t) := vo1(t) \cdot \Phi(Ts - t) + vo2(t) \cdot \Phi(t - Ts)$$

$$tmin := 0 \quad tinc := \frac{Ts}{100} \quad tmax := 3 \cdot Ts$$

$$t := tmin, tmin + tinc .. tmax$$

