EE365 Solution to HW#1 2007

Sunday, September 16, 2007
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Chapter 3

24. (a) $P = \left(\frac{I_{CCH} + I_{CCL}}{2}\right) V_{CC} = \left(\frac{1.6mA + 4.4mA}{2}\right) \cdot (5.5)$
$= 16.5 \text{ mV}$

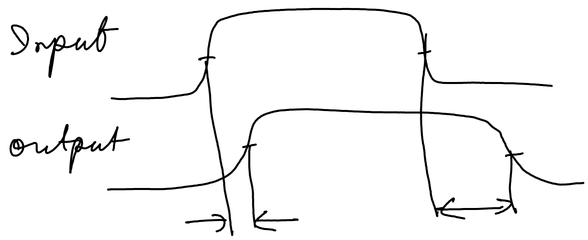
(b) $V_{OH\,min} = 2.7V$

(c) $t_{PLH} = t_{PHL} = 15ns$

(d) $V_{OL} = 0.4V$ ($@\ I_{OL} = 4.0mA$)
$= 0.5V$ ($@\ I_{OL} = 8.0mA$)

(e) $t_{PLH} = t_{PHL} = 110ns$ ($V_{CC} = 2V$ & $T = 125°C$)
$= 55ns$ ($V_{CC} = 3V$ & $T = 125°C$)
$= 22ns$ ($V_{CC} = 4.5V$ & $T = 125°C$)

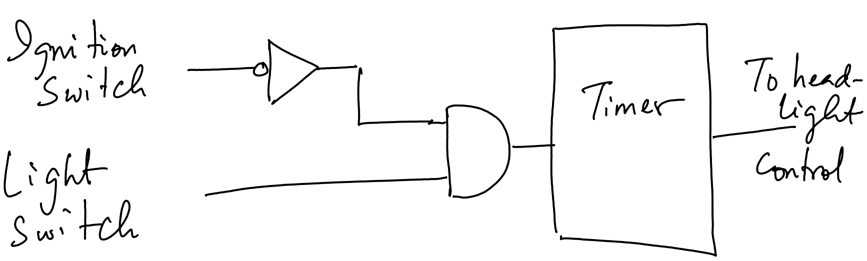
25.



$t_{PLH} = 4.3ns$ $t_{PHL} = 10.5$ ns

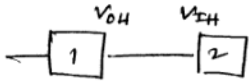
26. Gate A can be operated at a higher frequency because it has a shorter propagation delay than that of gate B.

49.



Timer produces a Low output 15 Secs after the and gate output goes HIGH output goes HIGH

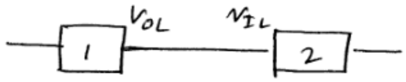
Chapter 14



1. NM_H = Noise margin$_H$ = $V_{OH(min)_1} - V_{IH(min)_2}$
$= 2.2 - 2.5 = -0.3 < 0$

No, they are not compatible.

2.



NM_L = Noise Margin$_L$ = $V_{IL(max)_2} - V_{OL(max)_1}$
$= 0.75 - 0.45 = 0.3V > 0$

Yes, they are compatible

4.

$NM_H = V_{OH(min)_1} - V_{IH(min)_2} = 2.4 - 2.25 = 0.15V$

$NM_L = V_{IL(max)_2} - V_{OL(max)_1} = 0.65 - 0.4 = 0.25V$

Maximum amplitudes of noise spikes equal the noise margins of 0.15 & 0.25 for high & low, respectively.

6.

$P_D(low) = (5V)(2mA) = 10mW$

$P_D(high) = (5V)(3.5mA) = 17.5mW$

$P_D(avg) = (10 + 17.5)/2 = 13.75\ mW$

9. Gate A Average prop delay $= \frac{1ns + 1.2ns}{2} = 1.1ns$

Speed-power product $= (1.1ns)(15mW) = 16.5pJ$

Gate B
Average prop delay = $\frac{5+4}{2} = 4.5\text{ns}$

Speed-power product = $(4.5\text{ns})(8\text{mW}) = 36\text{pJ}$

Gate C
Average prop delay = $\frac{10\text{ns}+10\text{ns}}{2} = 10\text{ns}$

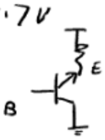
Speed-power product = $(10\text{ns})(0.5\text{mW}) = 5\text{pJ}$.

11. G2 is overloaded because it has 12 loads

16. (a) ON: high voltage on base forward-biases the base-emitter junction

(b) OFF: insufficient voltage. Need 0.6–0.7V

(c) OFF: Base voltage lower than emitter



(d) OFF: Base & emitter at same voltage

20. (a) The driving gate output is high, it is sourcing 3 unit Loads.

$I_T = 3(40\mu A) = 120\mu A$ (See Table on Page 842)

↑ I_{IH} of Load devices

$120\mu A < |-0.4\text{mA}|$ OK

I_{OH} for driver.

(b) The driving gate output is Low, it is sinking currents from 2 Loads.

$I_T = 2(-1.6\text{mA}) = -3.2\text{mA}$

Note $|-3.2\text{mA}| < 16\text{mA}$

I_{OL} max for the

driver. OK

(c) G1 output is high, it is sourcing 6 Loads.

$I_T = 6\,(40\mu A) = 240\mu A < |-0.4 mA|$

OK

G2 output is low, it is sinking currents from 2 Loads

$I_T = 2(-1.6 mA) = -3.2 mA$ OK

G3 output is high & it is Sourcing 2 Loads

$I_T = 2\,(40\mu A) = 80\mu A$ OK

22. (a) $X = A \cdot B \cdot \bar{C} \cdot \bar{D}$

(b) $X = \overline{(A \cdot B \cdot C)} \cdot \overline{(D \cdot E)} \cdot \overline{(F \cdot G)}$

(c) $X = \overline{(A+B)} \cdot \overline{(C+D)} \cdot \overline{(E+F)} \cdot \overline{(G+H)}$

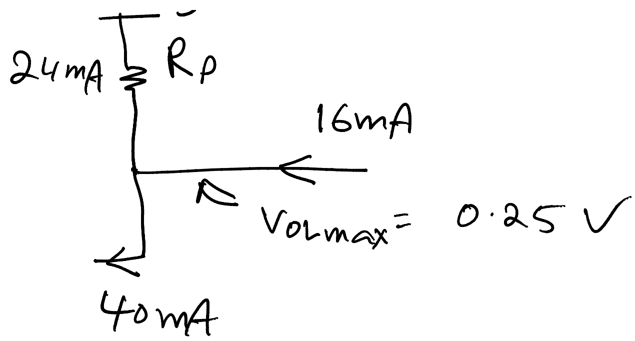
23. The worst case for determining the minimum value of R_p is when only one gate is sinking all the current (40mA maximum)

For 10 unit Load: $I_L = 10 \times |-1.6 mA| = 16 mA$

Current through R_p (for (a), (b) & (c))

$= 40 mA - 16 mA = 24 mA$

5V



$$\therefore R_p = \frac{5 - 0.25}{24\,mA} \approx 198\,\Omega \text{ (ohm)}$$