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6. Lab Report [10 Pts]

(Deadline: Tuesday of next week 2:00pm) (Individual submission)

1. [1.5 Pts] Record the values obtained in Experiment question 1 in Table 1 below.

Table 1

Propagation delay (t_{P_LH})	99.27ns
Propagation delay (t_{P_HL})	41.05ns
Average propagation delay t_p	70.16ns
Propagation delay (t_{P_LH}) per gate	29.11ns
Propagation delay (t_{P_HL}) per gate	20.09ns
Average t_p per gate (measured)	24.6ns
Average t_p per gate (from datasheet)	24.5ns

Is the recorded t_p value per gate same as in the datasheet? If not then how can you explain this difference?

The recorded T_p value per gate from the experiment results is nearly identical to the average value from the datasheet. Had there been a difference, it is possible that factors such as room temperature and sensor precision could have an impact on the propagation delay measurement values.

2. [1.5 Pts] Record the values obtained in Experiment question 2 in Table 2 below.

Table 2

V_{OH} (from datasheet)	3.98V
V_{OL} (from datasheet)	0.33V
V_{IH_min}	3.006V
V_{IL_max}	2.505V

Are the recorded values same as in the datasheet? If not then how can you explain this difference?

The discrepancy in the recorded values could be due to the imprecision of the potentiometer used for voltage variability. The knob was too sensitive for human precision, and it was difficult to pinpoint the exact location of where the voltage spike occurred to record the values.

3. [2 Pts] Why should V_{IL_max} be greater than V_{OL_max}? And similarly why should V_{OH_min} be greater than V_{IH_min}?

This is due to noise margins, which are important in digital circuits as they establish specific voltage thresholds for HIGH and LOW signals. This ensures accurate signal interpretations, even in complex circuits with numerous components and voltage fluctuations, maintaining reliable communication and preventing signal integrity issues.

4. [2.5 Pts] Research question: Describe briefly in 1-2 sentences the following physical characteristics of a logic gate. Also mention the problems that may arise if their values surpass their thresholds.
   a. Fan-out
   b. Current levels I_{OL} , I_{OH} , I_{IL} , I_{IH}

   a. Fan-out is how many inputs a logic gate can connect to its output without causing problems. Too many inputs, and the signal might get weaker and slow down.

   b. Current levels represent the maximum or minimum output and input currents a logic gate can handle If these current levels surpass their thresholds, it can lead to various issues like increased power consumption, voltage levels falling out of spec, and potential damage to the gate or connected components.

5. [2.5 Pts] Extract for the AND IC datasheet attached on BB the typical values for the following physical characteristics. Mention any conditions required to replicate these values in lab.
   a. Fan-out
   b. Current levels I_{OL} , I_{OH} , I_{IL} , I_{IH}

Fan-out:

Supports a fan-out of up to 10 LSTTL loads.

Current Levels:

Absolute maxim values for IOH/IOL($V_0 = 0\ to\ vcc$): ranges from -25 mA to 25 mA.

Otherwise, the values are:

ST CONDITIONS	V_{CC}
I_{OH} = -20 µA	2 V
	4.5 V
	6 V
I_{OH} = -4 mA	4.5 V
I_{OH} = -5.2 mA	6 V
I_{OL} = 20 µA	2 V
	4.5 V
I_{OL} = 20 µA	6 V
I_{OL} = 4 mA	4.5 V
I_{OL} = 5.2 mA	6 V

The following was extracted from the datasheet regarding input current

I_I	Input leakage current	$V_I = V_{CC}$ or 0	6 V	±0.1	±1	µA

To replicate these values in a lab, the operating conditions should be within the specified range. The supply voltage should be between 2-6V, and the operating temperature should be within the range -40°C to +85°C. Over operating free-air temperature range; typical values measured at TA = 25°C.