

Winter 2014 TCES 230 – Lab 4

Lab Equipment and Physical Circuits

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1 Objectives

The objectives of this lab were to gain experience with laboratory test equipment and in using IC chips (referencing datasheets and testing). Other objectives were the constructing a simple digital circuit and to compare the operation of the constructed circuit to an equivalent LogicWorks simulation.

2 Procedure

A square wave generated by the signal generator was observed using an oscilloscope. A counter was wired on a breadboard using a 7493 package as done on LogicWorks 5 in previous labs. A circuit was added to detect the value seven (111). The outputs out the 7493 were each input into a NAND gate. An inverter was added at the NAND gates output.

3 Observations

The oscilloscope measurements of the outputs of the 7493 were consistent with predicted behavior. The pins Q_A , Q_B and Q_C each output a square wave with a frequency half that of the previous. The output of the NAND gate (shown in Figure 1) was logic high unless each input was a logic high. This output was opposite of that desired. The inverter inverted this signal creating an effective AND gate. Thus only an input value of seven output a logic high.

4 Analysis

Signals observed on the oscilloscope generally behaved as expected and as observed in previous LogicWorks simulations. Every signal observed, however, was imperfect; noise was present in each wave form that deviated from an exact square wave. Also, distortion occurred as observed in previous labs. Propagation lag was present and presented as brief, inaccurate drops from high to low or spike from low to high.

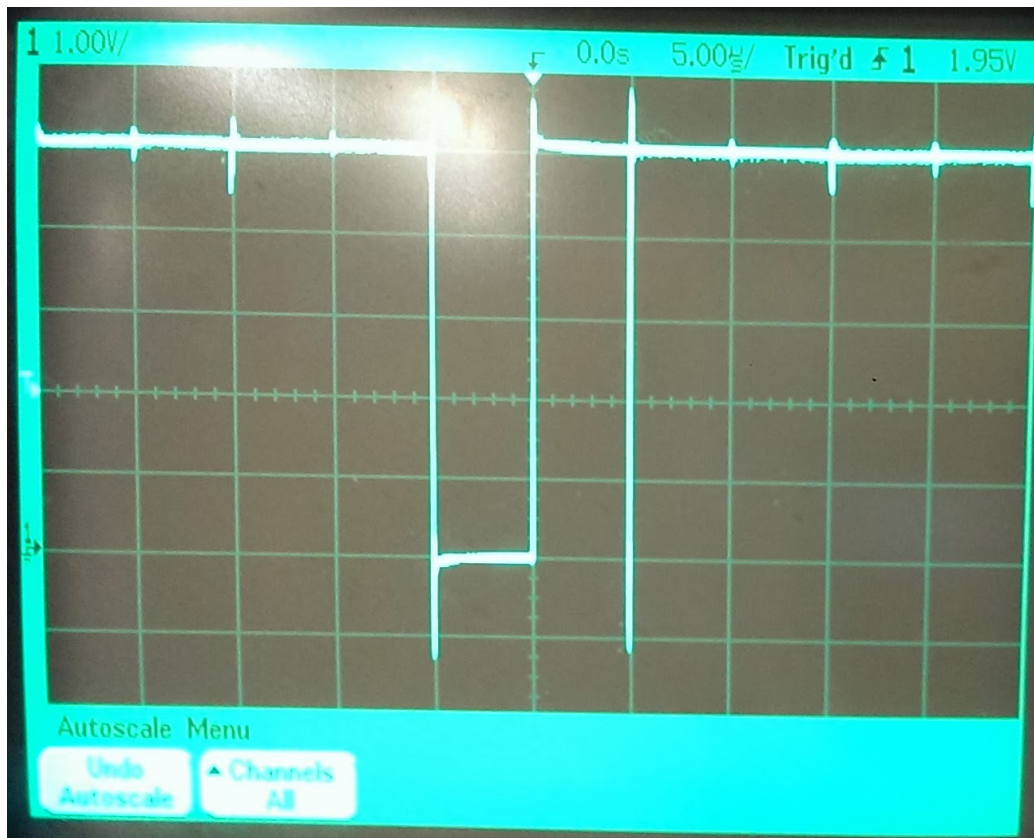


Figure 1: NAND gate output

5 Conclusion

The experiments conducted during this lab highlighted the strength and weaknesses of the simulations conducted in LogicWorks. Generally, the behavior of all the components used in these experiments closely followed that of those in simulations. Propagation lag was present as demonstrated in previous labs. Small differences were, however, present. Signal noise was not represented in LogicWorks, but was present, though small, in these circuits. Though at the relatively high voltage of 5V this did not interfere with high/low readings, it is possible that distortion could become problematic at lower voltages or in more complex circuits.