Bilkent University
EE102-02 Lab 3 Report:
Combinational Logic Circuit

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Purpose:

The purpose of this lab was to design a combinational circuit on a breadboard using real-life gates. It was also the lesson of this lab to understand the datasheets of the components and use this information in the circuit setup.

Methodology:

Instead of the circuit designed in the second lab, a new circuit consisting of only NAND and NOR gates was designed because the XOR gate used in the design in the second lab was not among the components supplied.

Design Specifications:

In circuit design, 74HC163 4-bit counter was used as input instead of switches. The counter's outputs were connected to four green LEDs. These outputs also were connected to the logic circuit as inputs. The logic circuit is designed with a 74HC02 2-input NOR gate that combines the outputs of two 74HC00 2-input NAND gates. The output of the circuit was connected to one red LED.

Results:

According to the datasheet, the 74HC163 4-bit counter was conveniently placed on the breadboard, and connections were made. After connecting the power supply (5V) and signal generator (2.5kHz square wave) appropriately, it has been verified that it works properly with an oscilloscope and four green LEDs. After adding the logic circuit to the breadboard, appropriate connections were made according to the Pinouts (Figure 1) of these components with the help of datasheets. The Schematic (Figure 2) and the actual breadboard (Figure 3) design were completed. Outputs were stimulated with a red LED. Also, the output waveform was displayed on an oscilloscope. The waveform was generated in the oscilloscope (Figure 4), the truth table (Figure 5) was created for the logic circuit, and the outputs seen with the red LED (Figure 6) were all the same, so the circuit was verified.

Conclusion:

The aim of this lab was a general introduction to designing combinational circuits on a breadboard and using a datasheet for information about components. Learned to integrate the components into the circuit by their Pinouts. The goal was to get a waveform suitable for the values in the truth table created for the logic circuit. The waveform was generated with a 4-bit counter, NAND, and NOR gates. No error was observed except for the delays caused by the inner resistances of these components and cables. In addition to designing virtual circuits with VHDL learned from the previous lab, this lab focused on real-life circuit design. Thus becoming more familiar with combinational circuit design.

Appendix:

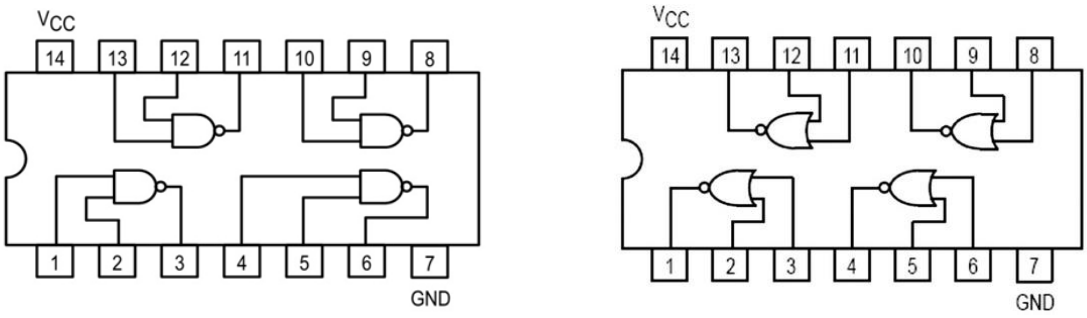

Figure 1: The pinouts for the NAND and NOR gates in order.

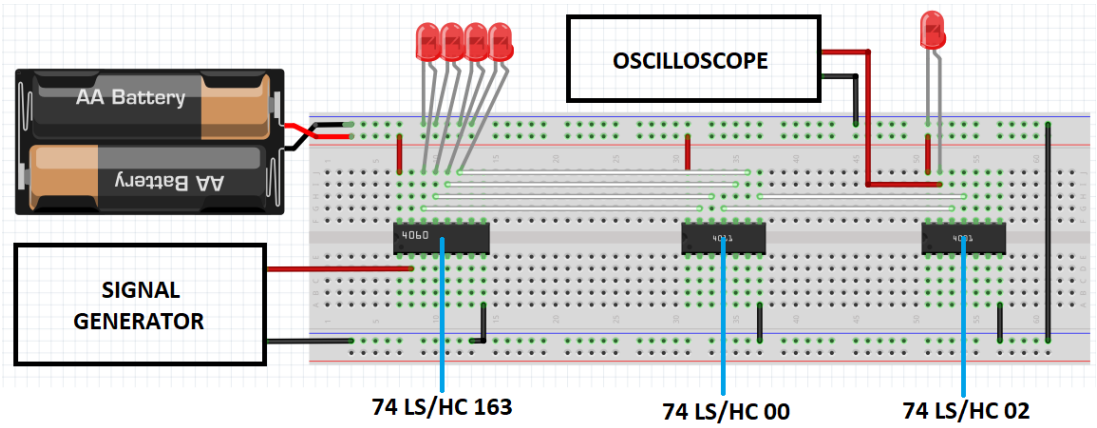

Figure 2: The schematics of the breadboard design

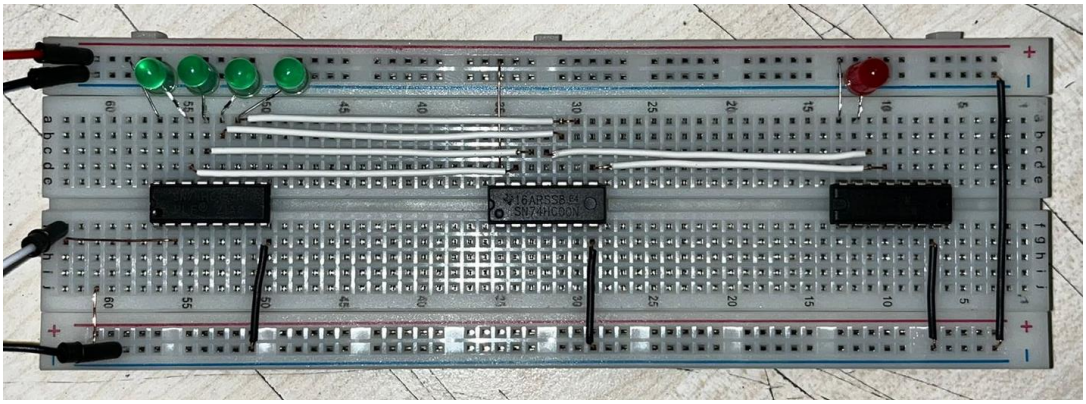

Figure 3: The actual breadboard design.

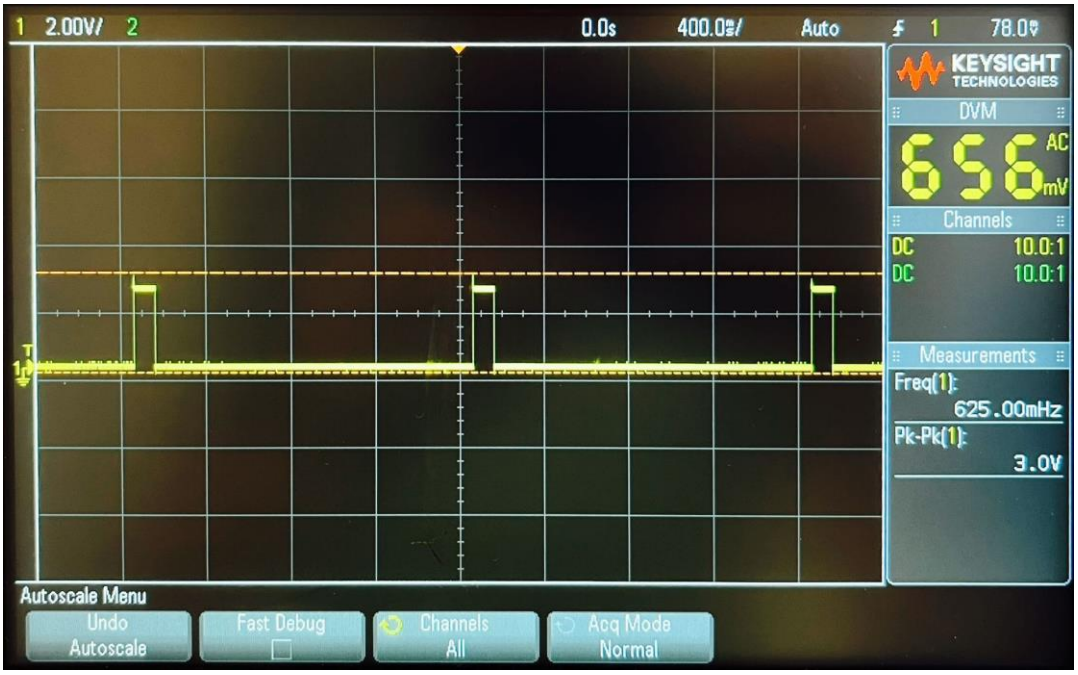

Figure 4: The waveform.

Q0	Q1	Q2	Q3	OUTPUT
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

Figure 5: The truth table of the logic circuit.

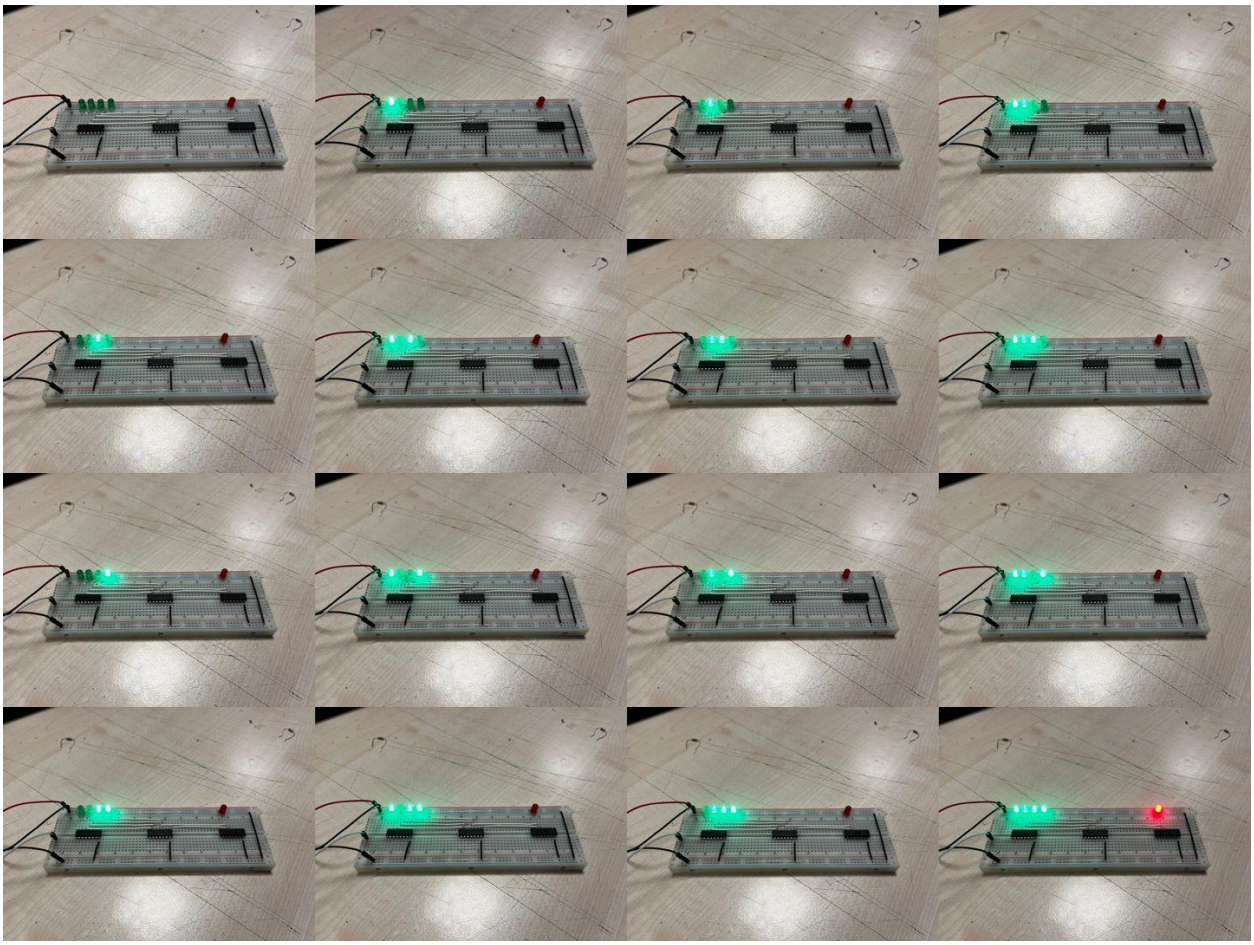

Figure 6: The LEDs outputs.