

Lab 3: Combinational Logic Circuit

In this lab, you will set up a combinational logic circuit, this time on the breadboard (no FPGA involved).

You can use your design from the previous lab or make a new design. It is recommended that you use at most two types of logic gates so that you can fit them on a breadboard easily and not have lots of trouble building it.

Instead of switches, your circuit will take inputs from a 4-bit counter and show the outputs on LEDs. You will be simulating a truth table by using a counter. LEDs, counters, and common logic gates are provided in the lab.

- 1) Study the datasheet for **74HC163 counter**. Get one from the lab and set it up on your breadboard. Make sure that it works properly (using an oscilloscope). Then, decide on the logic gates that you need to use. Examine the document **LogicGates.pdf**, get the necessary equipment from the lab. Check their code to see if they are the gates you wanted. You can use other components that are not in the list if that is what you find in the lab. Find the datasheets for the gates you have obtained, study them, and set up the gates properly. Display the **output waveform(s)** on an oscilloscope (and include it in your report). Is this the same as the output column(s) of your truth table? Finally, study the **LEDcircuit.jpg**, and display the output(s) on a **LED**. Get your TA's approval and include photos of the working circuit in your report.

Notes:

- Study the datasheet of each component you use before starting to set them up. Otherwise it is impossible to get them working. Make sure you do the vcc/clock/gnd connections properly. You should use the counter in **count mode** (see page 4 of datasheet). Build your circuit step by step and check that everything is working at each step. When you have a problem, troubleshoot using an oscilloscope.
- Do not use more than necessary components unless yours is broken etc. **Return the components at the end of the lab.**
- Using LEDs without any resistors might break your components or LEDs themselves. If 1K makes them too dim, you can use a lower resistance.