# Ohm's Law, Transistors, Elementary Logic Gates

***by Yousef Jarrar and Nicholas Chiodini***

1. **Resistor: Ohm's Law:**

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| --- | --- | --- |
| Data Measurements:  Resistor 1 alone: 100 $\Omega$  Resistor 2 alone: 500 $\Omega$  Resistors in series: 600 $\Omega$  Resistors in parallel: 83.333 $\Omega$ |  | Verify by Calculation:  Resistors in series: 600 $\Omega$  Resistors in parallel: 83.2 $\Omega$  Predict by Calculation:  Current through resistor 1: .05 mA  Current through resistor 2: .01 mA  Current through resistors in series: 8.3 mA  Current through resistors in parallel: 60 mA            $ma$ |

Use the multi-meter to measure the actual current for these four cases. Multi-meter must be in series with the circuit to measure current.

Data measurements:

Current through resistor 1: 0.0531

Current through resistor 2: 0.01333

Current through resistors in series: 8.34

Current through resistors in parallel: 60.01

1. **Diode**

Measure the resistance of a diode both ways. The resistance should be very small one way and very large the other. What would an ideal diode show? It should show 0 ohm one way and largest possible resistance that multi-meter can show the other. Measure voltage across the diode in series with one resistor and in series with both resistors. Notice that voltage drop is approximately constant independent of current. Ohm's law applies to linear devices. Diodes and transistors are non-linear devices, described by no simple law, but by `characteristic curves'.

Data measurements:

Diode one way: .603 $\Omega$

Diode reversed: 0 $\Omega$

Voltage across diode with one resistor: .5V

Voltage across diode with two resistors in series: 0.66V            $V$

* 1. Which end must be connected to the ground?

The end that must be connected to the ground should be the diode. This is because current flows out through the black end of the diode. It is much easier to understand this through the diagrams that have been provided to us.

* 1. What would happen if you use a resistor with a much larger resistance?

When you use a resistor with a higher resistance, this will in fact slow the current that flows. When the resister reaches close to infinity, the number then gets closer to 0. Although increasing the resistor will then in turn not result in anything.

**Discussion:**

In this portion of the lab, we did have an issue being able to setup the diode correctly. When we initially setup the diodes and measured them and nothing was being returned on the multi-meter. We then realized that we had been using the piece of equipment was actually the incorrect format. Overall, after discussing with other classmates about their methodology we were able to confirm that it was working. We also confirmed with Chris about this issue.

1. **Verilog Programming**

***Hello.v***

**module hello\_world;**

**//Inputs**

**reg [15:0] a;**

**reg [15:0] b;**

**//Output**

**wire [15:0] s;**

**Sum sumTest ( .a ( a ), .b ( b ), .s ( s ) );**

**initial begin**

**a = 89;**

**b=64;**

**$display ( "CSUSB CSE 310 is FUN!\n" );**

**$monitor ( " The sum of %d and %d is %d ", a, b, s );**

**#80 $finish;**

**end**

**endmodule**

**end**

***sum.v***

**module Sum ( input [15:0] a, input [15:0] b, output [15:0] s );**

**assign s = a + b;**

**initial begin**

**#20 $finish;**

**end**

**endmodule**

1. **Report**

This lab was exceptionally challenging for me and my partner. Initially we had an issue being able to understand how the breadboard actually works, and we had an issue being able to connect all the wires together. The most challenging part was being able to create the AND and OR gates. The graphs, we had the easiest portion with it. When we try and build it, I get the issue of making it work with the 1’s and 0’s