Basics: Introduction to Circuits

The TI Launchpad has numerous capabilities. Let’s start with the most basic usage and simply use its electrical power to make circuits.

Setup and Preparation

Item List
- TI LaunchPad MSP430G2
- Breadboard
- M/F Jumper Wires (2)
- M/M Jumper Wires (2)
- 3-5 Resistors (Any value)
- An LED
- Banana-to-Breadboard cables (2)

Preparing the breadboard
1. Connect the TI Launchpad to the computer with the USB cable.
   a. An LED on the LaunchPad should illuminate to signal that it is powered.
2. Using the 2 male-to-female jumper wires, connect the positive (VCC) and negative (GND) pins on the LaunchPad to the positive (red) and negative (blue) rails on the breadboard. (Figure 1)
   
   **NOTE!** - There are multiple VCC and GND pins on the LaunchPad; use the correct ones.

Figure 1: Powering the breadboard with the TI LaunchPad
Preparing the Multi-Meter

Above your desk, you have a digital multi-meter which can be used to measure useful quantities in circuits, like voltage. Plug in your banana-to-breadboard cables into the top right sockets shown in Figure 2. The location of the voltmeter and ohmmeter settings is also shown.

![Agilent 34401A Digital Multi-meter](image)

**Figure 2: Agilent 34401A Digital Multi-meter**

Tips on Breadboarding

The breadboard has a pattern of metallic rails underneath the sockets, which electrically connect wires inserted into the breadboard. Only certain sockets are connected (Figure 3). Notice that the **power rails** run all the way down the breadboard, contrary to the **terminal strips** in the middle.

*Your power rails may not extend the full length of breadboard. Examine the red/blue lines to be sure.*

![Hidden Connections of the Breadboard](image)

**Figure 3: Hidden Connections of the Breadboard**

Measuring Voltage Tutorial

If you haven’t used a voltmeter before, open the tutorial *Measuring Voltage with a Voltmeter* on the lab website. You may find this tutorial helpful as you progress through this lab material.
Circuit 1: LED

Create and test the following circuit (Figure 4) with a small value (around 100 Ω) of R1.

![LED Circuit Diagram](image)

**Figure 4: An LED circuit**

**Things to Consider**

- Note that the wires coming out of the LED have different lengths. This is deliberate.
- Try using the multi-meter to measure the voltage drop across the LED. Then across the resistor.
  - Compare to the voltage drop across all the components (from VCC to GND).
- You can determine the current flowing through the circuit using Ohm's Law.
- An article about voltage, current, resistance, and Ohm's law can be found at the following link:
Circuit 2: Two Resistors

Create and test this circuit (Figure 5) with different values for R1 and R2.

Figure 5: Two resistors in series

Things to Consider

- The colors on the resistors represent the value of the resistance.
- When a resistor is not in the circuit, you can measure its value of *resistance* by connecting the ohmmeter leads to both ends of the resistor. (The breadboard could help with this).
- Once the circuit is assembled, the *voltage drop across a resistor* can be found by connecting the voltmeter leads to both ends of the resistor.
- You can determine the current through each resistor by using *Ohm’s Law*. 
Circuit 3: Three Resistors

Create and test this circuit (Figure 6) with different values for R1, R2, and R3.

Figure 6: Three resistors in series

Things to Consider

- Consider the voltage drop across each resistor, and compare it with the voltage drop across all the resistors at once (the rail voltage).
- You can calculate the currents through each resistor using Ohm’s Law, and then compare the currents.
Circuit 4: Button

Create and test this circuit (Figure 7) using a large value for R1.

Figure 7: Button with Pull-down Resistor

Things to consider

- You can use a multi-meter to observe the voltage at different points when the button is used.
- You can determine how the 4 pins of the pushbutton are connected with a continuity test.
Review

After this lab, you should have a good understanding of the following topics. If you’re not sure about some of them, go back through the lab and try to find a good place to explore the topic.

You should be able to do the following

• Power the rails of a breadboard, and design circuits between the rails
• Read and measure the resistance of a resistor with an ohmmeter
• Measure the voltage drop across two points in a circuit with a voltmeter
• Determine the current flowing through a circuit with resistors using Ohm’s Law
• Design a circuit, such that a desired voltage appears at some point in the circuit
  o Example: Using only resistors, design a circuit such that 2.5 V appears on the voltmeter when measuring the voltage from GND to some point (several designs could work)
• Light up an LED in a circuit

Application

Try applying the skills you learned from this lab. You can come up with your own project idea or try one from the flowchart.