

ME 351 - Introduction to Measurement Systems

Lab 1 Report

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1 LAB SIGN-OFFS (10 POINTS)

Lab 1 Sign-offs Page

You do not need to write anything on this page, but it is a good reference for the sign-offs you should have completed during the lab. Before you demonstrate or email your sign-off, please make sure your recording is **school-appropriate**.

If you choose to submit your sign-off via email, you will automatically receive a confirmation that the file has been uploaded. **If you do not receive confirmation, try again, and then contact the teaching team if it fails.**

Please note that with a large online class, it is extremely important to **format and name files as noted below**. If there are errors in formatting, file-naming, or file submission we will apply **large formatting deductions**. We do this to ensure we can spend most of our time teaching you, rather than searching for your responses/files/etc.

Sign-offs for Lab 1:

1. _____ Demonstrating your custom blink program.
 - Show your system to a teacher, or:
 - Submit a video of your system with the following requirements:
 - An .avi, .mp4, .mov, or .mkv file
 - Smaller than 25 MB and shorter than 30 seconds
 - Titled "Firstname_Lastname-L1_S1", using your name
 - Email your video to Lab_1_S.zc23in85jwsgr37d@u.box.com
2. _____ Demonstrating your off button.
 - Show your system to a teacher, or:
 - Submit a video of your system with the follow requirements:
 - An .avi, .mp4, .mov, or .mkv file
 - Smaller than 25 MB and shorter than 30 seconds
 - Titled "Firstname_Lastname-L1_S2", using your name
 - Email your video to Lab_1_S.zc23in85jwsgr37d@u.box.com

2 DISCUSSION QUESTIONS (15 POINTS)

DQ1: Take a look at the Arduino Uno. Which two pins would be “shorted” (short-circuited) if you connected them together directly? There are multiple correct answers, so please include just two pins.

The 5V pin and the neighboring GND pin would brick my board if I connected them directly.

DQ2: Based on the [Blink example](#) documentation, what range of resistor values are acceptable for lighting an LED with the 5V power source we use in this lab? Which resistor do they suggest you use in the Blink example?

They suggest using a 220 ohm resistor on the website. The LED will also light up with resistors in series up to 1000 ohm.

DQ3: The resistors in your kit have labels on the yellow paper that holds them together to indicate their resistor value. However, in the wild you may need to identify resistors through their color bands, so knowing where to learn to do that will be helpful. Find an online link to a resistor color chart or calculator.

Link to an online resistor calculator: [Digikey.com](https://www.digikey.com)

DQ4: In the code for the Blink example, what function is called within the loop is used to turn on the built-in LED? What are the two arguments the function takes, and what do they represent? There are two possible values for the second argument; what are they, and what voltages do they lead to for the Arduino Uno?

The function ‘digitalwrite(arg1, arg2)’ is called to turn on the built in LED. The two arguments are arg1 = which led the code should initialise to, and arg2 = if the voltage should be high or low. As in should the LED light up or not. Because we configured the board with the function pinMode, the HIGH voltage is 5V and the LOW voltage is 0. Without configuring to pinMode, HIGH would be 3.3 V.

DQ5: In the original Button example circuit, when the pushbutton is pressed, what will we read at the pin: [HIGH](#) or [LOW](#)? You can determine this by seeing what the resistor is connected to in your circuit (ground or power), or by looking at the logic in the code. Briefly explain your reasoning.

In the original example, we would read HIGH at the pin when the push-button is pressed. This is because it was a 10k ohm pull-down resistor connected to ground, causing the pin to read LOW when the switch is open, and HIGH when closed.

3 POST-LAB QUESTIONS (15 POINTS)

PLQ1: Grounding

a) What does ground on the Arduino represent in terms of voltage?

Ground represents 0 Volts.

b) In electronics, what is a common ground? When and why is it necessary?

Having a ground is necessary in a circuit, because it's our reference point to measure other voltages. In terms of common ground, this is seen in battery powered circuits where our ground is the negative terminal of the battery. It creates a reference point of 0 V to the positive terminal.

c) Is the Arduino ground or the common ground the same as Earth ground? Why or why not?

Unless the board's ground is somehow connected to Earth ground: no, they are not the same. They aren't the same, because the board and usb connection (to my PC in this case) is an isolated circuit. Similar to a battery powered circuit.

PLQ2: Polarity

a) What is electronic polarity? What do we have to be careful about for polarized components?

Electronics polarity is the need for positive charge to only enter one side of the component, as in they aren't symmetric. We have to be careful to not blow out LED's for example as they can only be mounted one way. In better cases, the components might not be damaged but simply won't work.

b) What component(s) from this lab are polarized?

The LED is polarised.

PLQ3: Digital Reading and Writing

a) Which pins on the Arduino Uno can you use `digitalRead()` and `digitalWrite()` on? Please give your answer in terms of pin labels (e.g. A0, GND, 2). Hint: Analog pins can also be used as digital pins.

All of the digital pins can be used as inputs or outputs (13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1). According to the Arduino website, the Analog pins may also be used as digital pins. Those analog pins are denoted A0, A1, A2, A3, A4, and A5.

b) When you use `digitalRead()` on the Arduino Uno, above what voltage do readings end up being evaluated as **HIGH** and below what voltage are they **LOW**?
Hint: The answers are not 0 or 5V. In reality, there are a range of voltages that are mapped to these readings.

According to the Arduino website, the 5V boards will cut off LOW voltages at anything higher than 3V. The 3.3V boards, however, will read anything lower than 2V as LOW. I found another source saying that the command cuts the line at 2.5 V, as in anything lower than 2.5 V is LOW and anything up to 5V is HIGH.

4 LAB CODE (5 POINTS)

4.1 Sign-off 1: Example formatting for Arduino code, rename to fit

```
1 /*
2 4.1 in ME 351 Lab 1, Getting Started with Arduino
3 Blinking an LED on and off every 500 seconds
4 */
5
6
7 int LED = 7;
8
9 // the setup function runs once when you press reset or power the board
10 void setup() {
11     // initialize digital pin LED_BUILTIN as an output.
12     pinMode(LED, OUTPUT);
13 }
14
15 // the loop function runs over and over again forever
16 void loop() {
17     digitalWrite(LED, HIGH);    // turn the LED on (HIGH is the voltage level)
18     delay(500);                // wait for a second
19     digitalWrite(LED, LOW);     // turn the LED off by making the voltage LOW
20     delay(500);                // wait for a second
21 }
```

4.2 Sign-off 2: Example formatting for Arduino code, rename to fit

```
1 /*
2 4.2 in ME 351 Lab 1, Getting Started with Arduino
3 Setting up a logic gate such that the LED stays on when the switch is open,
   ↪ but off when you press the button.
4 Basically a pull up resistor = 10k Ohm
5 */
6 int LED = 7;
7 const int buttonPin = 2;
8 // variables will change:
9 int buttonState = 0;
10
11 // the setup function runs once when you press reset or power the board
12 void setup() {
13   // initialize the LED pin as an output:
14   pinMode(LED, OUTPUT);
15   // initialize the pushbutton pin as an input:
16   pinMode(buttonPin, INPUT);
17 }
18
19 void loop() {
20   // read the state of the pushbutton value:
21   buttonState = digitalRead(buttonPin);
22
23   // check if the pushbutton is pressed. If it is, the buttonState is HIGH:
24   if (buttonState == HIGH) {
25     // turn LED on:
26     digitalWrite(LED, HIGH);
27   } else {
28     // turn LED off:
29     digitalWrite(LED, LOW);
30   }
31 }
```