

## Mechatronics Lab 1

Name: \_\_\_\_\_

**Due date:** 09 / 11 Sep 14

### Reading:

- Arduino getting started

### Objectives:

- To gain experience programming the Arduino. All coding is to be done individually so that each student gains experience with the tools upon which all subsequent labs are based.
- To verify that software is installed and functional on students laptops
- To gain experience constructing circuits using a solderless breadboard
- To briefly introduce the wire wrap method
- To construct a functional Atmel ATmega328 (Sparkfun Arduino Pro Mini) breadboard circuit. This will be used in subsequent labs as well as homework assignments.

### Deliverables:

- Source code is to be placed into a GitHub.com repository for the instructor to review. No credit will be given without this code.
- This is a task based lab assignment similar to shipboard PQS you have completed in the past. Complete the listed Alpha and Bravo tasks and obtain signatures from the instructor. When you are complete submit the completed sheet so that instructor may enter grades into D2L.

**Grading:** This is a task based lab. Grading is based on the following equation:

$$Grade = \left[ \frac{num\ completed\ A\ tasks}{total\ num\ A\ tasks} (75) + \frac{num\ completed\ B\ tasks}{total\ num\ B\ tasks} (25) \right] * is\_code\_posted\_GitHub()$$

## Pre lab Discussion Points

This exercise assumes that you have had at least some exposure to the solderless breadboarding in the past. Still, there may be aspects that you are unfamiliar with. Consider the following points as you begin to construct the circuit. Ask your instructor for assistance if you are unfamiliar with any of the concepts.

- Layout of the breadboard's interconnects
- Resistor color code
- Orientation of the breadboard; there is an “up” and “down” side
- Pin 1 identification
- Diode direction

## Recommended Procedure:

Breadboarding an electronic circuit is an art. Like all skills, it takes time to develop. Ideally, you would construct the circuit several times striving to improve the layout with each iteration. Unfortunately, this activity would consume excessive amounts of time. To facilitate your construction efforts an instructor built board is available for you to copy.

The circuit should be constructed in stages as outlined below. Each stage should be tested before other stages are added. DO NOT attempt to construct the entire circuit before testing the individual sections.

- **Arduino Pro Mini** The Spark Fun Arduino Pro Mini has already been installed on your breadboard. As a first step you should test the device by opening the Arduino “blink” sketch and downloading the program to the Arduino. This is a good time to obtain signatures for Alpha tasks 1.1 to 1.3.
- **Power supply** The 5 VDC power supply is used for all electronics on the breadboard. Here a 7805 linear regulator is used to regulate the voltage taken from the 9 VDC battery. Construct the lower portion of the circuit as shown in the enclosed schematic. Connect the ground and 5 VDC output to the breadboard's horizontal power bus. Don't forget to connect the upper and lower rails. Use a voltmeter to verify that 5 VDC is present and that the regulator is cool to the touch.
- **Demo code** Sample code to use for this lab is available from:  
<https://github.com/macee/mechatronics.git>  
Work with your instructor to download the code, place in the appropriate directories, and flash it to the Arduino.
- **LCD** Connect the Liquid Quartz Display (LCD) module as shown on the schematic using a wirewrap method. When functioning the LCD should flash “Welcome to Mecha” every time the Arduino is reset. After the initial start up the LCD will display “V = XXXX, H = XXXX”. Where XXXX is a fluctuating number.

- **Buzzer** Install the buzzer. When complete you should hear a series of tones when the Arduino is reset.
- **Joystick** When the joystick is installed the LCD XXXX numbers will be stable and respond to the vertical and horizontal joystick commands. The LED mounted on the Arduino (pin 13) will light when the joystick is pressed.
- **Tri colored LED** The Arduino will sequence the tri-colored LED during the initial startup.
- **Serial control** Work with your instructor to control the tri-colored LED via the Arduino IDE's "serial monitor" .

### Alpha Tasks:

- A1.1 \_\_\_\_\_ Install the Arduino IDE on your laptop.
- A1.2 \_\_\_\_\_ Install the FTDI USB driver software on your laptop.
- A1.3 \_\_\_\_\_ Demonstrate the ability to program the Arduino by installing and running the example blink program.
- A1.4 \_\_\_\_\_ Construct the circuit presented in this lab using a combination of breadboard and wire wrap methods.
- A1.5 \_\_\_\_\_ Modify the code so that your name is printed to LCD line 1 and your home town appears on line 2. This should appear for 2 seconds upon start-up.
- A1.6 \_\_\_\_\_ Modify the code so that the LCD displays repeatedly counts from 0 to 9 with 0.5 seconds between counts. No other data should appear on the screen. Use of a FOR loop is recommended.
- A1.7 \_\_\_\_\_ Modify the code so that the Arduino beeps for 0.25 seconds every time the LCD count resets to zero.
- A1.8 \_\_\_\_\_ Establish a user account on GitHub.com. Email instructor your user name.
- A1.9 \_\_\_\_\_ Work with instructor to post this lab's code to your newly established <https://github.com/macee> account.

**Bravo Tasks:**

Locate the data sheets for the ATMEL ATmega328 and the Sparkfun Arduino Pro mini to answer B1.1 through B1.4:

- B1.1 \_\_\_\_\_ What is the minimum and maximum supply voltage for the ATMEL ATmega328?
- B1.2 \_\_\_\_\_ What is the maximum current any individual Arduino pin may source and sink? Also, what is the maximum combined current?
- B1.3 \_\_\_\_\_ What is the size of the ATmega328's RAM?
- B1.4 \_\_\_\_\_ Like nearly all data sheets, the ATMEL ATmega328's data sheet contains mechanical drawings for the device packages. For signature, show this drawing to your instructor and identify the acronym describing the package for the particular device used on the Sparkfun Arduino pro mini. Hint - it is not a UFBGA, MLF, PDIP, or a VQFN.
- B1.5 \_\_\_\_\_ State the purpose of Diodes D1 and D2 as shown in this lab's schematic.

**Tips and Hints:**

- Please resist the urge to remove your Arduino Pro Mini from the breadboard as it is easily damaged. Note that it has been positioned to allow clearance for parts in future labs.







