LAB 0: Lab Intro and PLD PCB Construction

OBJECTIVES

The objective of this lab is to add the required headers and connectors to *OOTB 3701 PLD Board Kit*, to learn the lab rules, and to learn some of the basics of digital circuit building. Since this PLD PCB is used as our power supply, we will use it in every lab this semester. To the parts in your *OOTB Kit*, students will first learn electronics soldering techniques and then solder the parts onto their PCBs. Students will also learn how to use a bread board, create switch and LED circuits, and to build a simple logic circuit.

MATERIALS

- Printouts (**required**) of the below documents:
  - Parts 5. i. a) – e) from the *Lab Rules and Policies* for your *Pre-Lab Report*
- Your laptop with Quartus installed.
- Download, read, and store on your computer:
  - The lab assignment (this document)
  - *Parts List*
  - *Lab Rules and Policies*
  - *Hardware: Getting Started* and related class notes
  - *OOTB 3701 Assembly Guide*
  - *Quartus 18.1 Installation Instructions*
  - Re-read the syllabus, Course Requirements, item 1, about the polic for missing a lab
  - *Electronic Assembly handout from Chapter 3 of the MIT 6270 Manual*
- A toolbox containing the following will be given to you in lab. Verify that your box contains **all** the parts on your parts list.
  - Prototyping bread board, power supply, wires, multi-meter, and chip extractor
  - IC components, resistors, LEDs, and switches
    - Verify the quantities and part numbers of these parts.
  - PLD board parts

LAB SAFETY

Although the voltages we are dealing with are unlikely to hurt you, care should always be taken when dealing with electricity. When soldering, you should wear safety glasses. Always be careful. Ask questions and use common sense. In an emergency, know what to do.

Keep your area clean and uncluttered. Report any broken or damaged equipment to your PI.

INTRODUCTION

In this lab you will solder the required headers and connectors onto the PCBs in your *OOTB 3701 PLD Board Kit*. These PCBs boards will be plugged into your prototyping bread board.

It is highly recommended that you take notes while your PI lectures or performs demonstrations. Feel free to ask question. You will be responsible for **all** the material discussed.

PRE-LAB REQUIREMENTS

1. Read all the required documents **before your lab.** Download these files to you laptop computer.
2. Read and understand all items presented within in the *Lab Rules & Policies* document. Agree to the document by electronically signing and dating it. Submit this document (through Canvas) **and** attach a screenshot of your completed signature page within your pre-lab report.
3. If you have not already done so, complete and submit (to Canvas) the Homework 0 assignment.
4. Create your *Pre-Lab Report* using something like MS Word. The report must be computer generated (even if parts of it are from scans. Ultimately, you will save this file as *Lab0.pdf* for submission on Canvas. You will have a *Pre-Lab Report* for **every** lab. Bring a computer printout on **paper** of parts 5. i. a) – e) to submit to your PI at the start of your lab. (This part of the report must include answers to the prelab questions. See *Lab Rules and Policies.*)
5. Take a screen shot of our twitter page (@EEL3701). Save this screen shot as a figure in your lab document. You can view the tweets as a web page by visiting https://twitter.com/EEL3701, but doing it this way defeats my purpose for the tweets. (You may alternately get email or text messages from our twitter feed. Print out screen shots of whichever one that you actual use.)
6. Install Quartus v18.1 on your laptop computer prior to your lab. See *Quartus 18.1 Installation Instructions*.
7. Submit the following to our Canvas account. If you have the wrong filenames, you will **not** get full credit for your submissions. (Note that sometimes Canvas will append a number at the end of your filename. This is unavoidable and allowed.) You will not be admitted into lab without submitting these items.
   1. Your Pre-Lab Report
      - Submit the pdf file **Lab0.pdf**
   2. If you have **NOT** already done so, complete Homework 0 **BEFORE** entering lab.

PRE-LAB QUESTIONS

You are required to submit the answer to these questions when you enter the room for your scheduled lab (in the *Summary* document). The answers to these questions can be found in the required readings for this lab. Turn these in through Canvas, as specified in the the *Lab Rules and Policies* document.

1. How late can you arrive for lab and still be admitted? How late can you arrive for lab and still be allowed to take the lab quiz?
2. When are your prelab submissions to Canvas due?
3. Can you drop this lab (Lab 0) if ... a) you overslept? b) project is due for other class?
4. Can any lab be dropped?
5. What minimum lab average is required in order to be eligible to pass the course?

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6. In electronic assembly, does neatness count?
7. If you are very careful, is it okay to do all of the soldering (described below) and then show your finished board to your PI?
8. Should the soldering iron touch the solder while soldering parts in place?
9. Should the long or the short side of the headers get inserted into the breadboard?
10. When soldering each of the two 5-pin headers into J3 on PLD PCB, should the short pins point down or up? These headers are inserted from the top of the board, where the J3 is visible.

IN-LAB REQUIREMENTS
1. As you walk into lab, turn in your *Pre-Lab Report,* Parts 5. i. a) – e), which includes answer to pre-lab questions.
2. Get your toolbox and parts from the PI and verify that you have received **everything** on the *Parts List*.
3. Use the multimeter on the resistance setting to verify that there is **no connecton** between the power rails on your bread board.
4. Use the *OOTB 3701 Assembly Guide* and to construct your PLD PCB. **Be sure to have your PI verify your key steps in the construction**, i.e., solder only a single pin on opposite ends of headers before showing it to your PI for approval to solder the rest of the pins. This is **required**!
   - Verify (with your PIs help, if necessary) that the board outputs 3.3V.
   - If you do not finish construction of your PCBs, you **must** do so during PI office hours **prior** to the start of your **Lab 1**.
   - **Failure to follow instructions will result in a deduction of <u>at least</u> 50% for this lab.**
5. Watch your PI demonstrate construction of a simple circuit with a single AND gate (74HC08), two switch circuits, and one LED circuit.
6. Clean up you work area and pack up your parts.

AFTER LAB SUGGESTIONS
- Every semester at least one student loses her/his toolbox. Therefore, you are **required** to write **something** inside of your toolbox. I suggest that you write your cell phone number or email address. If you don't want to write one of these, it is okay to write what you want, but you must write something identifying on the inside of your box. We have silver sharpies to write on our tool boxes. If you like, you can also write something (like your name) on the outside of your toolbox