UF-3701 CPLD Board Construction Guide

Soldering and Part Placement
See the Chapter 3 of the MIT 6270 Manual for information on electronic assembly, including soldering techniques and component mounting.

Construction Information
- All solder connections are through-hole, which means that the components go through the small holes and are soldered on the reverse side.
- A properly assemble board is shown in Figure 0.
- All components should be placed inside their outlines. Outlines are shown clearly in Figure 1.
- Practice soldering before soldering the parts onto your board.
- Make sure to solder the resistors and capacitors flush to the board, as shown in Figure 2.
- Make sure to solder all of the headers flush to the board, as shown in Figure 3.
- Notice that all components are place on top of the board EXCEPT the long 17-pin SINGLE ROW HEADERS (see Figures 0, 1, 4 and 5).
- Do not directly touch the solder to the iron; instead, indirectly melt the solder through the lead of component.
- Figure 1 shows a fully constructed board from the top, Figure 4 shows one from the side and Figure 5 shows one from the bottom.
- Never rest the soldering iron on the bench top. Instead, always use the soldering iron holder.
- When you are done soldering, cover the soldering iron tip in solder. This will prevent tip oxidation and will lengthen the life of the soldering iron tip.

Figure 0: Picture of assembled board. Parts are on top. (Top is defined as the labeled surface.)
Figure 1: Board layout with pin numbers and component labels (shown in two orientations).
Figure 2: Resistor bending and resistor and capacitor placement.
Figure 3: Header placement.
Figure 4: Side view of the assembled board.
Figure 5: Bottom of the assembled board.
**Construction Procedure**

1. See Figure 6 for a layout with each pin and component name labeled.
2. Practice soldering **BEFORE** you start soldering on your board.
3. Bend one of each resistor lead very near to the resistor to form a loop.
4. Insert a 1kΩ resistor (color code: brown, black, red) from the top into the hole labeled R13. Solder this resistor from the bottom of the board. **Have the TA check your soldering.**
5. Insert and solder 1kΩ resistors in the holes labeled R12, R11, and R10.
6. Insert and solder a 1μF capacitor (verify with your TA that you have the correct capacitor) into the hole labeled C6 (blue cap in Figure 7). The capacitor is non-polarized, so it does not matter which end goes in which hole.
7. Insert and solder 0.1μF non-polarized capacitor (orange cap hiding behind the tall dark cap in Figure 7) into the hole labeled C7.
8. The 10μF **polarized** cap that will go into the holes labeled C5 must be aligned properly when inserting. The negative terminal of the cap is labeled. Put that in the pin opposite the + sign on the PCB, i.e., the + terminal of the cap should go into the hole adjacent to the + on the PCB. Solder this cap in place.
9. Insert the LED (light emitting diode) into the LED holes marked D5. The long leg of the LED (the anode) goes in the hole near the +. (The LED in Figure 0 is green; your LED may be a different color.) Solder this LED in place.
10. Insert and solder a 330Ω (color code: orange, orange, brown) resistor in the hole labeled R14.
11. Cut the double row header to the proper length of 5 pins by 2. The header is on the left side of the board, vertically near the middle. **From the top, insert the short header pins through the holes.** The **long** pins and the plastic should be **on top of the board.** Solder **one pin on one edge** and then the most distant pin on the opposite edge. See Figure 3 for proper header alignment and Figure 1 for proper header appearance on the board. **Have your TA check your placement before soldering the rest of the header pins.** **With TA permission,** solder the rest of the header pins.
12. Cut the single row header pins to the proper length of 17 pins. You will need two 17 pin length headers. **Insert one header from the bottom of the board.** The plastic and the long thin pins should be on the bottom of the board; short thick pins should go through to the top of the board. Solder the **opposite ends of one header and verify it is aligned properly** (as shown in Figure 3). Have your TA check your placement before soldering the rest of the header pins. **With TA permission,** complete the soldering of this header. Solder the other header in a similar fashion.
13. Place the CPLD socket (a square part with a notch in one corner) on the top of the board, as shown in Figure 8. Take care to place the socket so that the bevel (notch) lines up with the outline of the bevel printed on the board. Solder the CPLD socket pins in place.

14. When you are done soldering (not just today, but each time you solder), cover the soldering iron tip in solder. This will prevent tip oxidation and will lengthen the life of the soldering iron tip.

Testing
Since you have not yet learned to use the test equipment or Quartus, your TA will test your board for you. Bring your TA your completed board. Your TA will do the following:

1. Insert the Altera 3064 (EPM3064ALC44-10) CPLD into the CPLD socket.
2. Place the board on a breadboard and connect +5V and GND to the correct pins on the board.
3. Place the programmer into the programming header by lining the red wire with pin 1 on the header.
4. Ensure that Quartus is set to the correct CPLD chip.
5. Plug in the breadboard and the LED should light.
6. Download a test design to the board to verify that the board can be programmed. Your TA will help with this in your lab.
   - A good test circuit (available on our website) is shown in Figure 9. A test circuit should exercise all the pins.
   - Put input switch circuits at the four inputs.
   - Put LED circuits at each output.
   - The simulation output is shown in Figure 10.
Figure 9: Test circuit to exercise all the pins.

Figure 10: Test circuit simulation file.