

## ELE 215 – Lab 2 – Soldering

### Objectives

- Learn to solder, assembling a PCB version of a digital circuit from ELE 201.

### Notes

- For safety:
  - Wear safety goggles to keep solder and other bits out of your eyes.
- Watch the tutorial videos and read the introductory materials **before** you go to the lab!
- Bring in your “kit” from ELE 202 for some of the parts – we will supply whatever is missing:
  - PC board
  - ICs:
    - (1) 556 – dual 555 timer
    - (1) 4081 – quad 2 input AND
    - (1) 4069 – hex inverter
    - (1) 4071 – quad 2 input OR
    - (1) 4520 – dual binary counter
  - Pushbutton switch
  - SPDT switch
  - (14) LEDs
  - Resistors:
    - (8) 1 kΩ
    - (3) 200 kΩ
    - (2) 180 kΩ
  - (2) 0.1 μF capacitors
  - 9 V battery connector
- This exercise is stretched over 3 weeks, with only one-half of you attending the first week, the other half the second week, and the third week for anyone who needs extra time. Check the online posting for your specific day.

### Procedure

#### 1. Putting in some Basic Components:

- a) Check to make sure that you have all the necessary parts. Most are in your kit from ELE 202; missing/remaining ones will be available in the lab.
- b) Install and solder the (8) 1 kΩ resistors for the LEDs, the (3) 200 kΩ resistors, (2) 180 kΩ resistors, and the (2) capacitors – see the figures on the third page for part locations:
  - Note that the orientation for these passive components is irrelevant.
  - You should touch the soldering iron to both the component’s lead and the board pad simultaneously for a second or two before applying the solder – the goal is to have the solder easily run without heating up the component too much!
  - Use the diagonal cutters available in the lab to trim off the excess leads from the back of the board; preserve these scraps for use in the next step – note that it is best to hold the end of the lead with your fingers to keep it from flying off into space; also, just snip it off, do not twist the lead.

- c) Install and solder on the following components (see the figures below for locations and the sample board as an example):
  - Wire loops for connecting to ground and the two clocks – use the scraps from the resistors or capacitors; leave the loops proud of (standing above) the PC board so that you can clip the scope leads to these points later.
  - Power switch and pushbutton switch – the orientation is irrelevant.
  - Battery connector – be sure to connect red to + and black to -.
- d) Install the 556 timer chip being sure to get the orientation correct – see the figure below for its location; note that it is useful to use a flat surface, such as the desktop, to slightly bend the pins for easy insertion – DO NOT SOLDER yet; first show your results to your TA for comments.

2. Getting the Clock Signals:

- a) Solder in the 556 timer – remember to use heat and solder sparingly so as to not destroy the chip (while it's possible to replace the chip if you get this wrong, it's a slow and tedious process). It is not necessary to trim the leads on the ICs.
- b) Connect your battery, connect the two scope channels to the two clock loops, and connect the scope grounds to the ground loop; check that you have two clock signals – demonstrate this to your TA. Note that they should NOT be synchronized.

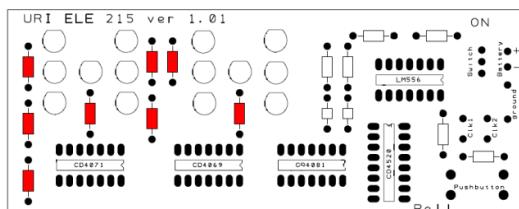
3. Adding the 0-1-2-3-4-5 Counters:

- a) Install the 4520, the 4081, the 4071, and the 4069 chips. Solder them in, again using heat and solder sparingly.
- b) Connect channel 1 of the scope to clock 1 and use another scope channel to test for signals on pins 11, 12, 13, and 14 of the 4520.
- c) Repeat for clock 2 and 4520 pins 3, 4, 5, and 6.
- d) Demonstrate your signals to your TA. Connect channel 1 of the scope to clock 2; channel 2 to the 4520 pin 4.

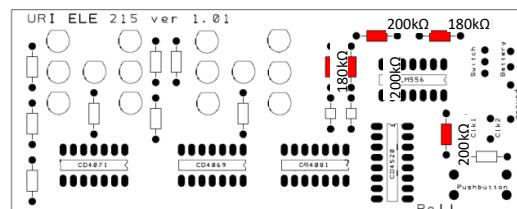
4. Adding the LEDs:

- a) On your breadboard, build a small test jig for the LEDs – this is just power (say 9 volts from the battery), a current limiting resistor (1 kΩ is fine), and the LED in a series connection – so that you don't, by accident, install a bad LED.
- b) Install and solder in the LED in the center of one of the dice patterns; be sure that you get the directions of the LEDs correct(!); line up the flat side of the package with the outline on the board.

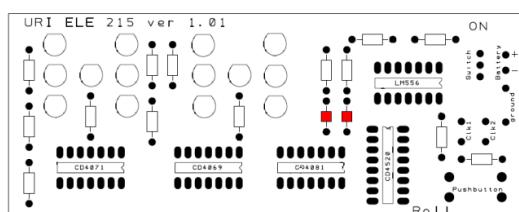
- c) Apply power to the circuit to make sure that the LED lights up when you press the push button. If it does, disconnect the battery and install the other 13 LEDs.
- d) Turn on your circuit and see if it works! If so, demonstrate to your TA; if not, start debugging....



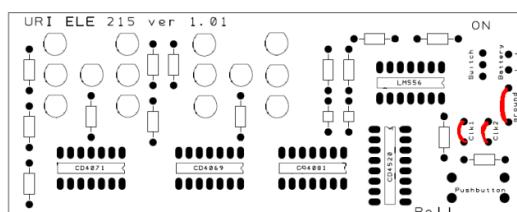
Locations of the 1  $k\Omega$  resistors



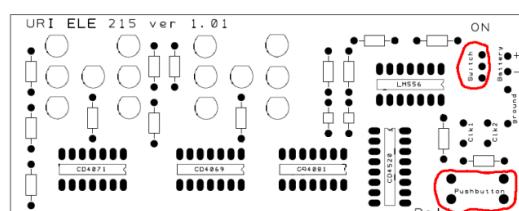
Locations of the 180  $k\Omega$  and 200  $k\Omega$  resistors



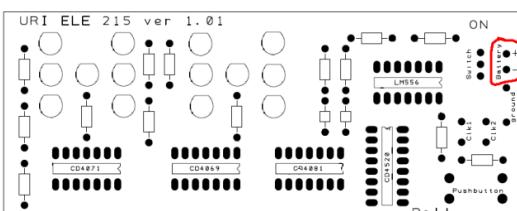
Locations of the capacitors



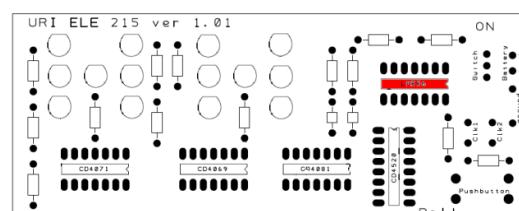
Locations of the wire loops



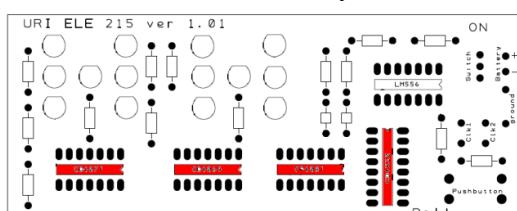
Locations of the switches



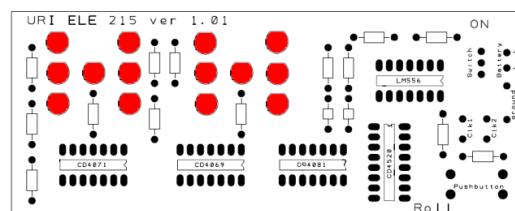
Location of the battery connector



Location of the 556 IC



Locations of the other ICs



Locations of the LEDs

**Get the orientations of the ICs and LEDs correct!!**

5. Reporting: your submission should just be the summary sheet.

- a) Scan the summary sheet to a single page pdf document.
- b) Use the last 3 digits of your HW ID number in the filename; specifically, if your 3 digits were 789, then the filename should be

Lab\_2\_789.pdf

- c) Upload it to the ELE 215 Brightspace site.