Electronics Workshops

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Level 1 - Through Hole Soldering

Click here to sign up for this workshop

Click here to see the workshop slides

Workshop FAQs

Workshop Resource #1

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ESS Training Resources

Level 1 - Simple Circuits & Measurements Fundamentals

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Level 2 - Integrated Circuits

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GEEN 3010 Workshop Series

This course is designed for engineering students to gain hands on + technical knowledge in circuits. The workshop series includes teaching Arduino 3: Migrating Smaller Microcontrollers, GEEN 3010 specific ECAD: Altium Basics, and GEEN 3010 specific PCB Assembly Workshop. This document was made to help guide new workshop teachers through leading these workshops/activities.

GEEN 3010 Workshop Series

Arduino 3: Migrating to Smaller Microcontrollers

First, we need to make sure all the supplies are ready to give this workshop. Included in the list below are all pieces that should be included in the workshop kit and brought to this workshop. In previous years enough kits were put together in expectation that everyone would work alone. However, when leading the workshop most students prefer to work in their lab groups (which is ok).

If working on their own personal computers, students will need to have downloaded the Arduino Legacy Version. Then do the driver install by downloading (zadig.-2.9.exe) in the folder, double clicking it, selecting libusb-win32, and installing it. Lastly, students will need to copy the thing in the workshop folder to paste it into preferences (board urls) and download the attiny board manager.

List of everything used in previous years

- Arduino Kit (fully intact)
- Sparkfun Programming Stick (verify it is working)
- ATTiny85 (should already be boot loaded and verified it is working)
- Mini Breadboard
- L7805 Voltage Regulator
- Breadboard Barell Jack Connector
- USB to USBC adapters (for students working with personal computers)
- Checkout Laptops
- ATTiny85 Identification Worksheet

Material Links

Find workshop material here: Arduino 3 – Migrating to Smaller Microcontrollers

ECAD 1: Basic of Using Altium (GEEN 3010 Version)

This workshop is very similar to the ECAD Level 1 Workshop but relies on a different library and schematic reference to build the Stoplight PCB. This is important because students are then expected to assemble their own Stoplight PCB in the assembly workshop.

Find workshop material here: ECAD 1 - Basics of using Altium Designer (GEEN 3010)

Material Links

Dr. Zarske sends a link for students to download Altium on their personal computers. You can find that process here: Altium Student License Page

The schematic library can be found here: GEEN3010_Stoplight_SP2026. Once downloaded, students will drag and drop this into Altium and click install.

Find workshop material here: ECAD 1 - GEEN 3010 Version Only.pptx.

Key Points (IMPORTANT!!!)

Dr. Zarske is very intentional with this workshop and built a lab document with questions surrounding important learning objectives. When leading this workshop, it is important that you know the questions she wants answered and include these answers within your presentation and walkthrough.

The questions include:

1) Schematic Capture – The schematic is a roadmap for your entire design. It is the first step in the process of making the PCB (after building it on the breadboard). Make sure you also talk about the schematic etiquette and rules that are included on the ECAD slides.

2) Libraries – A library is a structured storage system for electronic components, containing essential models needed for design, including schematic symbols (.SchLib), PCB footprints (.PcbLib), and 3D models.

3) Node – Nodes or junctions are net lines or wires that branch to more than 2 pins. These are important as they allow connectivity between multiple aspects.

4) Errors and Warnings – Errors are the critical failures and high value checks that must be resolved. Warnings are design preferences or expected attributes that are missing (do not always need to be fixed). Warnings usually point to better practices or better etiquette.

5) PCB Layout – We want to make sure we emphasize that when routing you should not include 90 degree angles. That power signal should usually have a larger trace width if room permits. When showing the polygon pours, we want to emphasize that often we attach this to ground, and it is used to save copper and reduce noise. Use DRC (design rule check) to see if you have any errors or warnings.

6) Air Wires – Yellow thin wires on the PCB Layout between components are known as air wires. These are computer-generated lines that show the shortest distance between two elements that need to be connected. These represent the physical copper traces you need to lay down (in a sense), and it is important that you try and untangle these before you route.

7) Autoroute – Altium has a built-in auto routing feature that allows the software to generate traces that satisfy the schematic netlist. These tracs are the computers idea of “best way possible”. We do not use it because our brain allows us to think outside of the board and create better solutions based on circumstances.

8) Fabrication Outputs - CAM/Gerber files are the files needed to manufacture your board. These files contain the information and form factors that your manufacturer needs. Different manufacturers have different required files, and these can be found on the specific manufacturer's website.

Feedback and Recommendations

- This software can be quite intimidating at first, so making sure students feel comfortable navigating everything is crucial. Also offer students to use a mouse if they are not working on a lab station computer (we have them in ECAD kit).
- Because there is so much covered in this workshop and it is a valuable skill, we suggested that all students work on their own computer. The lab stations should work perfectly fine if you have access to these. The checkout laptops do have some finicky issues, ensure that you have looked over how to set these up (included in the slide deck) and are ready to troubleshoot as you go.
- Make sure all students are on the same steps. It is harder and less valuable for you to catch them up later than it is to stop really quickly and help. Make sure everyone is on the same page by asking if anyone needs help frequently. Then walk around and visually confirm this is true when giving them work time.
- Bring schematic diagrams for them to have in front of them as they work. Makes it a lot easier for them to reference, and you to point stuff out.

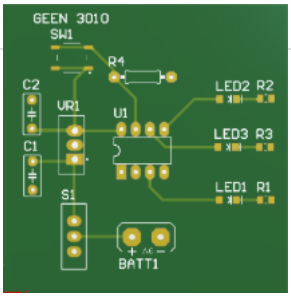
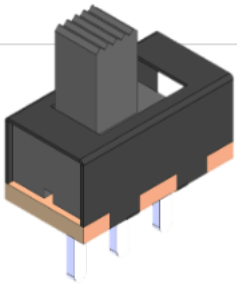
GEEN 3010 Workshop Series

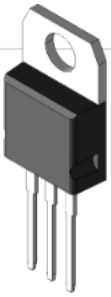
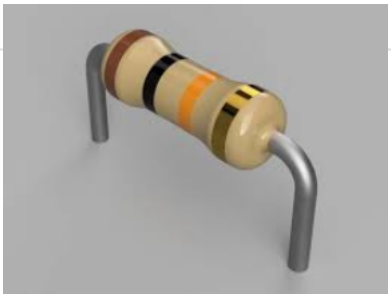
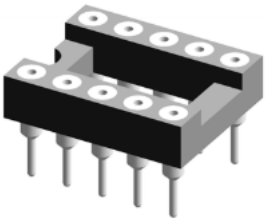
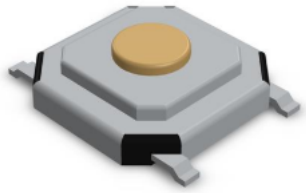
PCB Assembly: Stoplight Board

The final workshop of this series is the stoplight PCB assembly. This workshop takes a lot of preparation to ensure all components and assembly bags are ready to go on the day of the workshop.

Preparation

1) Assembly bags will need to be made for each student enrolled in the class. These bags include all of the parts that are essential for the PCB to work as intended. Each bag should have:

Components Needed in Bag	
Stoplight PCB	
9V Battery Connector	
Toggle Switch	

1x 0.1 uF Capacitor 1x 0.33 uF Capacitor	
Voltage Regulator (LM7805)	
10k Resistor	
8-pin DIP socket	
Push Button (SMD)	
3x LED’s (Green Yellow Red) (SMD)	

3x 330 ohm Resistors (SMD)	

2) All of the ATTiny85 IC's needs to be ordered, bootloaded through the Arduino IDE software, and loaded with the stoplight code (StopLight.ino)

3) Check that the code works on a working stoplight PCB. I would assemble a new board and check all IC's to verify both the newly ordered PCB's and IC's are all working as expected.

Bring to the Workshop

- Soldering Kit Workshop Cart (grey cart with wood top in EFAB)
- Tweezers and Micro wire Cutters (should be in grey cart)
- Assembly bags + IC's + Extra components
- PCB Stencils + Solder Paste + Solder Paste Scarper
- Component Identification sheet

Teaching Workshop

1) Students are given bags and an identification sheet, they are asked to identify all components in their bag, find where they go on the PCB, and if they must be placed in a specific orientation. Check each students work off for them to start the next steps.

2) With the PCB stencil, students then learn how to apply solder paste to the surface mount pads of their board. Teach them how to fix the stencil in place, line it up, and spread the paste (one swipe to apply and another to spread excess off).

3) Students will then move to assembly and soldering. They will need to grab a soldering kit from the cart (make sure they solder on the mats). Students can plug soldering irons into the lab station hutch outlets. They should start by placing and soldering their surface mount components. Then move to the through hole soldering on the bottom side of the board. Make sure students know that the order of which they solder components matters. Smaller through hole components (in height) should be soldered first for components to stay flush to the board (important to reduce risk of short circuiting or components snapping off).

4) Check board is properly assembled and all joints are soldered. Once verified, students are then allowed to plug in ATtinty85 microcontroller (in proper orientation) and 9v battery.

5) If the board does not work, introduce students to the multimeters at the lab stations and show them how to troubleshoot connections (checking continuity and measure voltage)