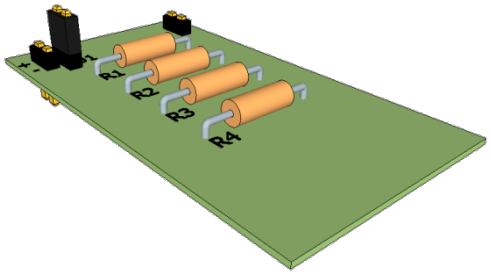
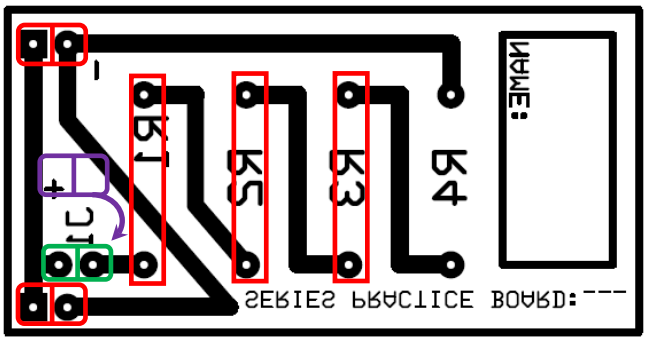
Series Practice Board

Objective

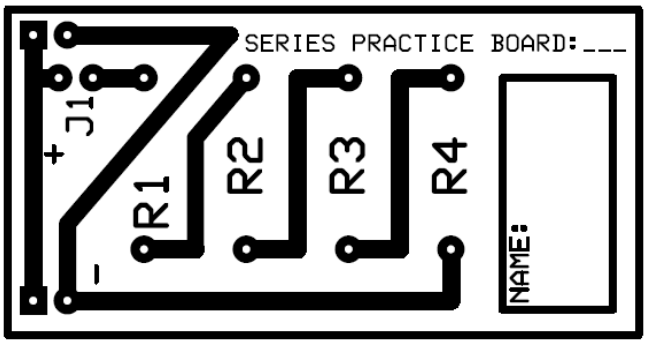
Students will practice making a printed circuit board (PCB) using safe production methods, correctly identify components and their values, and the safe soldering of those components.



COMPONENT SIDE



SOLDER SIDE



Legend

Resistors R1 to R4 

Header pins face up 

Header pins face down, pins pushed to be flush with black plastic 

Female Header 

PCB Procedure

1. From your instructor obtain a transfer and a piece of copper board.
2. Using a pencil and a set square draw out the shape of the board on the copper. Note that it should be the exact dimensions of the outer boarder of the transfer.
3. Using the foot shear safely cut your board to the lines drawn on the copper board. **Caution:** Keep fingers well away from yellow guard.
4. Using a copper scrub pad clean the copper board (both sides if it is a double sided board) until it is shiny like a brand new penny. Note that the board should be free of oils. Make sure your fingers only touch the edges of the board.
5. Plug in a clothes iron and set at the highest setting (linen). **Caution:** The clothes iron will be close to 220°C . On a wood board place the PCB face up with a piece of paper towel over it. In a circular motion move the iron over the board. Heat for four minutes.

6. Peel back the paper towel and place the transfer down so that you can still read the text on the transfer. Make sure the transfer does not shifted when placing it on the PCB. Cover with the paper towel and heat for another two minutes.

7. Remove the paper towel. Then take the iron and press down with the tip of the iron over the pads, pathways and text.

8. Holding the board with the paper towel (so that you are not burned) place the PCB in a tray of water to cool it down. After 30 seconds remove the board and dry it off.

9. Holding tight one end of the board, lift the plastic from the other end of the board like you are opening a door and not like you are pulling back bed sheets. This method will provide the greatest chance for the toner to transfer to the PCB from the plastic transfer. Check the PCB to see how successful you were. Your instructor can help you in determining if you can use it or try again.

10. If less than 85% of the image has been transferred to the PCB, repeat the process. Scrub the PCB with the copper scrub pad until shiny again and obtain another transfer from your instructor.

11. If 85-90% of the image is on the PCB, then the board can be used. Using a permanent marker fix up the image so that it looks exactly like the image that was on the transfer (see the top of this document for the image). You must go over your corrections three times with the marker, otherwise it will not survive the etching process. Also, make sure you use the marker to put your name and board number. Your teacher will assign you a board number. See the table below.

BOARD #	R1	R2	R3	R4
☐ 1	100Ω	220 Ω	330 Ω	470 Ω
☐ 2	220Ω	330 Ω	470 Ω	680 Ω
☐ 3	330 Ω	470 Ω	680 Ω	1k Ω
☐ 4	470 Ω	680 Ω	1k Ω	100 Ω
☐ 5	680 Ω	1k Ω	100 Ω	220 Ω
☐ 6	1K Ω	100 Ω	220 Ω	330 Ω
☐ 7	100Ω	1k Ω	680 Ω	470 Ω
☐ 8	220Ω	680 Ω	470 Ω	330 Ω
☐ 9	330 Ω	470 Ω	220 Ω	100 Ω
☐ 10	470 Ω	330 Ω	220 Ω	100 Ω
☐ 11	680 Ω	470 Ω	330 Ω	1k Ω
☐ 12	1K Ω	100 Ω	220 Ω	330 Ω

12. Instructor Conference: PCB Preparation Review Notes

What have I done well:

What I can work on to do better:

13. When you are satisfied that your board is ready to be etched, give it to your instructor. The board will be placed in ferric chloride ($FeCl_3$) a corrosive material which will react with the exposed copper. The result is that all the copper will be pulled off the board except where protected by the toner and permanent marker. The process will take 30 minutes or longer, depending on how old the $FeCl_3$ solution is. Your instructor will pull the PCB from the solution and rinse off the ferric chloride. **Caution:** Only your instructor will be in contact with the Ferric Cloride.

14. Using the copper scrub pad clean off the black toner and permanent marker to expose the copper pads, letters and pathways on the PCB.

15. Using a multimeter set for continuity testing, check all the pathways to make sure there are no breaks or shorts. Mark any breaks with the permanent marker. The breaks can be repaired during the soldering process. If there are shorts, use a fixed hobby knife to break the short. **Caution:** Hobby knives are very sharp. Make sure to wear a Kevlar glove on the non cutting hand and to use short strokes while breaking the pathway.

16. Using a permanent marker, place a dot in the middle of the pads that are to be drilled. This visual aid makes sure that the pads to be drilled stand out. Drilling a missed pad after you have half populated your board makes it difficult to do.

17. Using a #60 drill bit, drill all the pads on your PCB. Accuracy is very important. Take the time to line up the drill bit. Drill slowly through the board as these drill bits are fragile and will break when forced.

18. Caution: You must wear safety glasses while drilling.  Also, long hair tied back and no loose clothing.

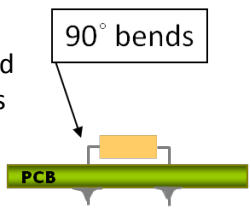
19. Using your finger nail brush off and copper burs that may be left after the drilling. If left they may cause shorts.

20. Instructor Conference: Completion of PCB Notes

What have I done well: What I can work on to do better:

Soldering Procedure

21. Your instructor should have provided you with a board number. Using the table above insert the proper resistor values onto your board. The resistor leads should have 90° bends so that the resistor can be easily inserted. Use needle-nose pliers to make the bends. Components should be close to the board.

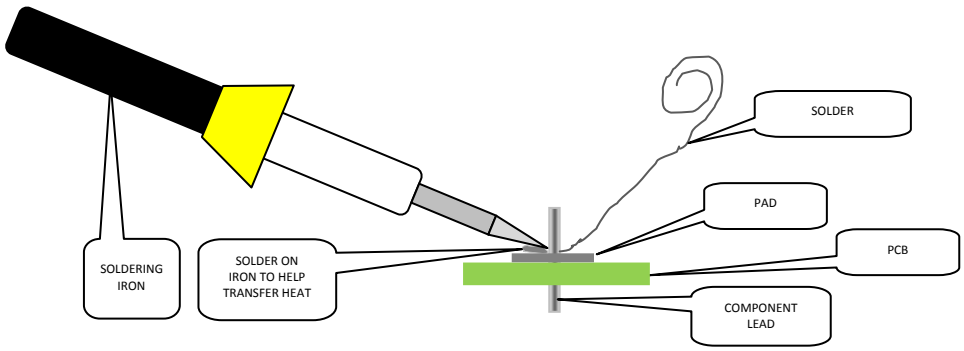


22. Your soldering station should include: ①safety glasses, ②wood board, ③soldering iron, ④stand with wet sponge, ⑤fume extractor and ⑥ PCB stand. Make sure that the cords do not come in contact with the iron as it will melt the insulation and will cause an electrical short. Caution: Tip temperature is above 200°C

23. Caution: Your safety glasses should be on while soldering! 

24. Once the iron has reached its normal operating temperature, clean the tip with the wet sponge and apply a small amount of solder. This is to help transfer heat to the pad and lead, not to add solder to the joint.

25. Place the soldering iron on the pad beside the lead. On the other side of the pad apply the solder. When the pad is hot enough the solder will begin to melt. Feed in enough solder so that it fills in the hole completely and surrounds the lead. At this time draw both the solder and iron up along the lead. The solder will have bonded to both the pad and the lead. The solder should be concave or volcano shaped. The surface should be shiny with no grainy texture.



26. Trim the lead and then solder a few more leads.

27. Instructor Conference: Soldering First Few Leads

What have I done well: What I can work on to do better:

28. Continue soldering the rest of the PCB.

29. Instructor Conference: PCB Preparation Review Notes

What have I done well: What I can work on to do better: