

Chapter 38

Printed Circuit Board Fabrication

Objectives

- After completing this chapter, you will be able to:
 - Describe the fundamental process for making a printed circuit board
 - Design and lay out a printed circuit board from a schematic diagram
 - Discuss how to transfer a design to a copper-clad board using hand transfer, direct transfer, or screenprinting technique

Objectives (cont'd.)

- Identify techniques to remove the excess copper from a copper-clad board on which a design is formed
- Explain how to drill the appropriate holes in an etched printed circuit board
- Identify the purpose and parts of a material safety data sheet (MSDS)

Fundamentals

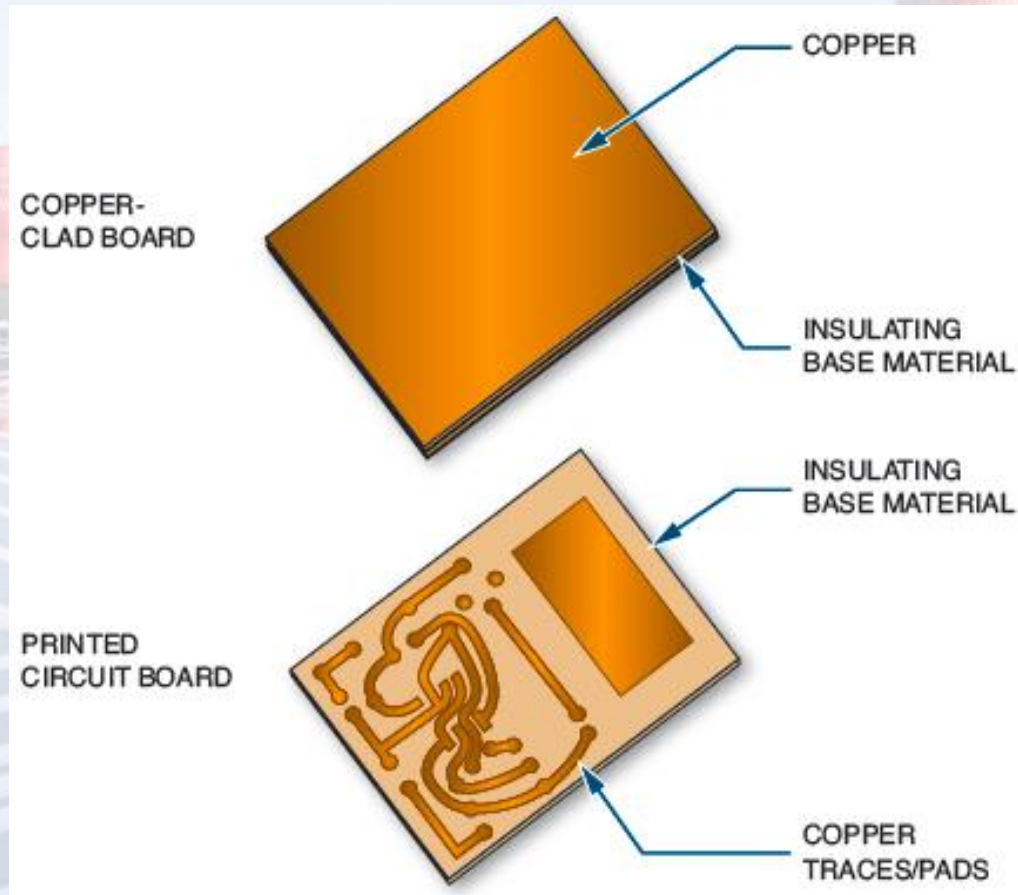


Figure 38-1. Copper-clad board which is made into a printed circuit board.

Fundamentals (cont'd.)



Figure 38-4. Example of an etched printed circuit board.

Fundamentals (cont'd.)

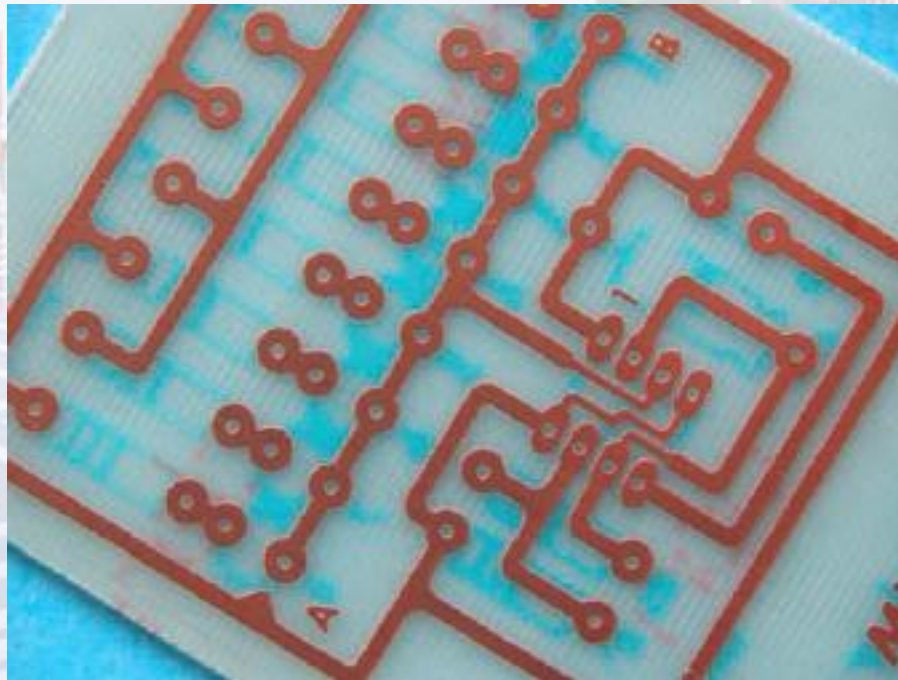


Figure 38-5. Printed circuit board that has been etched and resist removed.

Fundamentals (cont'd.)

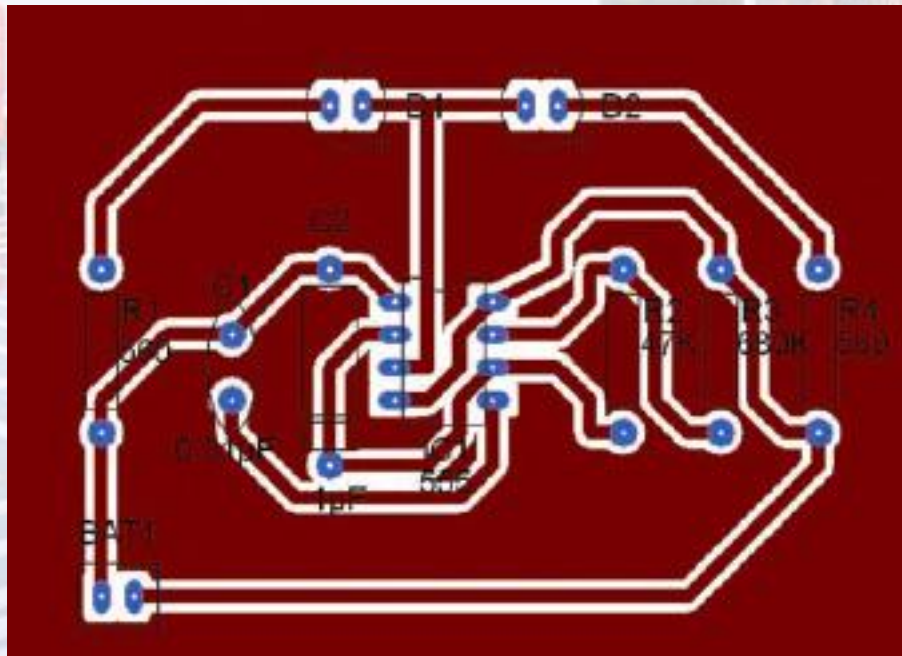


Figure 38-6. X-ray view of a printed circuit board layout from the component side.

Fundamentals (cont'd.)

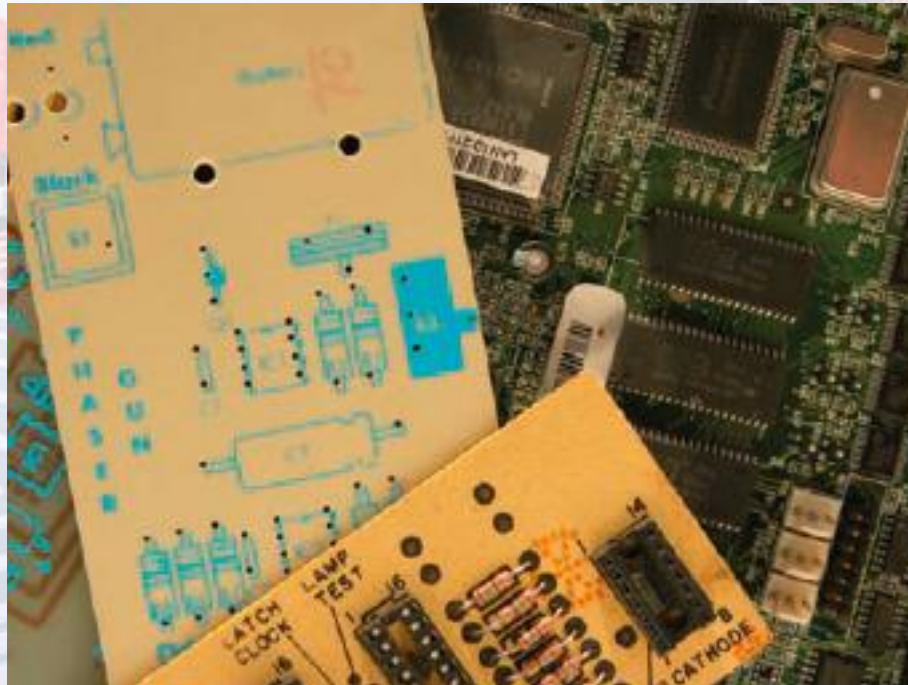


Figure 38-7. Examples of the component layer on printed circuit boards.

Fundamentals (cont'd.)

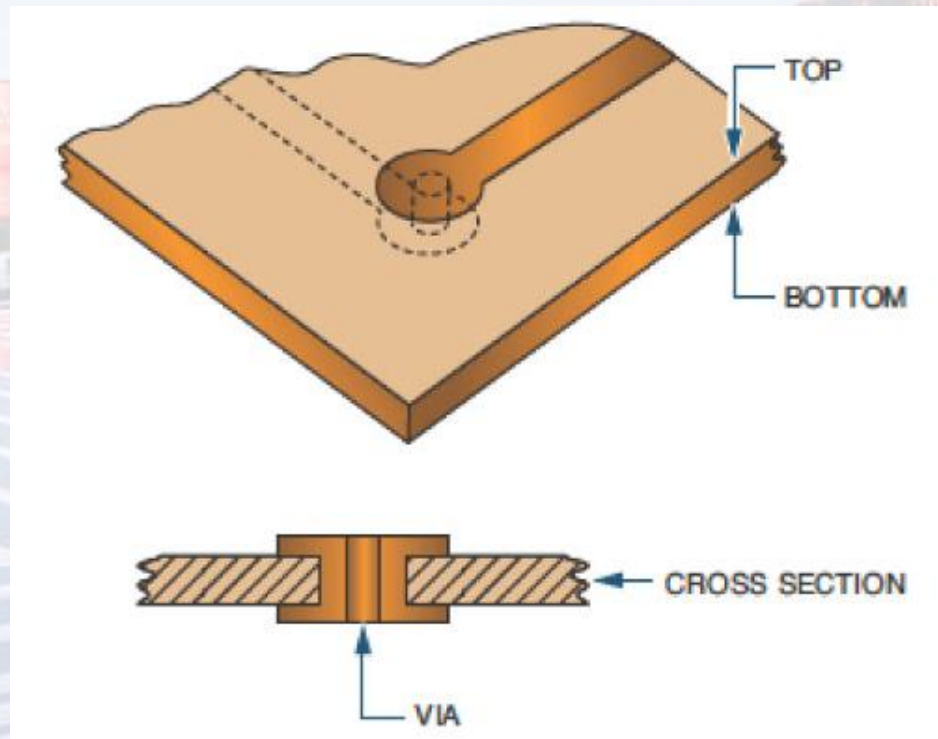


Figure 38-10. Vias connect the top to the bottom trace of a printed circuit board.

Schematic Diagram

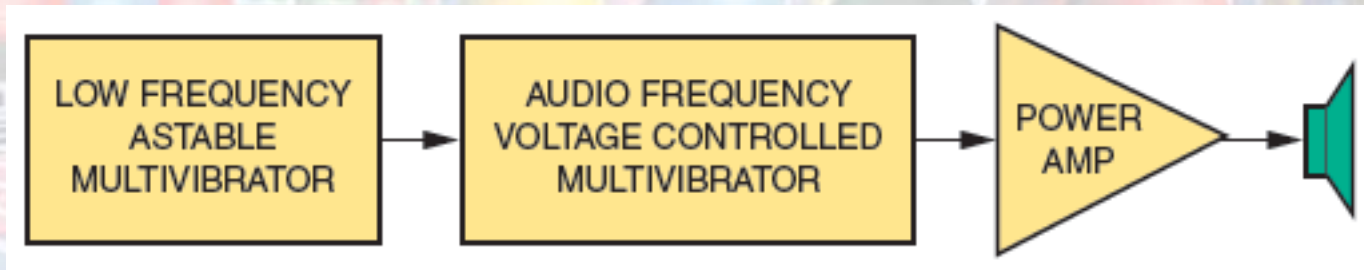


Figure 38-11. Block diagram.

Schematic Diagram (cont'd.)

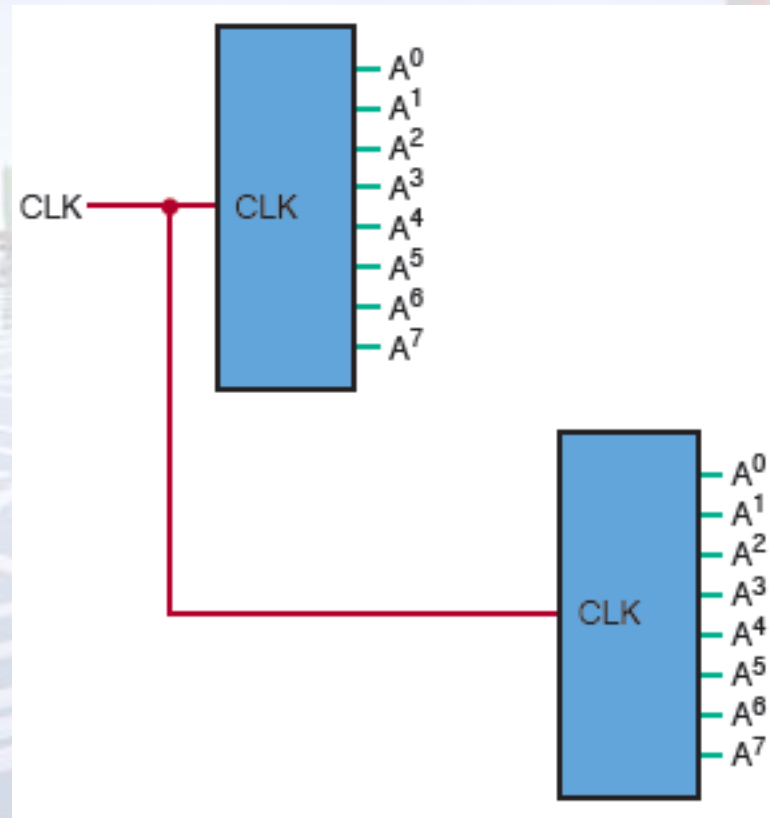


Figure 38-12. Label common signals in digital circuits.

Schematic Diagram (cont'd.)

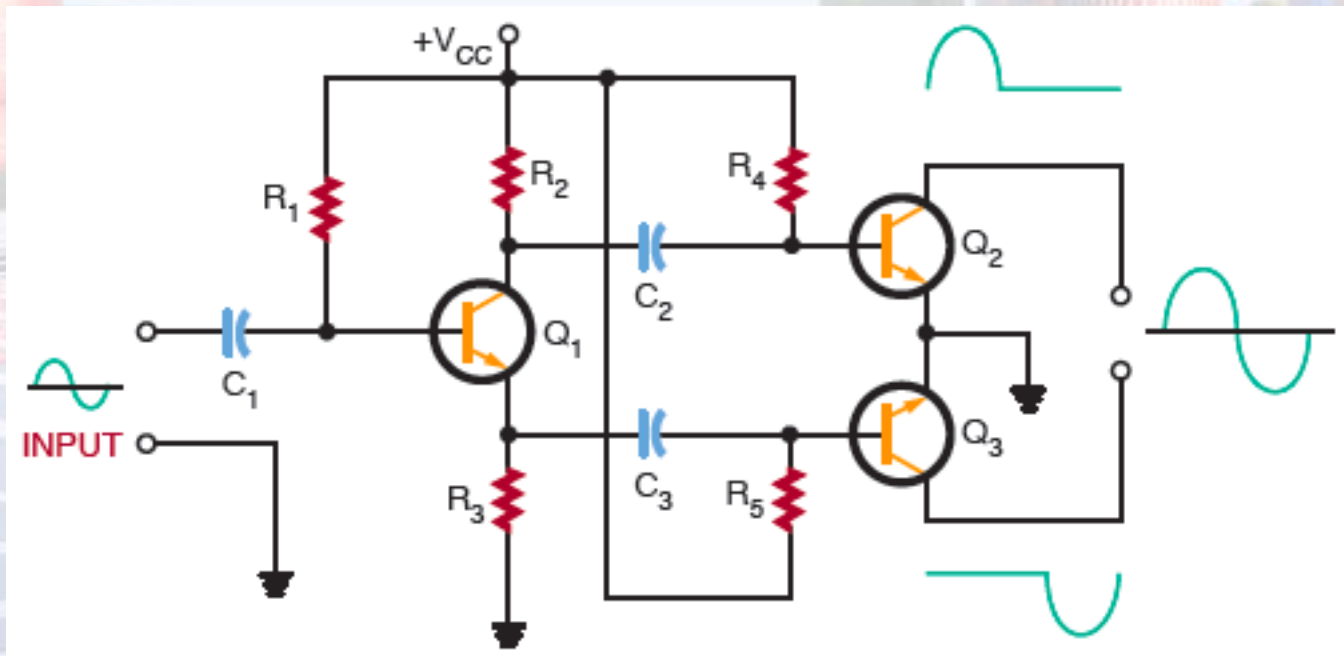


Figure 38-13. Signal flows from left to right, voltage potential has highest potential at top.

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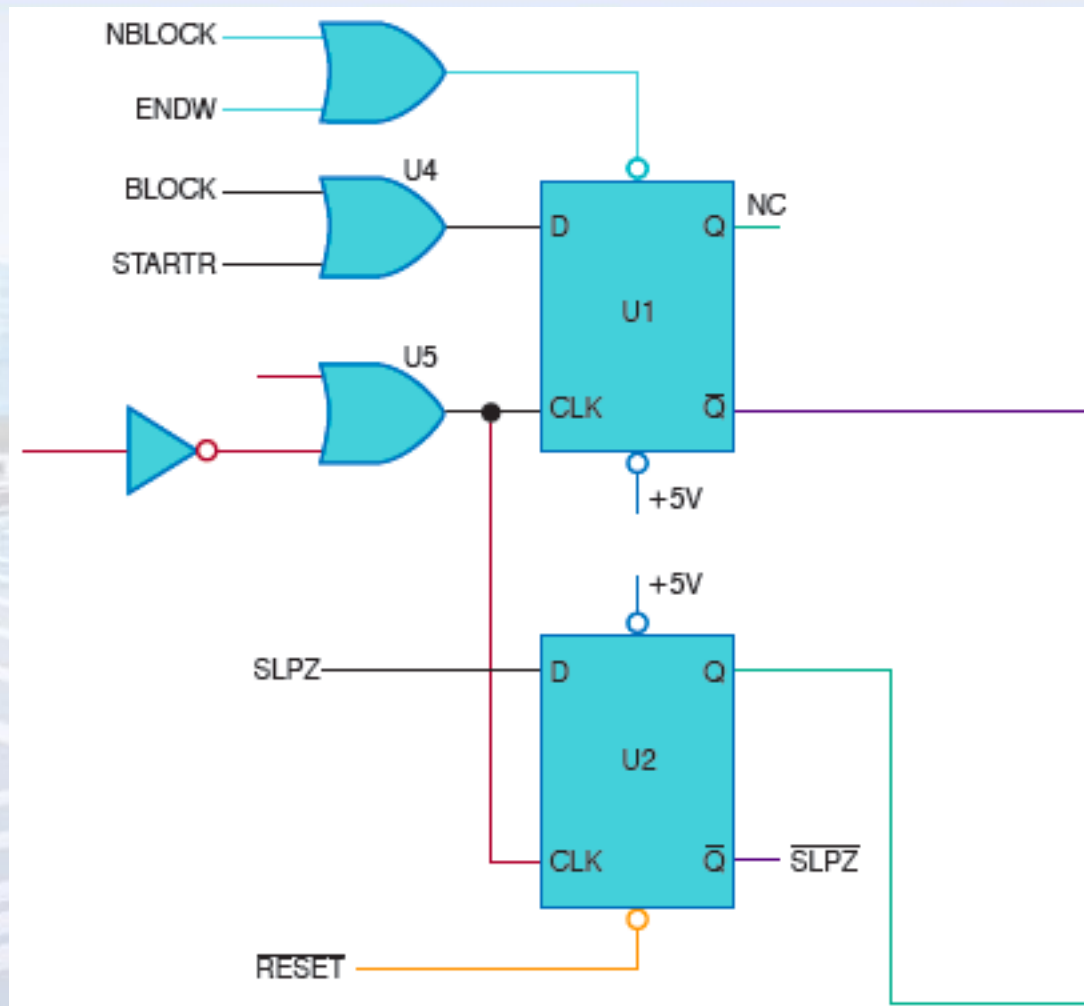


Figure 38-14. Use signal abbreviations rather than draw a maze of lines.

Schematic Diagram (cont'd.)

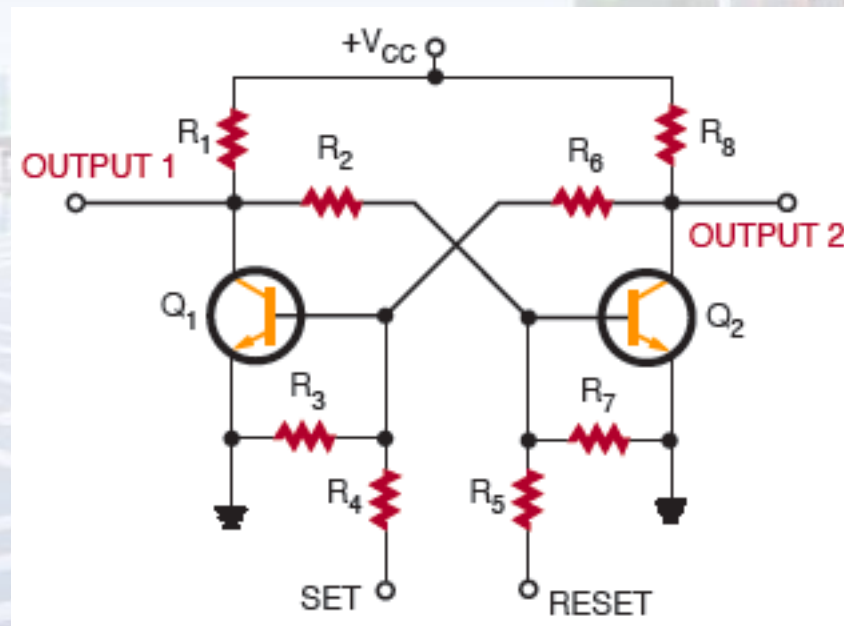


Figure 38-15. Label components starting at the left side and move top to bottom repeating across the schematic.

Breadboarding

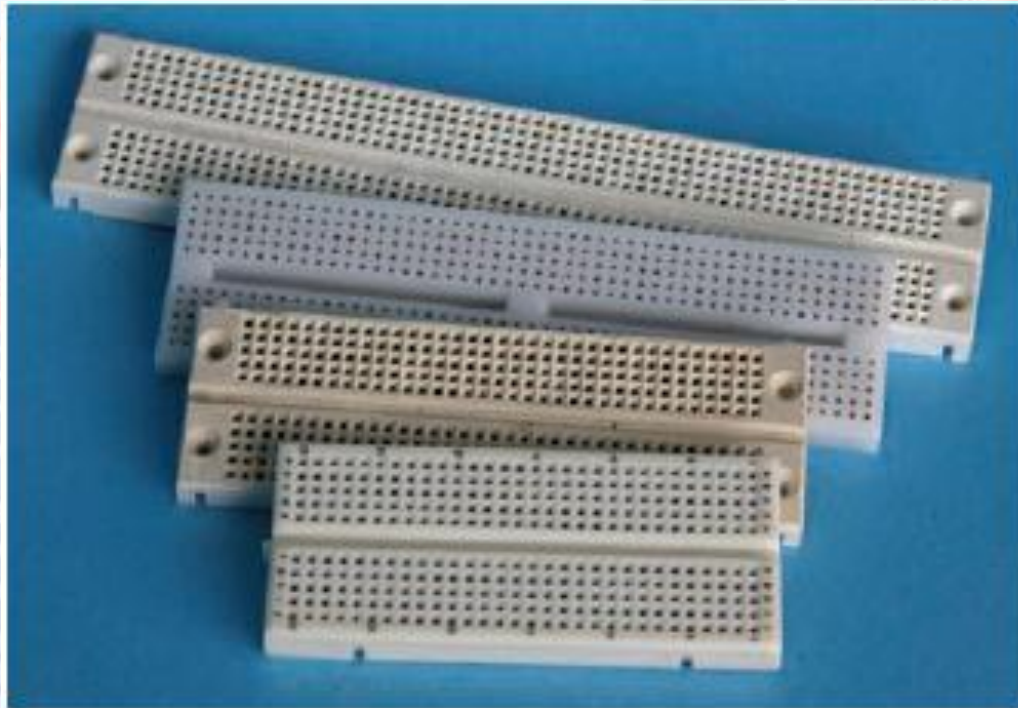


Figure 38-19. Solderless breadboards.

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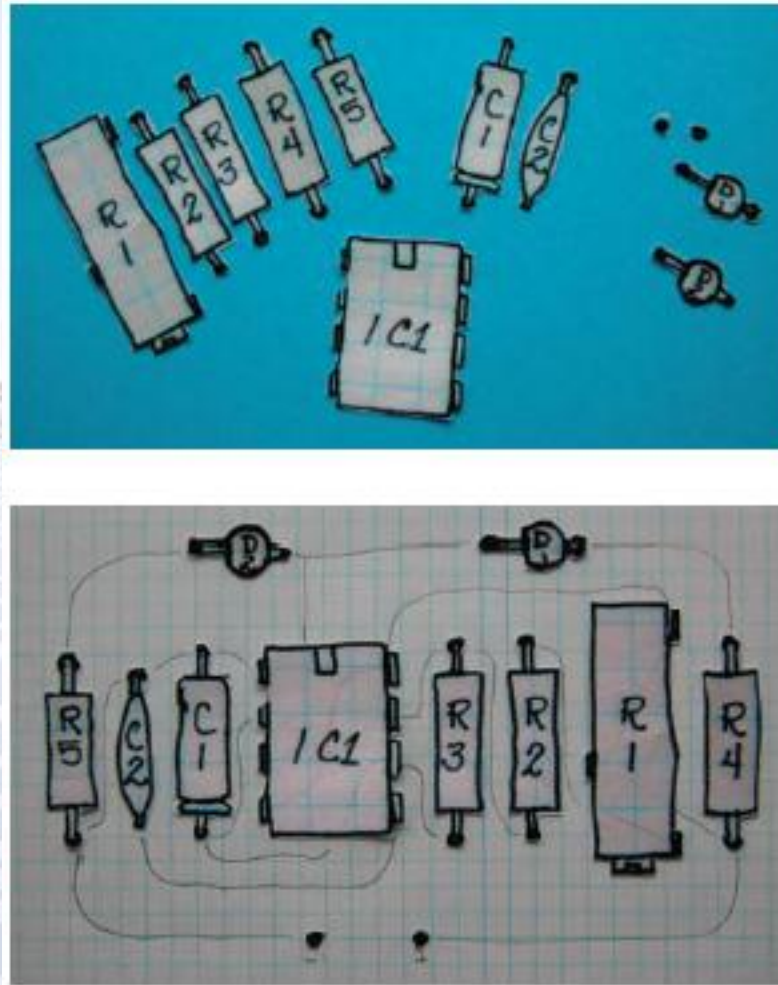


Figure 38-20. Using paper dolls for laying out a printed circuit board design.

Laying Out Printed Circuit Boards (cont'd.)

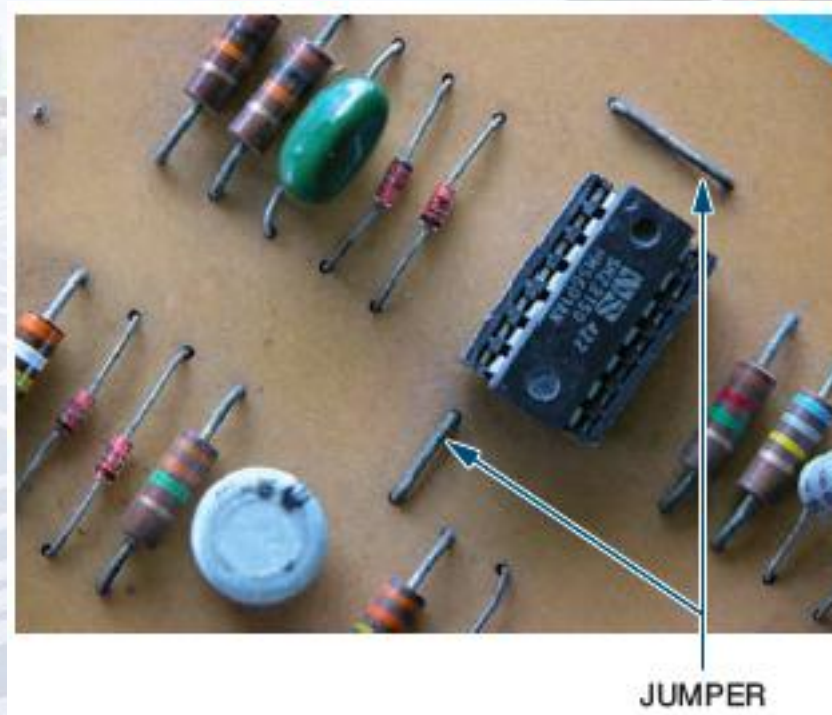


Figure 38-22. Single-sided printed circuit board using jumpers.

Transferring Designs

- Hand-draw the design on the board
 - Resist pen
 - Permanent marker with a very fine tip
- Positive film transparency
- Screenprinting

Etching Printed Circuit Boards

- Techniques for removing excess copper
 - Use a mild acid such as:
 - Ferric chloride
 - Ammonia persulphate
 - Use a CAD type program and a CNC (computer numerical control) machine

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Figure 38-28. Examples of commercial spray etchers.

Preparing the Etched Printed Circuit Board



Figure 38-32. High-speed drill for drilling holes in a printed circuit board.

Preparing the Etched Printed Circuit Board (cont'd.)

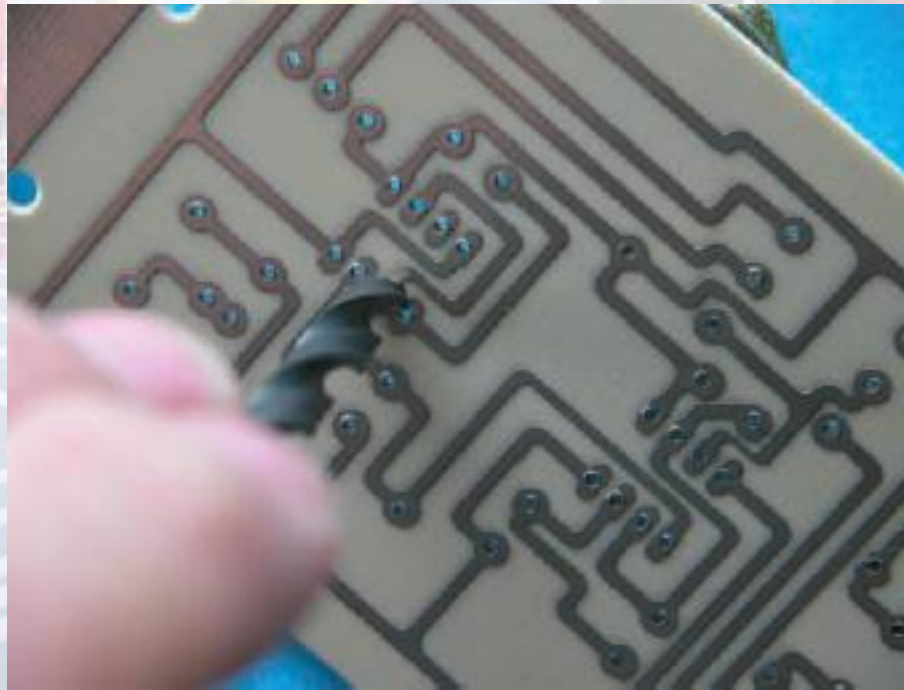


Figure 38-33. Removing burrs from drilled holes.

Material Safety Data Sheet

- MSDSs should be kept on file
 - To help protect from injury and exposure hazards
 - It is required by law

Summary

- A schematic diagram should show the entire circuit in as few drawings as possible
- Transferring the artwork to a copper-clad board
 - Can be done by hand, with transparency film, and through screenprinting

Summary (cont'd.)

- To remove copper from a copper-clad board to form a printed circuit board
 - Use a mild acid or a CAD-type program with a CNC machine
- Use a high-speed drill for drilling all holes in a printed circuit board
- Material Safety Data Sheet (MSDS)
 - Data needed for the safe handling and storage of the hazardous substance