IME 100 - ELECTRONIC MANUFACTURING I

BASIC CLASS NOTES **NOVEMBER 9, 2015**

Reading Review and Class Preparation
This should be filled out prior to class.

Key Concepts to Be Discussed in Class:

Questions About Subject Matter for Class Session:

So What? Why? Who Cares?

- Most Electrical Devices We Use Today Would Not Be Possible
  - If Everything had to be hard wired?
  - Electric Controls are Everywhere

Outline

- Circuits on Circuits on Circuits
  - Dissect the Populated Circuit Board

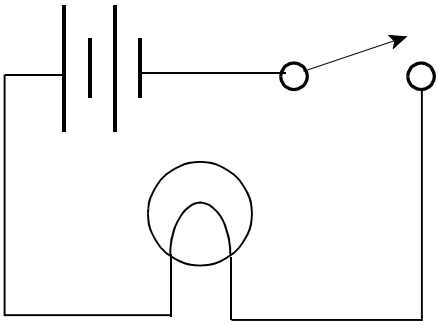
- The Board Itself
  - Fabrication
  - Component Placement and Connection

- The IC Package

- The Integrated Circuit
  - Component Creation
  - Circuit Creation

Electrical Circuits

- Definition of Circuit
  - A Closed Path for Electricity to Flow in Order to Achieve a Specific Purpose
- Circuits Can Be
  - Hard Wired
  - On a Printed Circuit Board
  - On a Silicon Chip Inside a Package

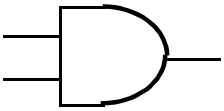
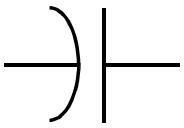
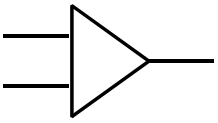
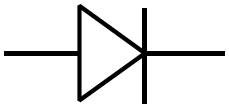
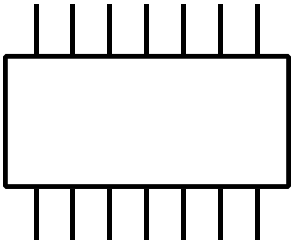
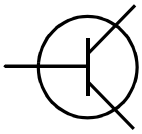


Light Bulb With a Battery and Switch

Concept Question

- Obviously Circuits Can Be More Complicated than the one Shown
- What is Necessary for the Light Bulb Circuit to Work?
- What Similar Things Would be Necessary for a Circuit Mounted to a Board?

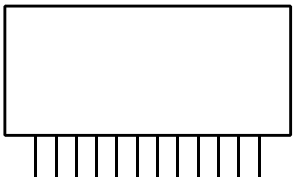
Electrical Components

Resistor 	AND Gate 
Capacitor 	Op Amp 
Diode 	Integrated Circuit 
Transistor 	

Mounting of Board

- The Circuit Board Must Be Made Part of the Larger Assembly
  - Programmable Thermostat
  - Computer
  - Automotive Sensing Unit

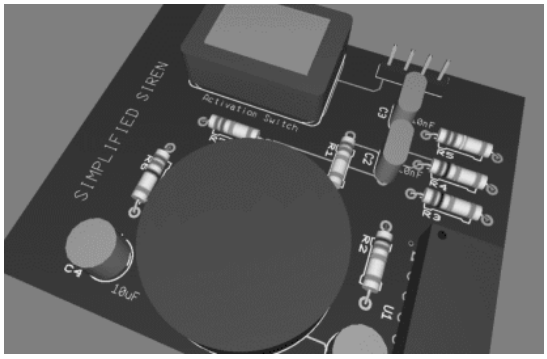
Hard Mount

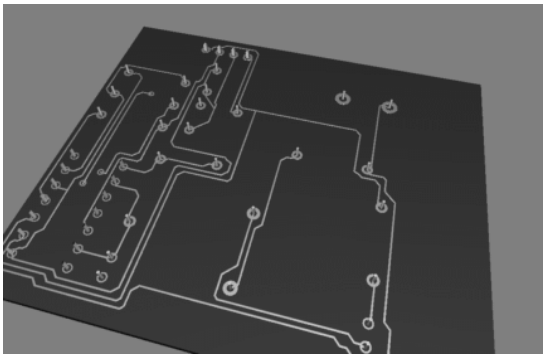


Connected Mount

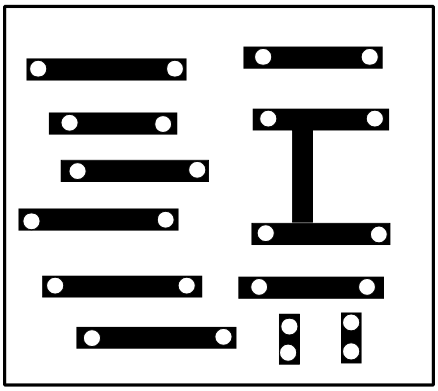
Concept Question

- Determine the Steps Needed to Make a Printed Circuit Board
  - Make a Sketch if It Helps
  - Consider the Last Four Slides
  - Try to Order Them
  - What is the End Product?



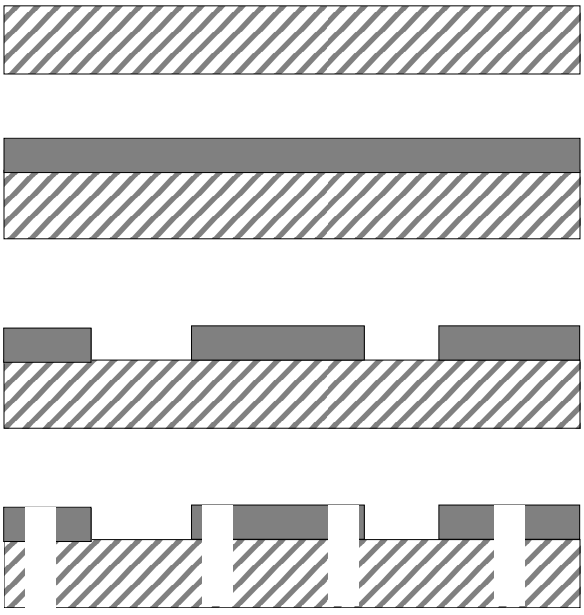


From: Prof. M. Thompson



The Goal

- A Board on Which Components Can Be Placed
  - Appropriate Electrical Connections Made
  - Appropriate Insulation
  - Holes

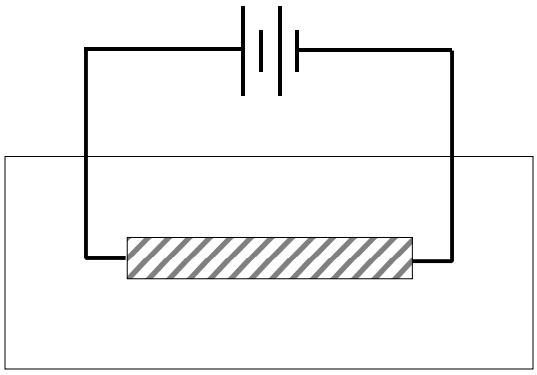


The General Process

- Start With Insulating Material
- Place Copper on Top
- Remove Unwanted Copper
- Drill Holes

Step One - Copper on Board

- Board
  - Insulating Polymer
  - FR-4 (Resinated Glass Cloth) Most Common
- Copper Application
  - Plating (Dipping)
  - Electrolytic Process
  - $7x10^{-4}$mm/min
  - 320 A/m^2

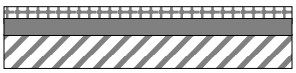
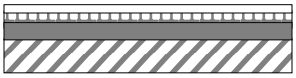
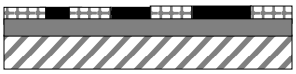
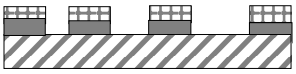
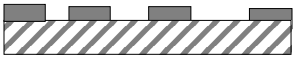


Electrolytic Process

Plating Enhanced by Application of Electric Current

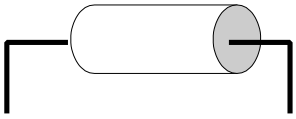
Removal of Copper

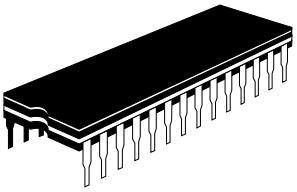
- Copper Removed From Areas
  - Provide Resistance
  - Only Required Connections Remain
- Five Step Process
  - PhotoResist Application
  - LayOut of Pattern
  - Exposure
  - Etching
  - Resist Removal

Copper Placed On FR-4	
Resist Placed on Copper	
Pattern and Exposure	
After Exposure Resist Changes	
Etching Removes Exposed Resist and Copper	
Remove Remaining Resist	
Ready for Drilling and Component Placement	

Mounting of Components

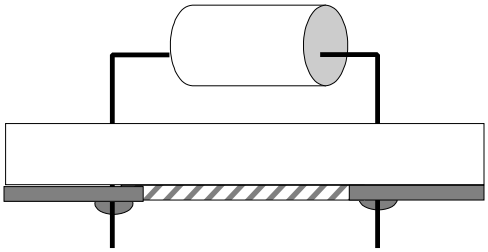
- Components
  - Oddly Shaped
  - Have Different No. of Leads
- Must Be Fixed
  - Can't Move Around
  - Fall Off





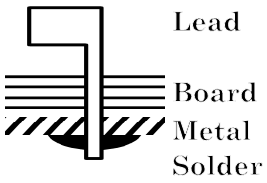
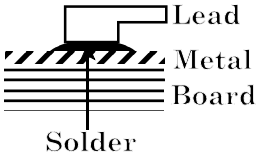
Establishing Electrical Connection

- The Components
  - Must Be Connected Electrically
  - Insulated From Each Other
- Electrical Connection
  - Requires Metal Path
  - Requires Connection to Path



Component Placement

- Through Hole
  - Connection on Bottom
  - Components on Top
  - Solder Applied After Placement
- Surface Mount
  - Connection on Top
  - Components on Top
  - Solder Applied Before Placement

	
Through-Hole	Surface Mount