Electrical and Electronic Drawing

Part 1: Electronic Components

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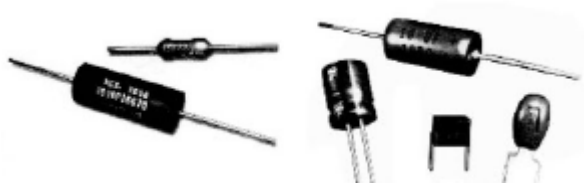
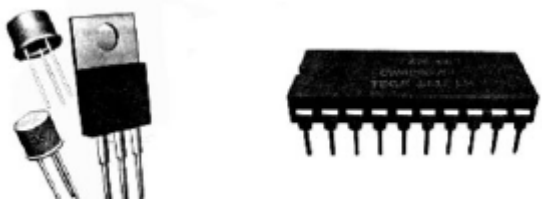
Basics of Electronic Components

- An electronic component is any device that handles electricity.
- Electronic components come in many different shapes and sizes, and perform different electrical functions depending upon the purpose for which they are used.
- Electronic equipment make use of a variety of components.

Active vs. Passive Components



- Passive
  - One that contributes no power gain (amplification) to a circuit or system
  - No control action and does not require any input other than a signal to perform its function



- Active
  - Capable of controlling voltages or currents and can create a switching action in the circuit
  - Can amplify or interpret a signal

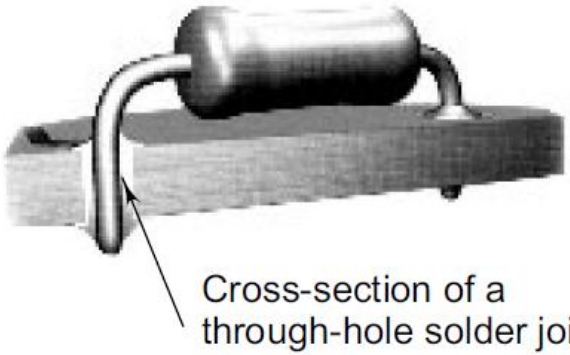
Discrete vs Integrated Circuits

- When a component is packaged with one or two functional elements, it is known as a *discrete* component
  - Examples: resistors, inductors and capacitors

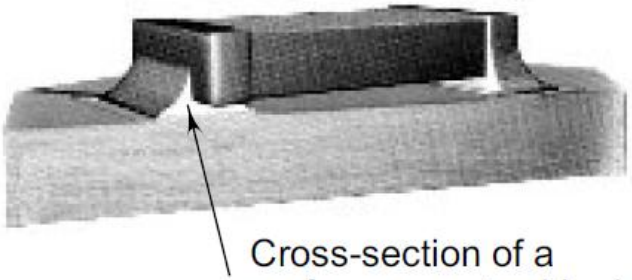
- An *integrated circuit* is a combination of several interconnected discrete components packaged in a single case to perform multiple functions
  - Examples: microprocessors and OP AMPs

Component Leads

- Two types on the basis of the method of their attachment to the circuit board
  - Through-hole components
  - Surface mount components



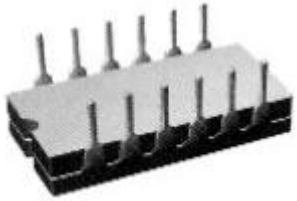
Cross-section of a through-hole solder joint

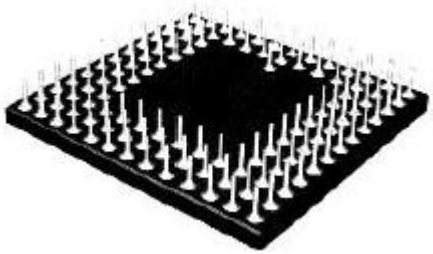


Cross-section of a surface mount solder joint

Component Leads: Examples

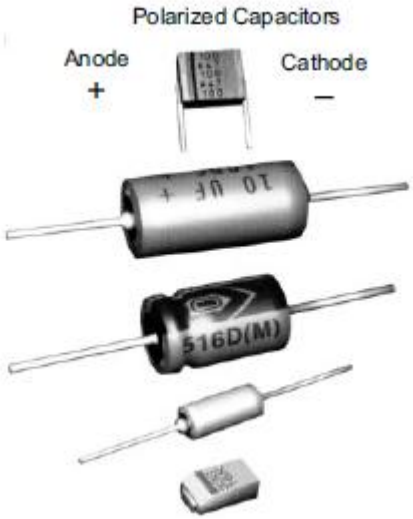
- Components with axial leads
- Components with radial leads
- Single-in-line package (SIL)
- Dual-inline package (DIP)
- Pin grid arrays (PGA)
- Ball grid arrays (BGA)
- Leadless components

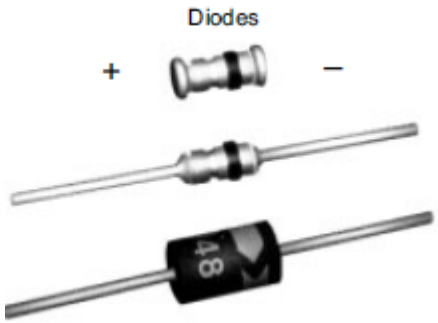




Polarity in Components

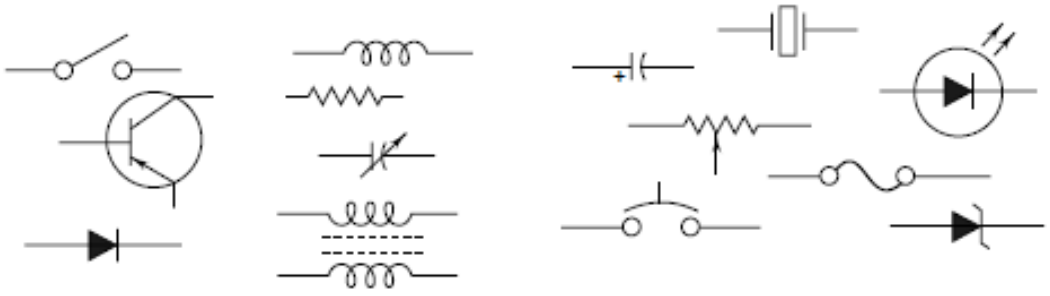
- Some components are polarized and therefore have leads which are marked with positive and negative polarity
  - Must be placed on the board in the correct orientation
  - Examples: electrolytic capacitors and diodes



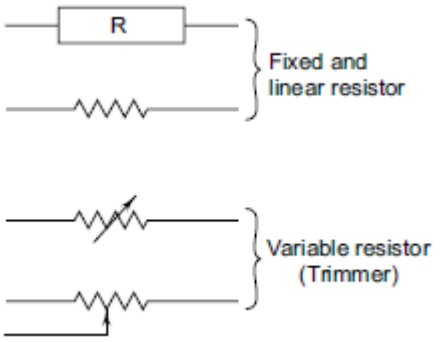


Component Symbols

- Each discrete component has a specific symbol when represented on a schematic diagram
  - Standardized and specified in the IEEE standard 315 and 315A (ANSI Y32.2)
- Integrated circuits are generally represented by a block in the schematic diagram
  - Do not have a specific symbol



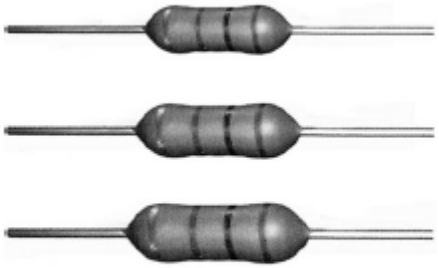
Resistors



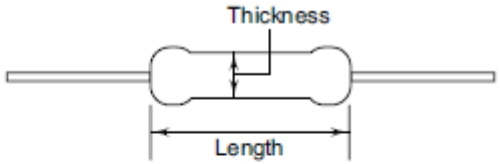
- Fixed or variable
- Carbon
  - Good in high frequency
  - Limited accuracy to 1%
  - Drift with temperature and vibration
- Metal film
  - stable under temperature and vibration
  - Reach accuracies of 0.1% in precision films
- Wire-wound Resistors
  - Very high accuracy possible

Resistors: Examples

- Carbon film



From the top of the photograph
1/8W
1/4W
1/2W

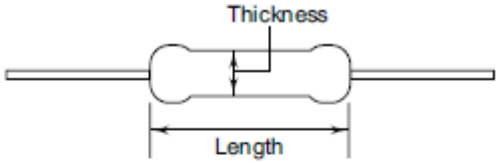


Approximate size

Rating power (W)	Thickness (mm)	Length (mm)
1/8	2	3
1/4	2	6
1/2	3	9

- Metal Film

From the top of the photograph
1/8W (tolerance ± 1%)
1/4W (tolerance ± 1%)
1W (tolerance ± 5%)
2W (tolerance ± 5%)

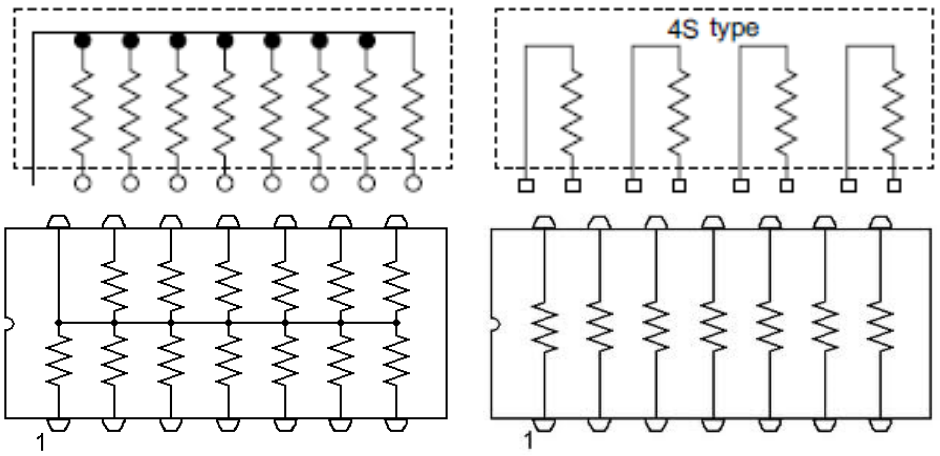


Approximate size

Rating power (W)	Thickness (mm)	Length (mm)
1/8	2	3
1/4	2	6
1	3.5	12
2	5	15

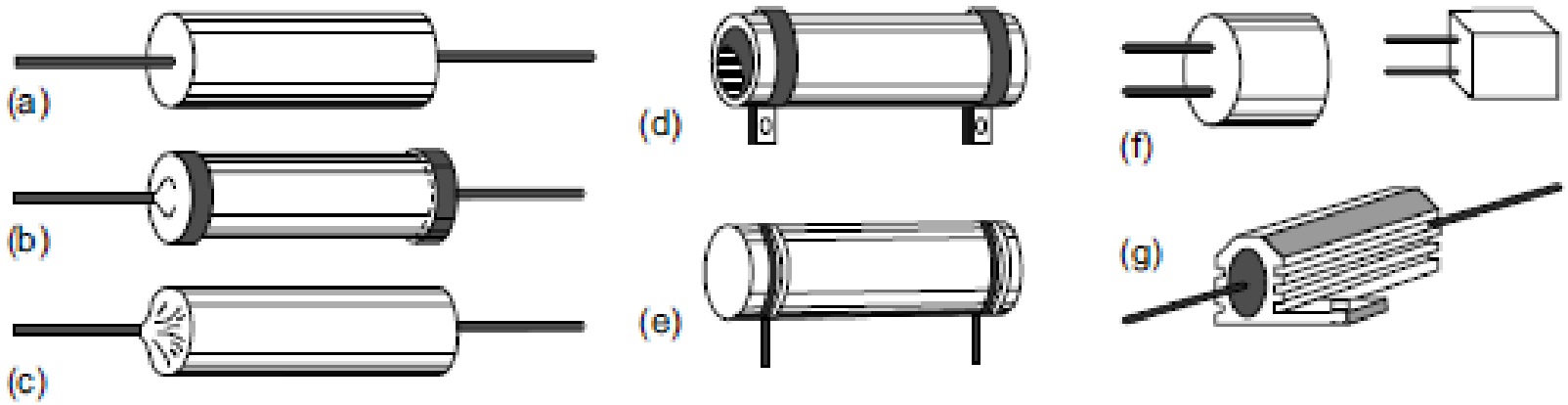
Resistors: Thick Film Networks

- precious metals in a glass binding system which have been screened on to a ceramic substrate and fired at high temperatures
  - Miniaturization and rugged construction
  - Inherently reliable, not subject to catastrophic failures
  - SIL or DIP packages



Resistors: Packages

- (a),(b),(c) Cylindrical package with axial leads
- (d), (e) Cylindrical package with radial leads
- (f) radial package with radial lead
- (g) high-power package, with axial leads and copper body for increased heat dissipation



Resistors: Characteristics

- Resistance
- Tolerance
- Power Rating
- Temperature Coefficient (hot spot temperature)
- Stability or Drift
- Noise
- Parasitic Effects
- Maximum Voltage
- Identifiation

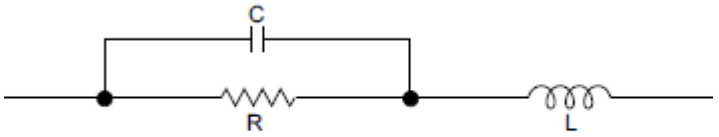


Fig. 2.10 Lumped model of a resistor C = 0.1-2 pf, L = 0.1 μH (for a leaded component)

Resistors: Values

- Code

F = ± 1% G = ± 2% j = ± 5%

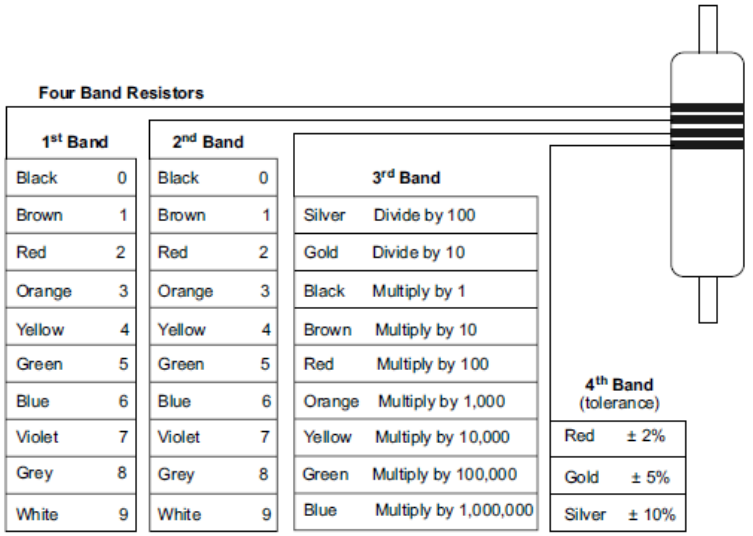
K = ± 10% M = ± 20%±

R 68M is a 0.68 Ω ± 20% resistor

5K 6J is a 5.6 kΩ ± 5% resistor

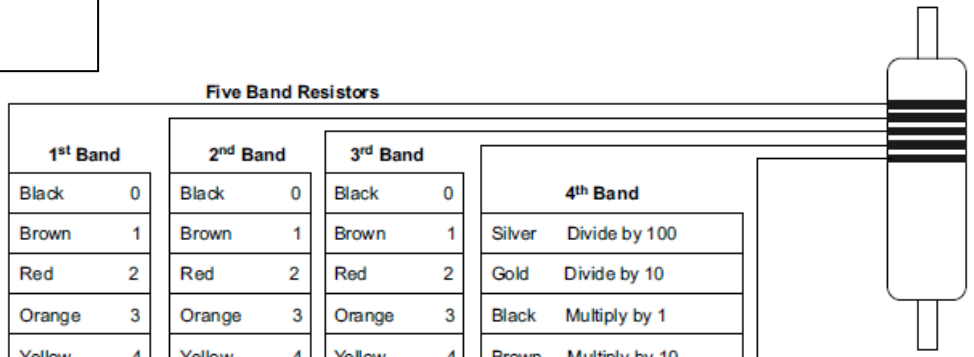
82KK is 82 kΩ ± 10% resistor

- Preferred range:
  - E 12 series (common): 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82
  - E 96 series: for ± 1%



Four Band Resistors

1st Band		2nd Band		3rd Band		4th Band (tolerance)	
Black	0	Black	0	Silver	Divide by 100	Red	± 2%
Brown	1	Brown	1	Gold	Divide by 10	Gold	± 5%
Red	2	Red	2	Black	Multiply by 1	Silver	± 10%
Orange	3	Orange	3	Brown	Multiply by 10		
Yellow	4	Yellow	4	Red	Multiply by 100		
Green	5	Green	5	Orange	Multiply by 1,000		
Blue	6	Blue	6	Yellow	Multiply by 10,000		
Violet	7	Violet	7	Green	Multiply by 100,000		
Grey	8	Grey	8	Blue	Multiply by 1,000,000		
White	9	White	9				



Five Band Resistors

1st Band		2nd Band		3rd Band		4th Band		5th Band (tolerance)	
Black	0	Black	0	Black	0	Silver	Divide by 100	Brown	± 1%
Brown	1	Brown	1	Brown	1	Gold	Divide by 10	Red	± 2%
Red	2	Red	2	Red	2	Black	Multiply by 1	Gold	± 5%
Orange	3	Orange	3	Orange	3	Brown	Multiply by 10	Silver	± 10%
Yellow	4	Yellow	4	Yellow	4	Red	Multiply by 100		
Green	5	Green	5	Green	5	Orange	Multiply by 1,000		
Blue	6	Blue	6	Blue	6	Yellow	Multiply by 10,000		
Violet	7	Violet	7	Violet	7	Green	Multiply by 100,000		
Grey	8	Grey	8	Grey	8	Blue	Multiply by 1,000,000		
White	9	White	9	White	9				

Assignments

- Visit Digikey Corp. web site (www.digikey.com) and select sample 10 resistor values for different types/packages discussed in this lecture. Report the specifications (including catalog page number and picture) of each and include your comments about the cost of different types.