

Workshop Part Identification Lecture



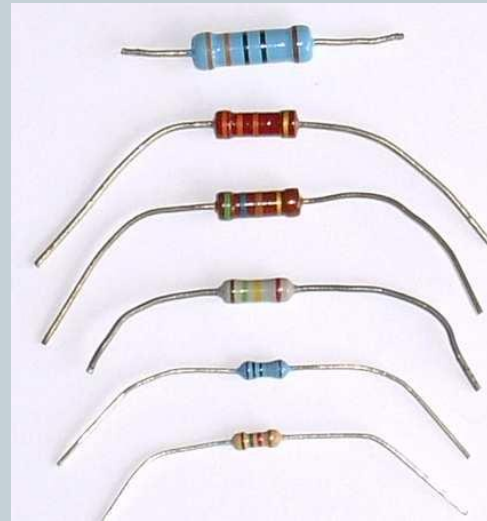
NIAGARA COLLEGE TECHNOLOGY DEPT.



Identifying Resistors



- Resistors can be either fixed or variable. The variable kind are called “potentiometers” or “pots” or “trim resistor”.
- They can be VERY large, or VERY small.



Type of Resistors



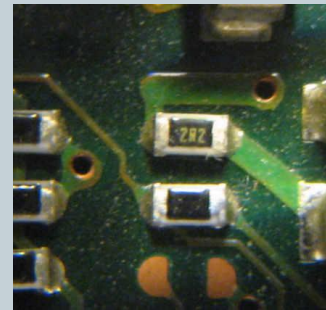
- Resistors are made of different materials depending on the application, accuracy, power dissipation and size.



Wire Wound
Power Resistors
-Large currents



-Carbon Film
-Carbon Composite
-Metal Film
-Metal Oxide Film



-Thick Film
-Chip Resistor
-Surface Mount (SMT)

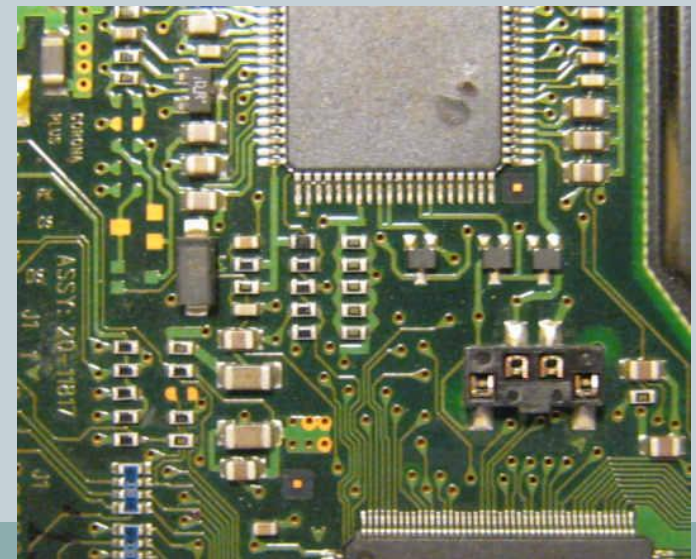
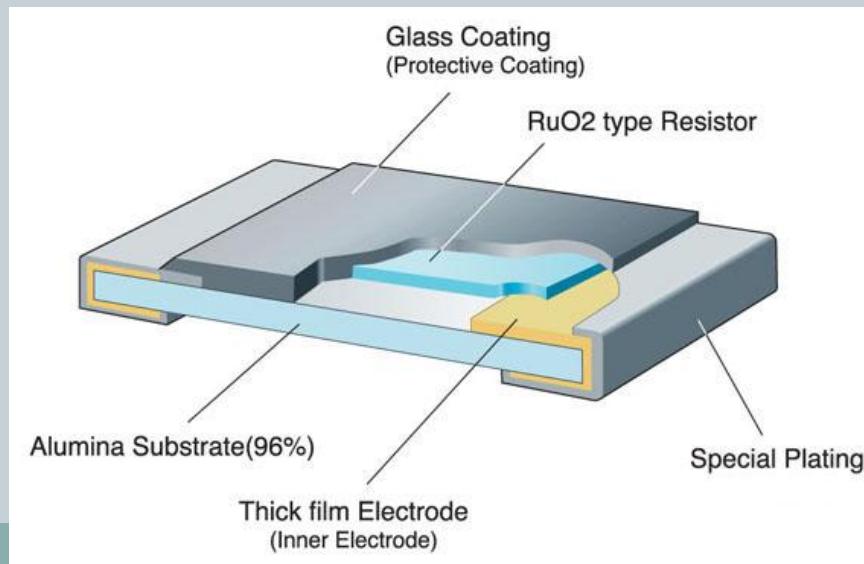


-Shunt Resistor
-Typically Copper Bar
-Large currents, ultra low resistance, used for measuring current flow

SMT Resistors



- SMT or surface mount resistors are VERY common in electronic products. They commonly vary from $\frac{1}{4}$ " (6.35 mm) to 0.04" (1 mm) in length.
- A common sizing description uses length/width in tens of thousandths of an inch: ie 2512 = 0.250" x 0.120" and 0402 = 0.040" x 0.020".



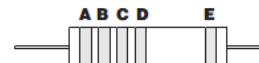
Resistor Value Identification

- Three major types of resistor identification:
 - 4 Band (most common)
 - 5 Band
 - Letter Labelled
- Different manufacturers may have different rules.

Resistor Colour Codes

Five Band Precision Resistor

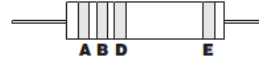
Note:(1) Bands A to D are grouped together.
 (2) Band E is tolerance



	Band A	Band B	Band C	Band D	Band E	Band F
Colour	First Digit	Second Digit	Third Digit	Multiplier	Tolerance	Reliability
Black		0	0	1		
Brown	1	1	1	10	± 1 %	1 %
Red	2	2	2	100	± 2 %	0.1 %
Orange	3	3	3	1000	± 3 %	0.01 %
Yellow	4	4	4	10,000	± 4 %	0.001 %
Green	5	5	5	100,000	± 0.5 %	
Blue	6	6	6	1,000,000	± 0.25 %	
Violet	7	7	7	10,000,000	± 0.1 %	
Gray	8	8	8	100,000,000		
White	9	9	9	1,000,000,000		
Gold				0.1	± 5 %	
Silver				0.01	± 10 %	
No Colour					± 20 %	
	Band A	Band B	Band C	Band D	Band E	

Standard Four Band Resistor

Note:(1) Bands 1 to 3 are grouped together.
 (2) Band 4 is tolerance



Five Band Resistor with Reliability Band

Note:(1) These are composition type resistors.
 (2) Bands are evenly spaced



Resistor Value Identification



- Resistor Number Codes

- Physically larger resistors tend to have letter markings indicating their resistance value. The letter used indicates both the multiplier and the position of the decimal place. Many different systems and schemes.

- R01 = 0.01 Ω
- 1R5 = 1 Ω 5 = 1.5 Ω
- 4k7 = 4.7k Ω
- 22 = 22R = 22 Ω
- 470 = 470 Ω
- 33M = 33M Ω



Resistor Value Identification



- Resistor Number Codes

- Large Resistors also have tolerances. They are represented by letters.

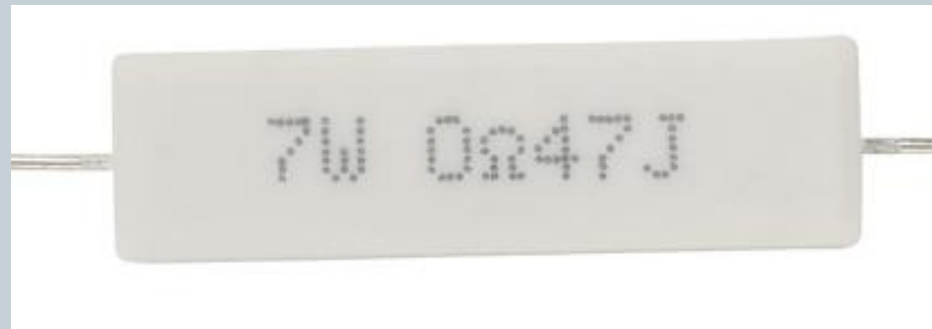
- F = 1%

- G = 2%

- J = 5%

- K = 10%

- M = 20%



Example: above resistor = 0.47 Ω 5%, 7W

A Note on SMT Resistor Values



There are several ways manufacturers mark their SMT resistors.

- Three or Four #: Digit, Digit, Multiplier

- Ex: 103=10k Ω



- Letter Digits: Same as ceramic resistors

- Ex: 6R2=6.2 Ω , 3m Ω F=0.003 Ω /1% & R005=0.005 Ω



- Some manufacturer have special codes or no markings at all. The tiniest resistors may have no markings, as they are robotically picked and placed.

Identifying Capacitors



Capacitors are devices that hold electrons, just like a water tank holds water. Their unit is Farad.

- **Size:** Can be very small (2mm x 2mm x 1mm), to extremely large (12” high x 4” dia and much larger!).
- **Polarity:** Some are non-polarized, others ARE polarized.
- **Material:** The dielectric can be paper, glass, tantalum, ceramic, plastics, etc...
- **Voltage:** Caps are designed to withstand a fixed amount of voltage between their plates.

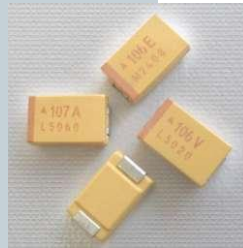
Capacitor Types



- Polarized Capacitors:

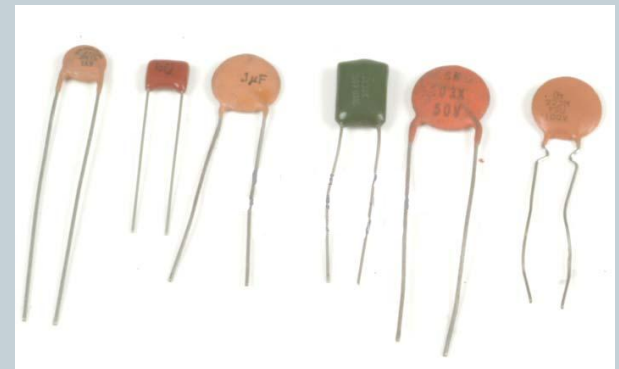
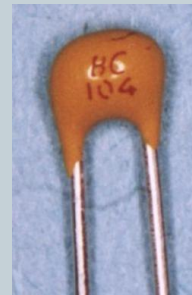
- Electrolytic

- Tantalum



- Non-Polarized Capacitors:

- Ceramic



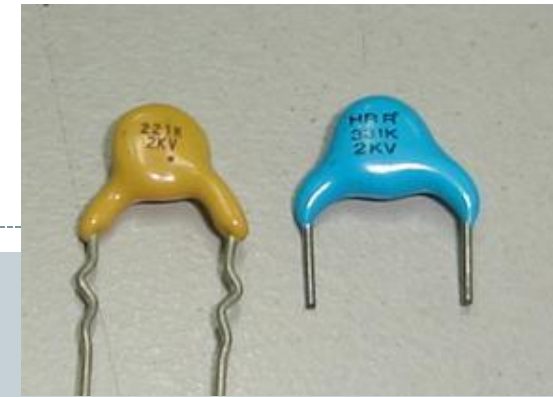
Capacitor Value



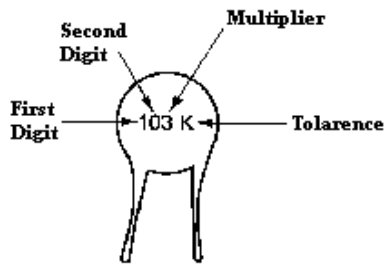
- Most large capacitors have their value indicated on them, typically in μF or mF .
- Tolerance values can be $-50\%/+100\%$, $-20\%/+80\%$, simply $\pm 20\%$, or 5% or better, but cost a lot more!
- Ex: $68\mu\text{F}$, with a maximum 400V
- Ex2: $47\mu\text{F}$, with a maximum 400V



Ceramic Capacitor Value



- Smaller capacitors are measured in pF (Pico-Farad).



Capacitor Value Codes						
1st Digit	2nd Digit	3rd Digit	Multiplier	Tolerance 10pF or less	Tolerance Over 10pF	Letter
0	0	0	1			
1	1	1	10	±0.1pF		B
2	2	2	100	±0.25pF		C
3	3	3	1,000	±0.5pF		D
4	4	4	10,000	±1pF	±1%	F
5	5	5	100,000	±2pF	±2%	G
6	6	-	Not Used		±3%	H
7	7	-	Not Used		±5%	J
8	8	8	0.01		±10%	K
9	9	9	0.1		±20%	M

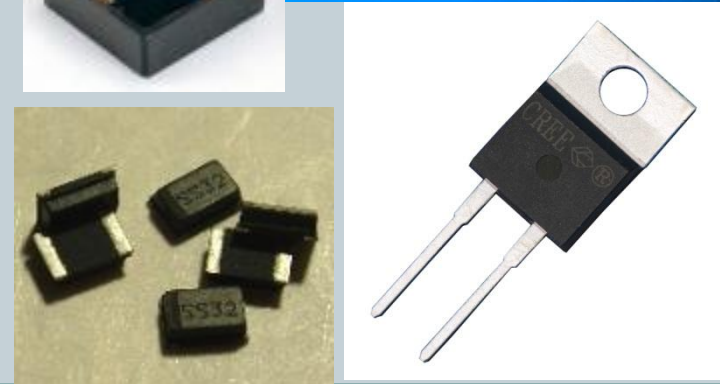
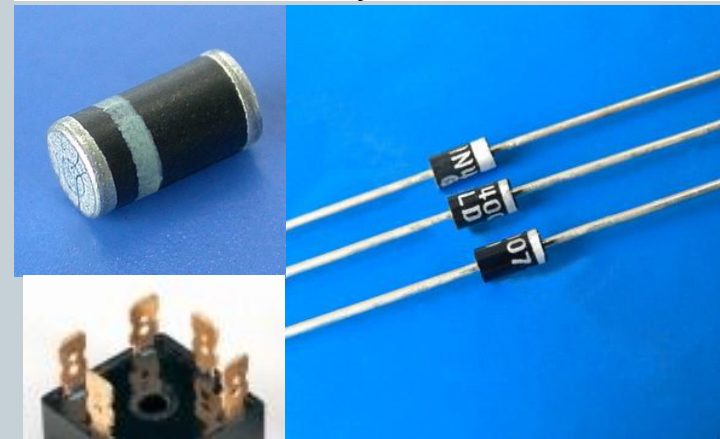
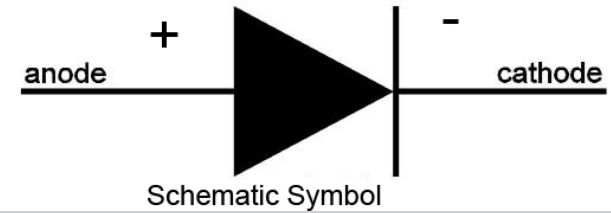
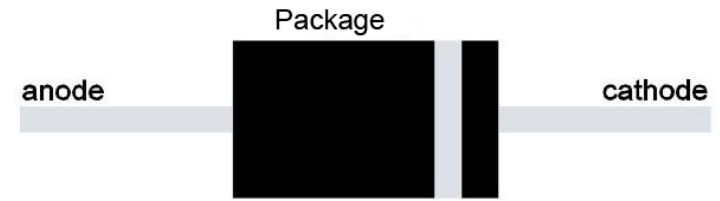


Ex: '10' x 1000pF = 10nF 20% = 0.01uF 20%

Diodes

Diodes are a one way electrical valve. Current can only go in one direction (ie. polarized).

- **VRRM:** Maximum reverse breakdown voltage.
- **V_f:** Forward voltage drop.
- **I_m:** Maximum forward current.
- **Package:** Typically axial, but can be in any package type. Metal housing for cooling in large diodes. Have a marking (usually a stripe) at one end to denote the cathode.

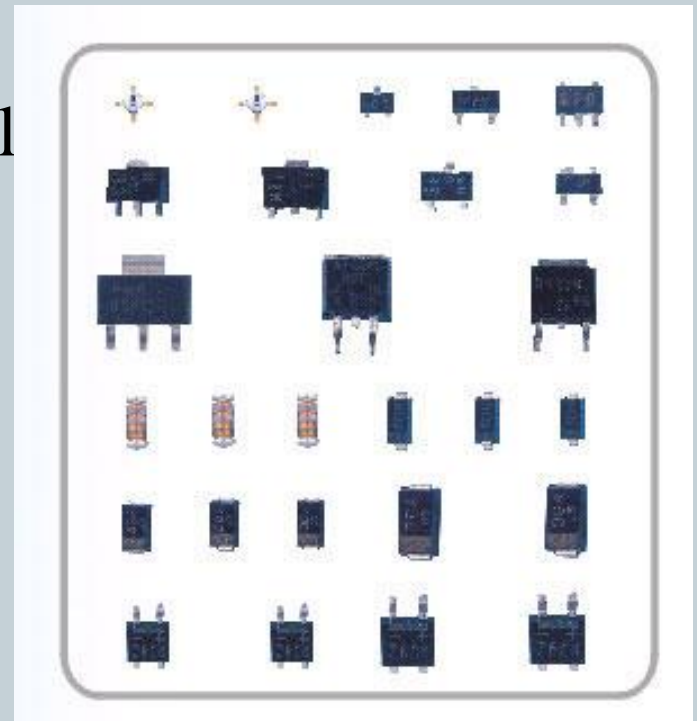




Schottky Diode

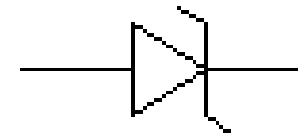


- Schottky diodes are special; their forward voltage drops are very low. They are used in the input of DC electronic equipment to protect against reverse polarity and in high efficient DC/DC switching converters.
- Packages range widely.

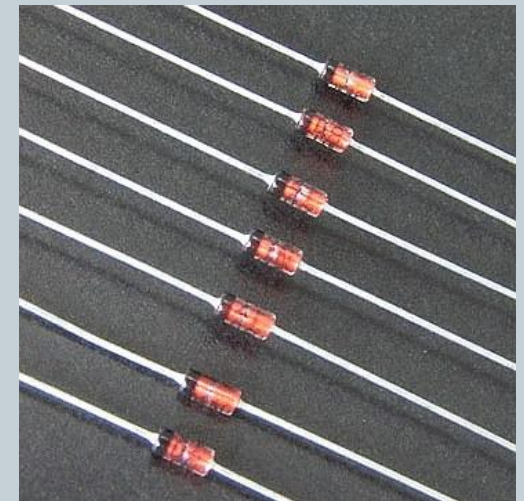




Zener Diodes



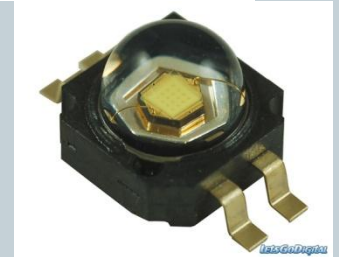
- Zener diodes are used in reverse bias, where a fixed voltage is created across it. They are designed for a small range of current. Must select accordingly.
- Often (but not always) low power zener diodes are glass construction, orange/red in colour, with a black bar denoting the cathode.





LEDs

- **LED: Light Emitting Diodes**
 - **Long leg = Positive (Anode)**
 - **Notch in glass = Negative (Cathode) side**
 - **CAUTION: Check datasheet to be sure!**
- **Intensity:** Varies from 1 milliCandela to multiple Candela
- **Size:** SMT to 3mm, 5mm etc..
- **Colour:** Single wave length, infrared -> visible spectrum -> ultra violet.





Fuses



- Fuses – protect electronic circuits from overcurrent – a filament ‘blows open’ when current too high – must be replaced after blowing.



- Fuse types
 - Type: slow blow, medium blow, fast blow, resettable
 - Current: wide range
 - Voltage: from a few volts to thousands of volts AC & DC
- Resettable Fuse:
 - PTC – Positive Temperature Coefficient. Very popular for new electronic devices. Resistance increases dramatically when heated thus reducing current to near zero, resistance drops back down when cooled (when overcurrent event removed). Slow reaction times compared to medium and fast blow fuses.

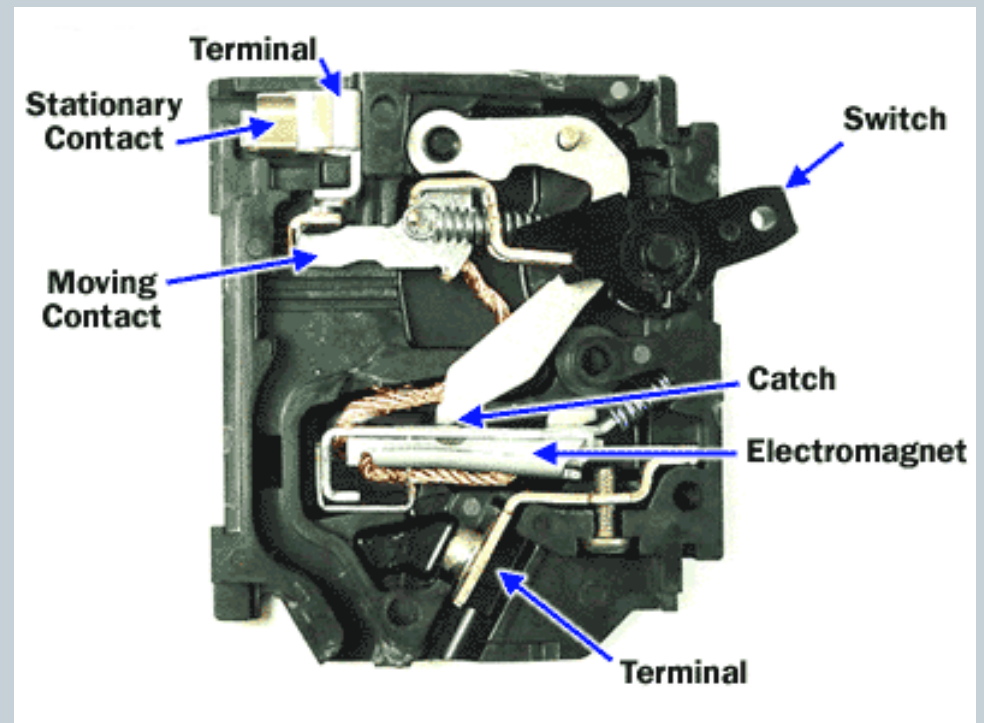


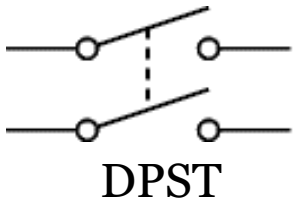


Breaker

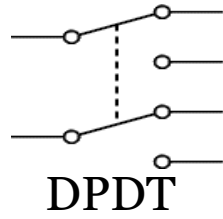


- Breakers are made of two different types of metals, where it bends when heated due to current. When it bends, the connection is tripped. They are resettable.





DPST

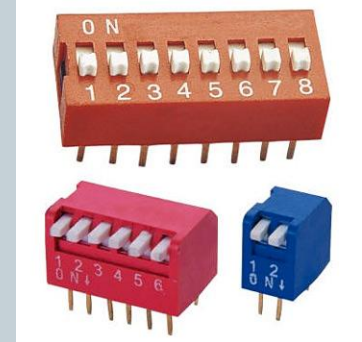


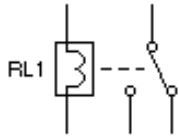
DPDT

Switches



- Switches interrupt current flow through a connection. Some terminology:
- **Poles:** How many contacts are changed in one event.
- **Throw:** Number of different positions
- **Types:** Rotary, Slide, Dip, Toggle, etc.
- **NO:** Normally Open
- **NC:** Normally Closed
- Latch vs. Momentary
 - Latch remains in position
 - Momentary is temporary





Relays



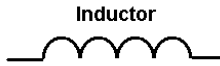
- Relays are electrically controlled switches
 - An input current through a coil activates a switch.
 - An input voltage triggers a solid state device to turn on/off.
- **Size:** Depends on current and voltage ratings



Solid State



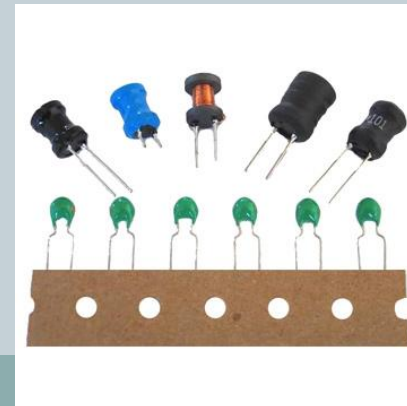
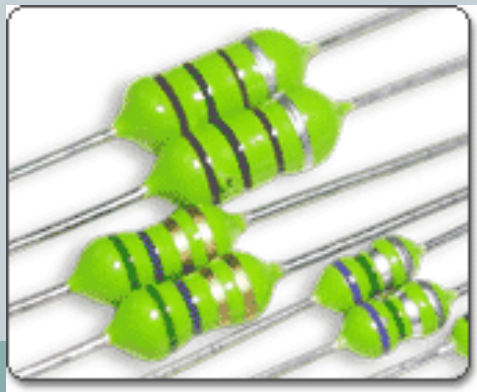
Mechanical Relay

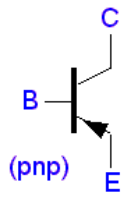
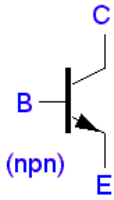


Inductors



- Inductors are coils that store magnetic energy created from electrical current. Units are **Henry (nH,uH,mH or H)**.
- Very useful for communications equipment, transformers, filters, converters, etc.
- Often coils consist of a wire wrapped around permeable magnetic materials to increase inductance value.
- Can be either color coded, number coded or non-marked.
- Can be SMT, coils, radial or axial lead, shielded/unshielded.



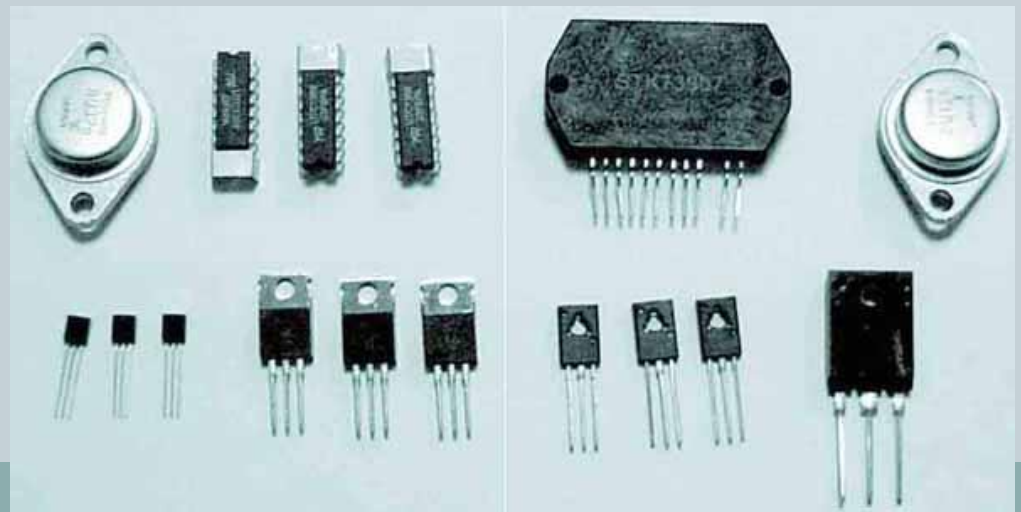
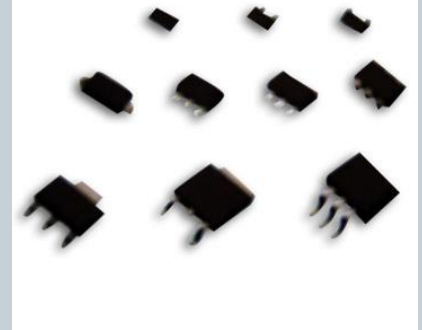


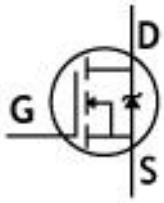
Transistors



Transistors are electronics current valves:

- **Three legs:** Collector, Base, Emitter
- **Types:** PNP and NPN
- **Power:** Can be low power, or high power
- **Gain:** Low gain, or high gain (Darlington)
- **Package:**
SMT, Through Hole,
Panel mount.

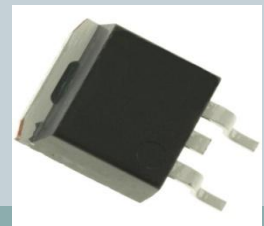
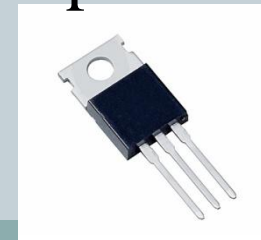
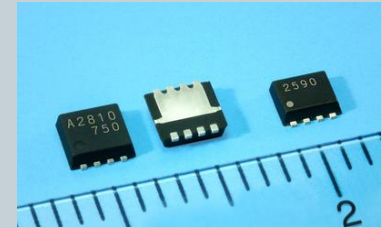




MOSFET



- MOSFETs are voltage controlled current valves:
 - Very low internal resistance
 - Good high-current control
 - Very sensitive to ESD
 - Some have built in ESD or over voltage protection
 - Some have overcurrent protection
- Three legged device: Drain, Gate, Source.
- Extremely popular for most modern electronics due to their ease of fabrication, and excellent properties.



Integrated Circuits (IC's)



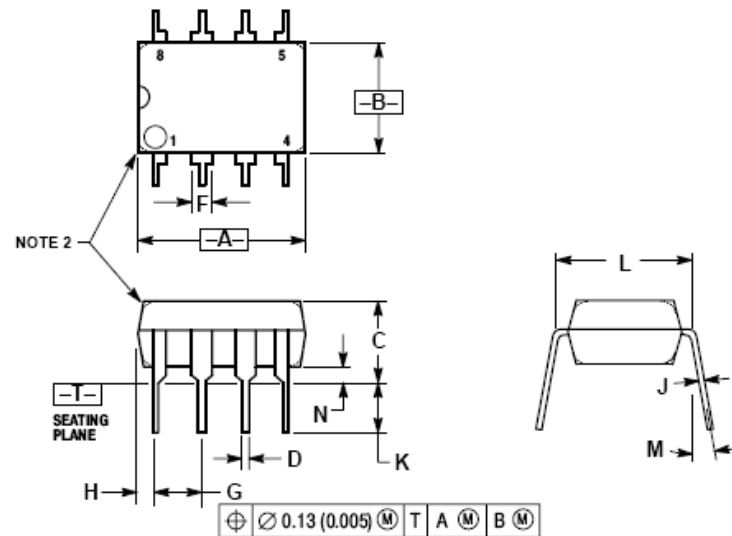
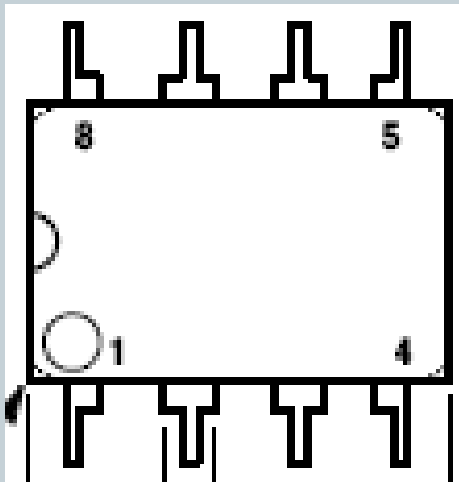
- Integrated Circuits come in a variety of sizes and packages:
- Dual In-line Package (DIP)
 - DIP IC's are used on through-hole Printed Circuit Boards
 - The same number of pins in a row on opposite sides of the package
 - 6, 8, 14, 16, 18, 20, 22, 24, 32, 40, 48 and 64 pins (narrow and wide)
 - Pin spacing conforms to JEDEC Standards and are typically 0.100"
 - Can be soldered directly to PCB or inserted into a socket making it more serviceable
 - Can be very sensitive to ESD



Integrated Circuits (IC's)



- Pin identification is standardized in industry
 - With the centred indicator (notch) on your left, Pin 1 is located directly below this spot
 - Starting at Pin 1, the numbers increase going right to the last pin, then continue directly across from the last pin, going left to the last pin.



Integrated Circuits (IC's)



- **Surface Mount Device/Technology (SMD or SMT)**
 - Small-Outline Integrated Circuit (SOIC), Thin Small-Outline Package (TSOP), Quad Flat Pack (QFP), Plastic Leaded Chip Carrier (PLCC), Pin Grid Array (PGA), Ball Grid Array (BGA), etc.
 - Pin count varies from as little as 4 pins to 672 pins and up
 - Pin spacing varies by package but is typically .5 mm (0.019685")
 - Devices are soldered directly to PCB making serviceability difficult
 - Can be very sensitive to ESD

