



**LaACES
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Electronic Components

LaACES Lecture L02.01

Identification of components and handling precautions to protect them from damage due to electrostatic discharge



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Passive Components

Resistors

Capacitors

Inductors

Diodes

Interface components



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Resistors



Europe



USA, Japan

Values specified in ohms (Ω),
kilo-ohms (K), or mega-ohms (M)

Marked with value using a color
code

0 1 2 3 4 5 6 7 8 **9** 5% 10%

Big Bears Run Over Your Gladiola Bed Vexing Garden Worms (go see now)





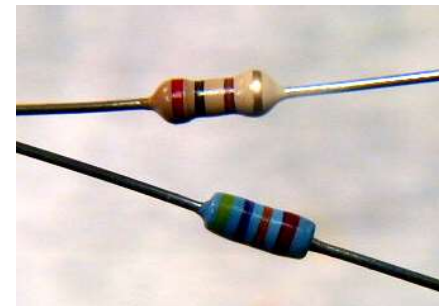
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Resistor ratings

Physical size of resistors
determines power handling ability

Commonly available as 1/8, 1/4,
1/2, 1,
and 2 watt components

Much higher powers available ,
usually as wirewound or ceramic
encapsulated parts





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Resistor handling and installation

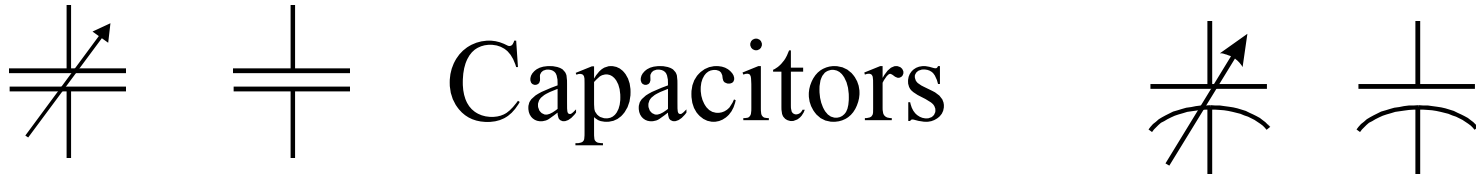
Resistors are not polarized and may be installed in either direction.

Resistors are not generally susceptible to ESD damage, so special precautions are not required.

Mechanical stress due to lead bending should be minimized.

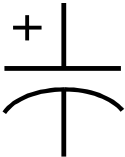


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Values specified in microfarads (μF) or
picofarads (pF)

Marked with actual value or a numeric code

Some varieties are +/- polarized 

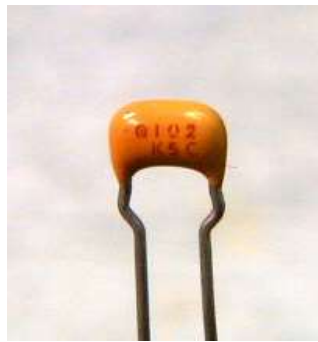


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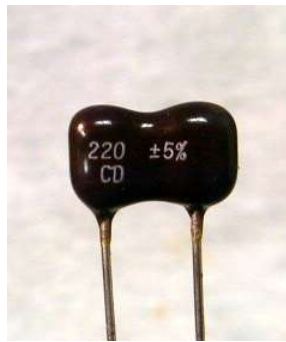
Capacitor types



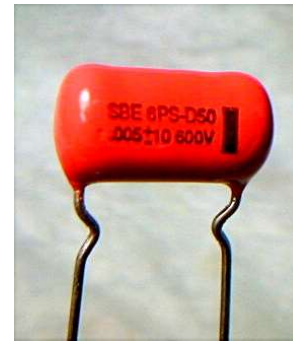
Ceramic disk



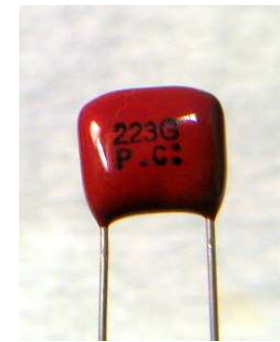
Monolithic ceramic



Dipped silver-mica



Mylar

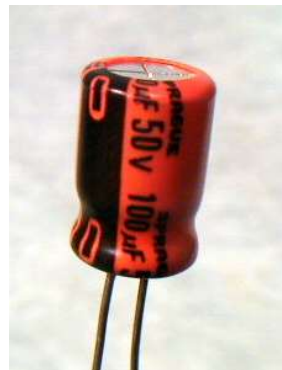


Mylar



(+/-)

Solid tantalum, polarized



Radial aluminum electrolytic



Axial aluminum electrolytic



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Capacitor ratings

Physical size of capacitors is related to voltage handling ability – WVDC – working voltage DC

Temperature coefficient may also be important – can be + or – or nearly zero

Temperature coefficient depends upon dielectric material



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Capacitor handling and installation

Most capacitors are not polarized and may be installed in either direction.

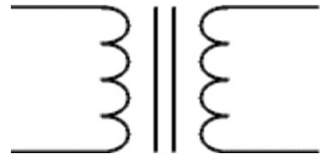
Electrolytic capacitors **ARE** polarized and **MUST** be installed with proper polarity, else catastrophic failure!

Capacitors are not generally susceptible to ESD damage, so special precautions are not required.

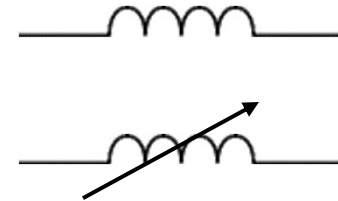
Mechanical stress due to lead bending should be minimized.



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Inductors



Values specified in henries (H), millihenries (mH) and microhenries (μH)

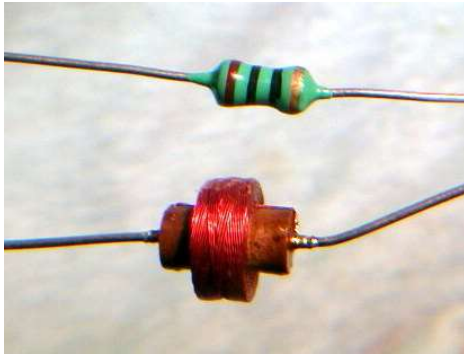
A coil of wire that may be wound on a core of air or other non-magnetic material, or on a magnetic core such as iron powder or ferrite.

Two coils magnetically coupled form a *transformer*.



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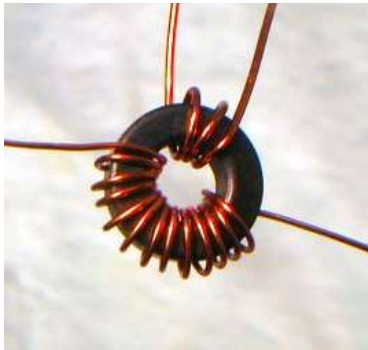
Inductor types



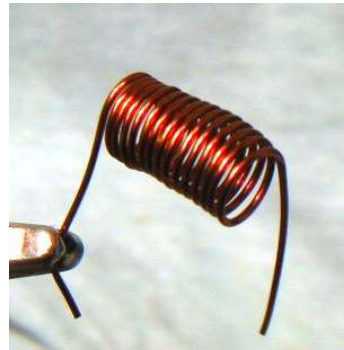
Molded inductor & air-wound inductor



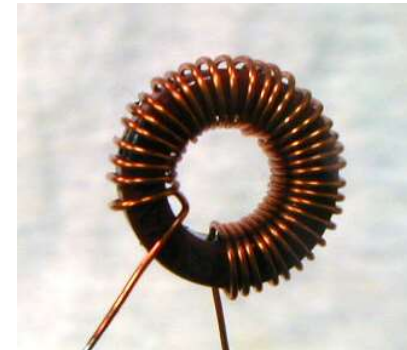
Adjustable air-wound inductor



Ferrite core toroidal transformer



Air wound inductor



Iron powder toroidal inductor



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Inductor ratings

Wire gauge and physical size of the coil determine the current handling capacity.

Core material will have a temperature dependence. Air is best, followed by iron powder, then ferrites.



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Inductor handling and installation

Inductors are not polarized and may be installed in either direction.

Inductors are not generally susceptible to ESD damage, so special precautions are not required.

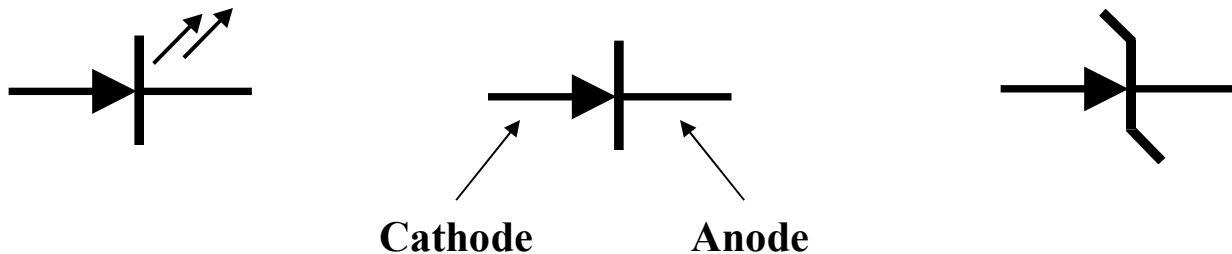
Mechanical stress due to lead bending should be minimized.

Inductors in timing or frequency determining circuits should be installed in a mechanically rigid fashion.



Diodes

Most modern diodes are semiconductor devices, but are considered *passive* since they do not contribute any amplification or *gain* to a circuit.





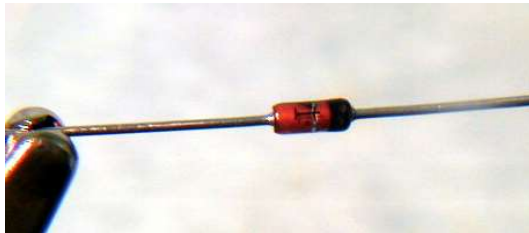
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Diode types

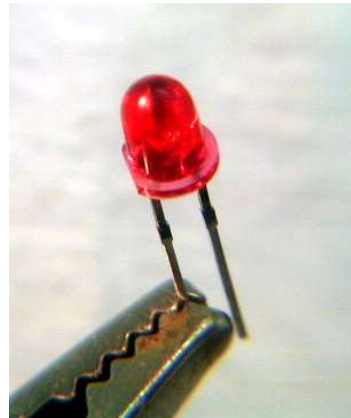
May be classified by semiconductor material

silicon, germanium, gallium arsenide, etc.

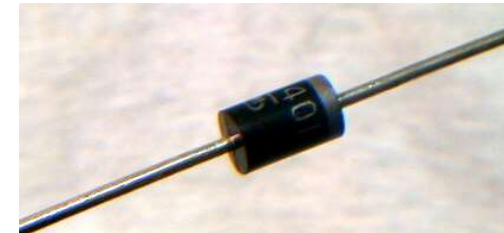
Or classified by circuit function



Small signal detector or switching diode



Light-emitting diode (LED)



Rectifier diode



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Diode Ratings

Peak inverse voltage (PIV)

Maximum forward current (I_F)

Maximum forward voltage drop (V_F)

Reverse leakage current (I_R)



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Diode handling and installation

Diodes are polarized and must be installed in with correct orientation.

Many diodes are modestly susceptible to ESD damage, so normal ESD precautions should be taken.

Mechanical stress due to lead bending should be minimized.



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Interface components

Switches

Plugs

Sockets

Panel controls



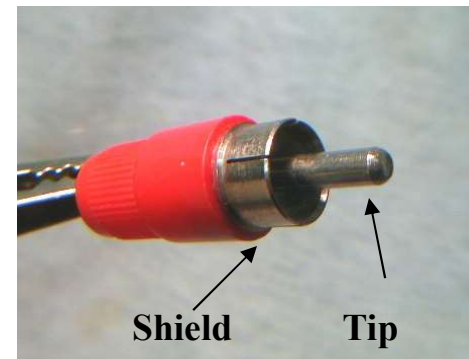
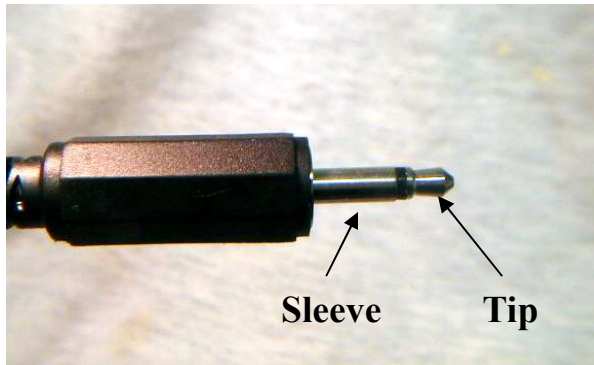
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Two common plug styles



1/8" stereo phone plug

1/8" mono phone plug



RCA plug



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Active Components

Transistors

Bipolar

Field effect

Integrated circuits

Analog

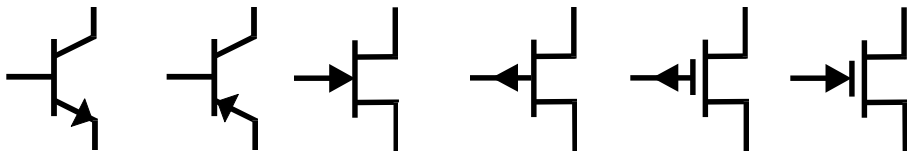
Digital

Microcontroller



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Transistors



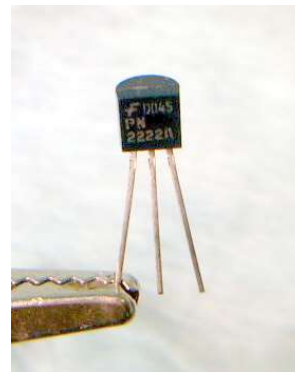
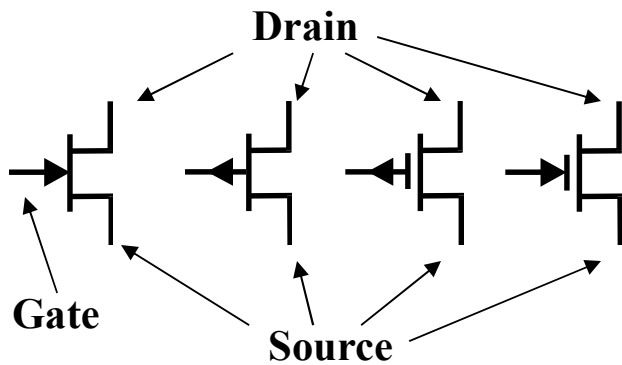
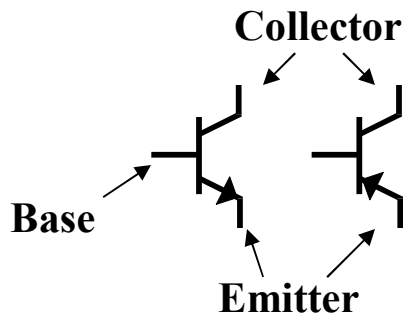
Three terminal devices
manufactured in a variety of
package styles.

Can you find the three
terminals of this, the very first
transistor?

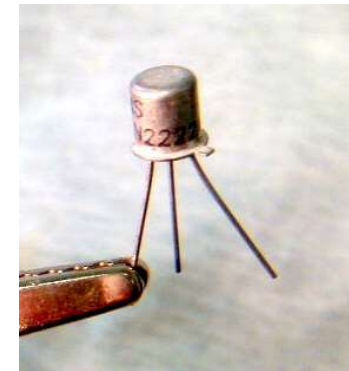




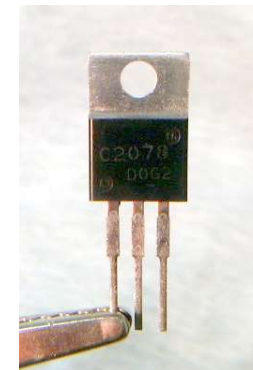
Terminal Designations and packaging styles



**2N2222 in a
TO-92 package**



**2N2222A in a
TO-18 package**



**2SC2078 in a
TO-220 package**



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Transistor handling and installation

Transistors are polarized and must be installed in with correct orientation.

Most BJT transistors are modestly susceptible to ESD damage, so normal ESD precautions should be taken.

MOSFET (IGFET) transistors are *very susceptible* to ESD damage, so rigorous precautions should be taken.

Mechanical stress due to lead bending should be minimized.



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Integrated Circuits

Integrated circuits (ICs) are multi-terminal devices that provide an array of functions and applications far to numerous to list here.





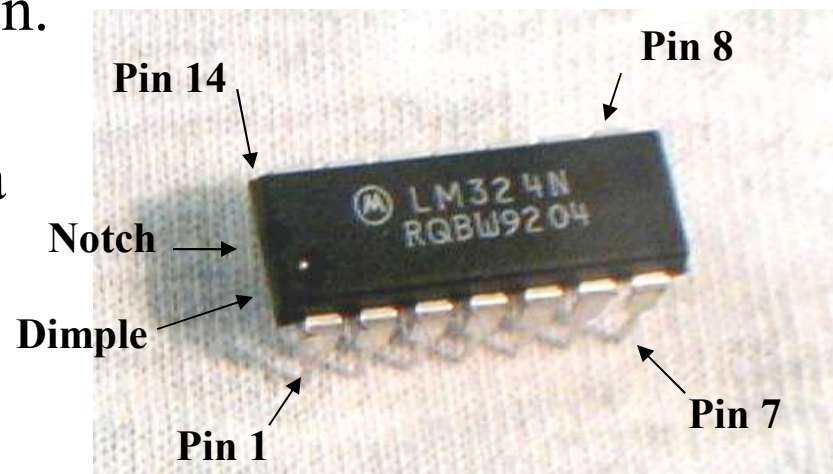
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Pin identification and numbering convention

Pins are numbered sequentially in a counterclockwise direction.

Pin 1 is often identified with a dot or a dimple.

The pin 1 end of the chip is often identified with a notch.





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IC handling and installation

ICs are polarized and must be installed with correct orientation. Observe pin 1 location on sockets or circuits.

Treat all ICs as if they are *very susceptible* to ESD damage (very many actually are), so rigorous precautions should be taken.

Leads generally should not be bent.



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Electrostatic Discharge (ESD) Protection

Ground your work surface

Use an anti-static mat

Ground your tools (i.e., soldering iron)

Many irons are constructed with a grounded tip

Ground yourself

Use a wrist or ankle strap, *but always include a series resistor of high value to avoid any shock hazard.*

Touch a grounded object before handling static sensitive components.



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Activity A04.01



<http://www.kpsec.freeuk.com/symbol.htm>

Inventory the parts supplied in your *SkeeterSat* kit. A complete parts list is provided.

Determine if any parts require ESD precautions.

Sort the parts into groups according the component types you have studied today

Determine the value and tolerance of each part as appropriate.