Electronic Components

LaACES Lecture L02.01

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

Resistors
Capacitors
Inductors
Diodes
Interface components
Resistors

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

Marked with value using a color code

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

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

Marked with actual value or a numeric code

Some varieties are +/- polarized
Capacitor types

Ceramic disk
Monolithic ceramic
Dipped silver-mica
Mylar
Mylar
Solid tantalum, polarized
Radial aluminum electrolytic
Axial aluminum electrolytic
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
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.
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.
Inductor types

Molded inductor & air-wound inductor

Adjustable air-wound inductor

Ferrite core toroidal transformer

Air wound inductor

Iron powder toroidal inductor
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.
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.
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
Diode Ratings

Peak inverse voltage (PIV)

Maximum forward current ($I_F$)

Maximum forward voltage drop ($V_F$)

Reverse leakage current ($I_R$)
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.
Interface components

Switches
Plugs
Sockets
Panel controls
Two common plug styles

1/8” stereo phone plug

1/8” mono phone plug

RCA plug
Active Components

Transistors
  Bipolar
  Field effect
Integrated circuits
  Analog
  Digital
  Microcontroller
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
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.
Integrated Circuits

Integrated circuits (ICs) are multi-terminal devices that provide an array of functions and applications far too numerous to list here.
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.
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.
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.
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 to the component types you have studied today.

Determine the value and tolerance of each part as appropriate.