

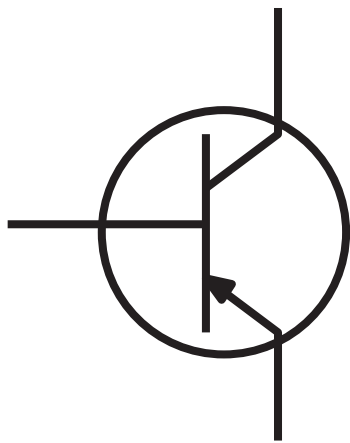
Electronics for Artists

Class # 3

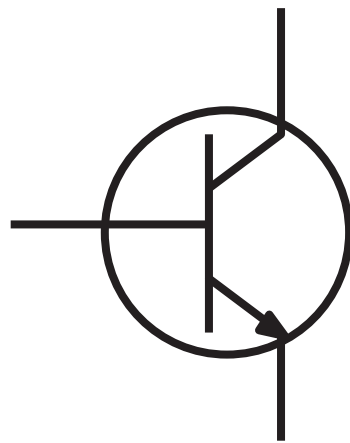
Transistors, Doin' Stuff With Light, Piezos and Soldering

Transistors

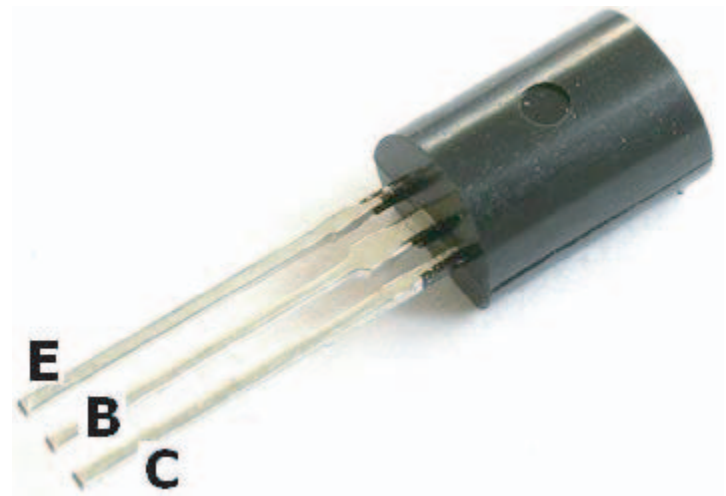
- 1) Used to amplify a signal
- 2) Semi-conductor device built usually from silicone
- 3) Two types "bipolar" invented in 1947 and field-effect transistor (FET)
- 4) We'll look at bipolar PNP and NPN transistors



PNP

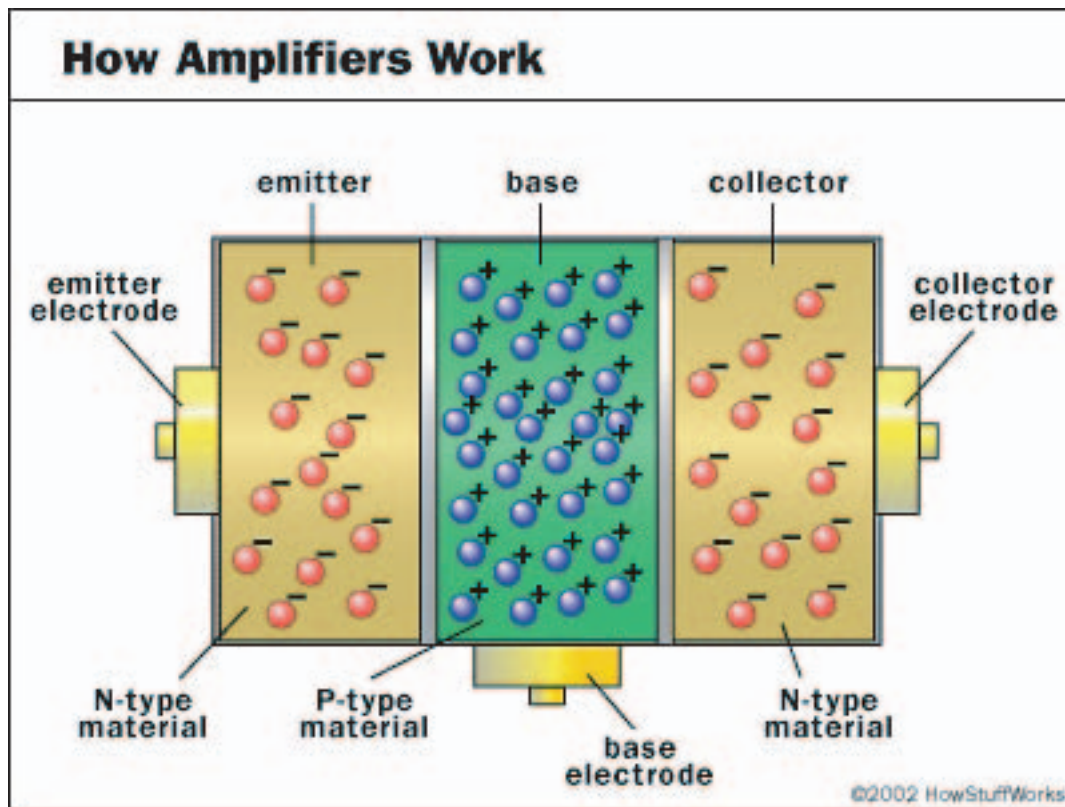


NPN



Transistors

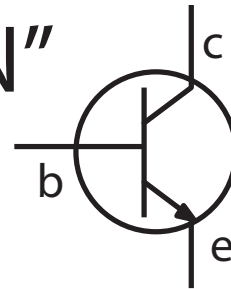
- 1) PNP or NPN - Letters P or N denote types of “charge carriers” in a layer of silicone.
- 2) P type charge carriers are holes or spaces where electrons can go (have a Positive charge)
- 3) N type charge carriers are extra electrons in need of a home (have a Negative charge)
- 4) So PNP is a sandwich made of holey bread with electron laden meat and a NPN is a sandwich with bread full of electrons and swiss cheese on it.
- 5) Three pins on a bipolar transistor are base, collector and emitter.



Electrons in the N type layer fill the holes in the P type layer in the absence of current. This creates “depletion zones” between the layers. When a current enters the base it gets electrons flowing across these zones again. In an amplifier situation the voltage going into the base is very low while the emitter receives a much higher voltage. The voltage out of the collector is high but fluctuates based on changes in voltage at the base. In this way a changing low voltage is amplified into a changing high voltage with the same “shape”.

Transistors

- 1) Can be used as a switch too.
- 2) NPN as a switch is "on" when its base voltage is low compared to the emitter voltage.
- 3) PNP as a switch is "on" when its base voltage is high compared to the emitter voltage.
- 4) You can remember NPNs symbol with the mnemonic "Not Pointing iN"



- 5) You can remember PNPs symbol with the mnemonic "Points iN Proudly"

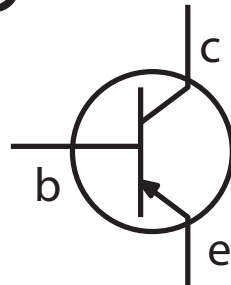
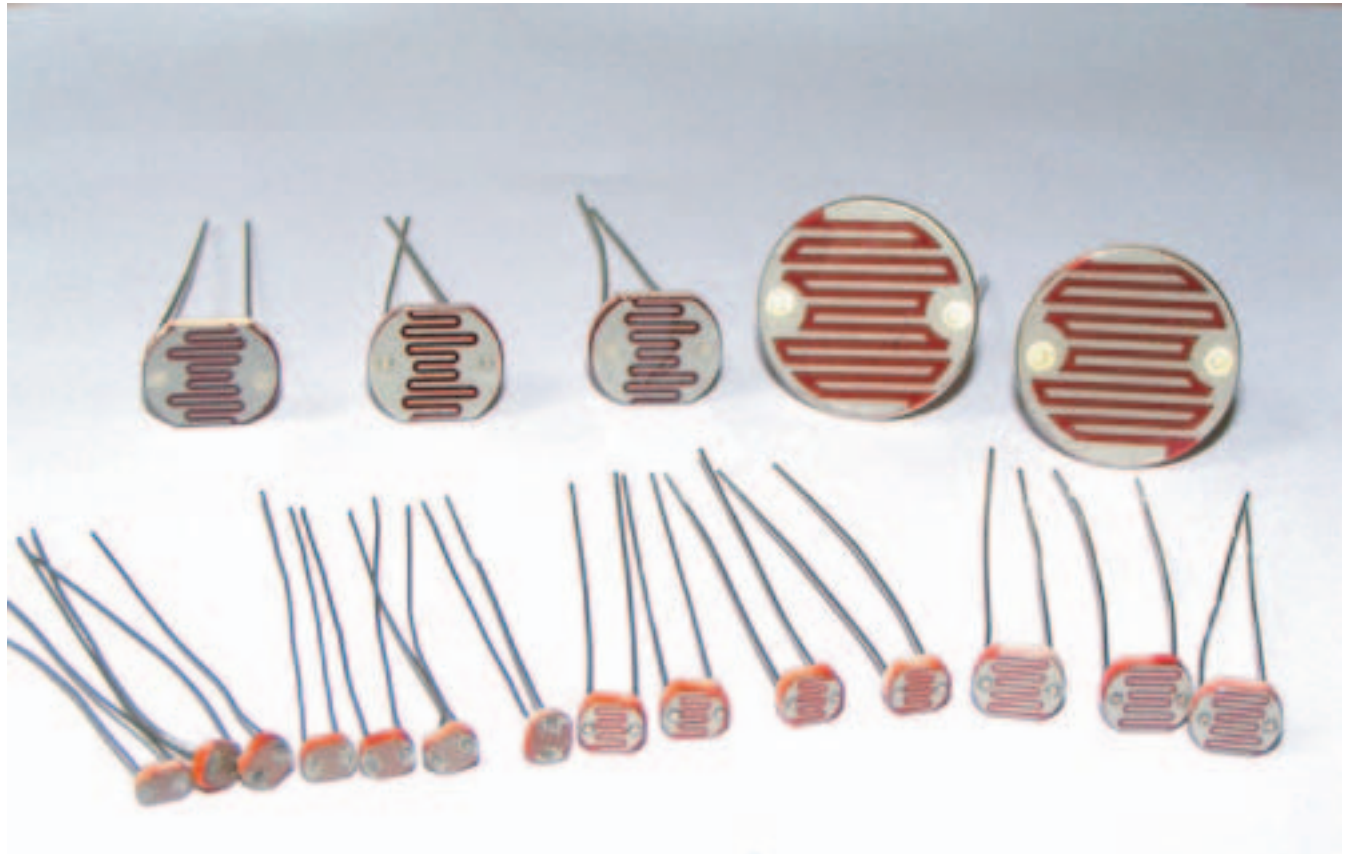


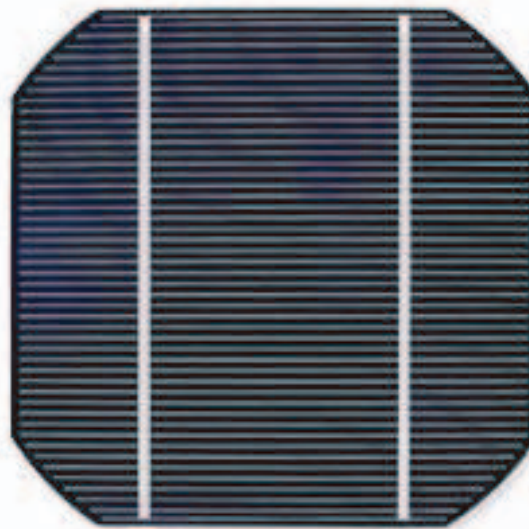
Photo Resistors

- 1) Also called light dependent resistors (LDR) or Cadmium Sulfide cell (CdS)
- 2) More light, less resistance
- 3) Less light, more resistance
- 4) Electrons have a hard time finding their way in the dark



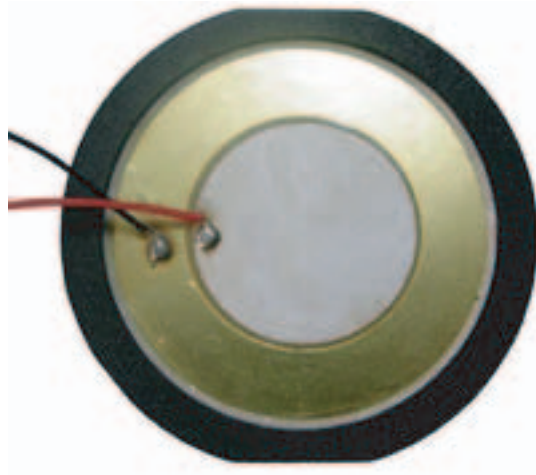
Solar Cells

- 1) Also called photovoltaics
- 2) Turns light energy into electrical energy
- 3) Photons from the sun dislodge electrons in silicone
- 4) Dislodged electrons leave behind positively charged atoms which attract free electrons in the silicone
- 5) This movement of electrons in the silicone creates a small amount of current



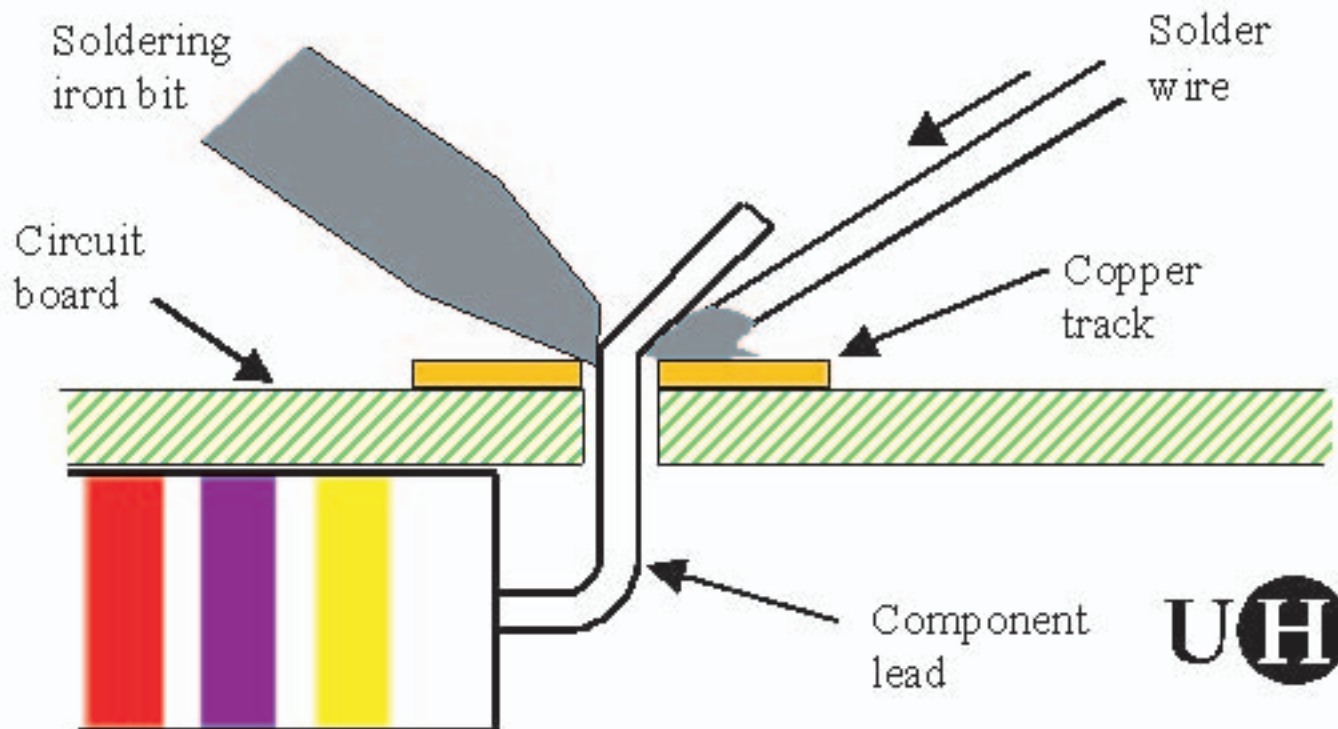
Piezo Disk

- 1) Piezo crystal or ceramic creates a charge when exposed to mechanical stress
- 2) Piezoelectric materials will also cause mechanical movement when exposed to a charge
- 3) Stress in, electricity out. Electricity in, stress out.
- 4) Used as contact mics and pickups in musical instruments
- 5) Also used as high frequency speakers (our purposes today)



Soldering

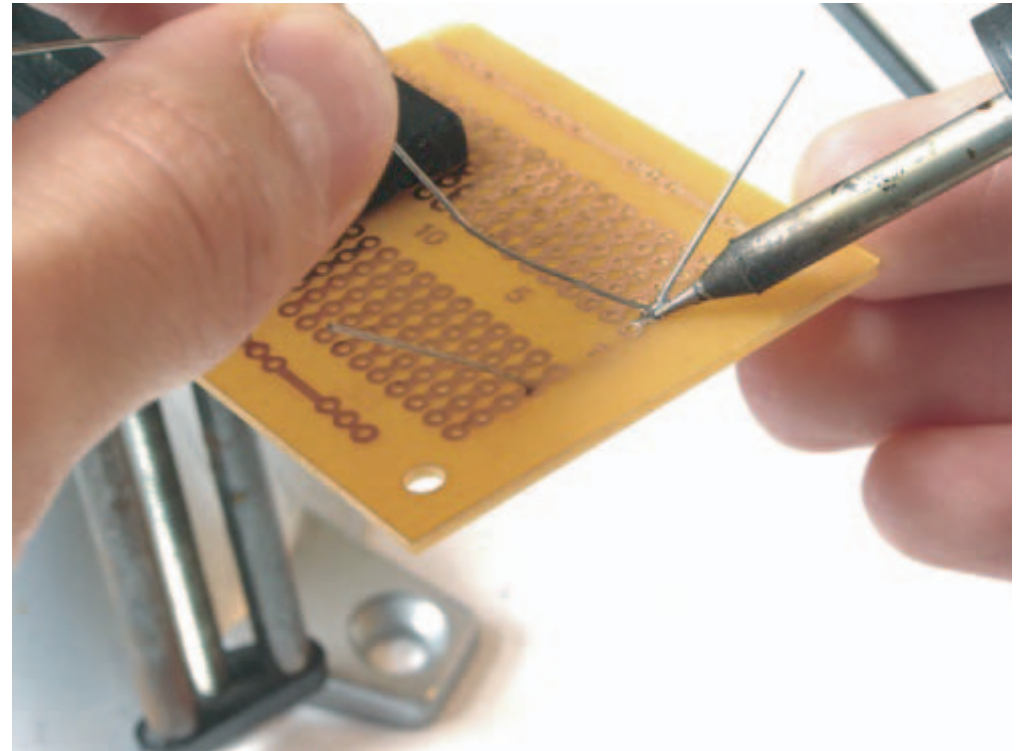
- 1) Turn on soldering iron and wait for it to heat up
- 2) Make a good mechanical connection between things to be soldered
- 3) Clean tip with golden fleece
- 4) Tin the tip by putting a small layer of solder onto it
- 5) Apply hot iron to area to be joined (BOTH items being soldered must get hot)
- 6) Feed solder onto joint and then remove iron



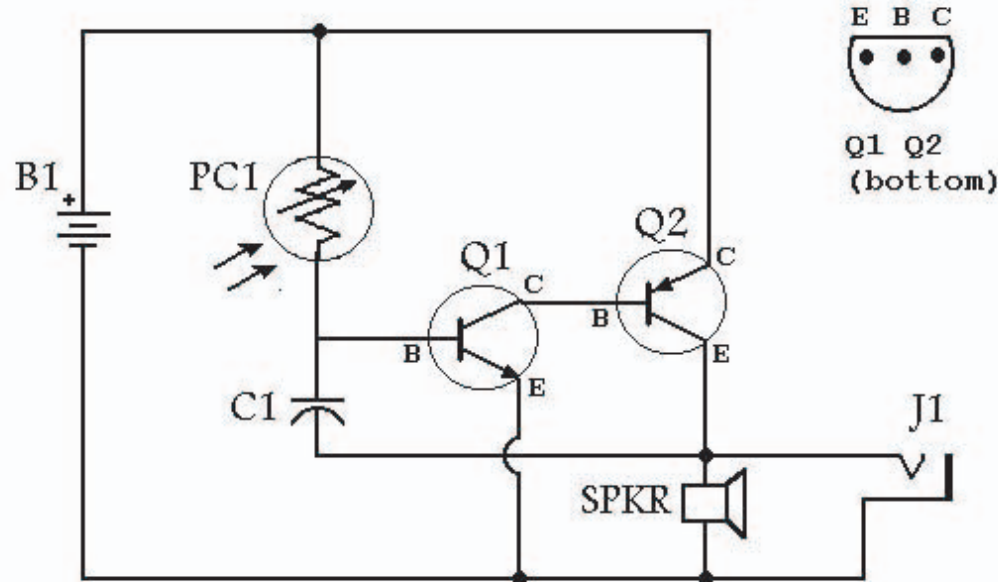
1. This is a good joint with a smooth shiny appearance.
2. There is not enough solder on this joint.
3. This is a 'cold' joint with a rough, dull crystalline appearance. This is caused by moving the joint as it is cooling or by taking solder to the joint on the soldering iron.
4. This is a 'dry joint' where the solder has not flowed onto the PCB track.
5. This is a solder bridge onto an adjacent track. This board has a green 'solder resist' coating on the tracks. The solder resist may prevent a short circuit but even so, solder bridges like this should be avoided

Soldering tips

- keep things clean (components, tip of iron, etc.)
- work quickly - once proficient you should be able to complete a solder joint in 2 or 3 seconds max. some components can be damaged by heat (especially ICs)
- secure the things you're soldering. use a "third hand" device or get creative using wires, or other components
- safety first: this stuff is hot and toxic. work in a ventellated area. don't breathe the fumes. be very aware of where you're putting the hot iron when it's not in use
- patience and a steady hand are helpful
- solder is not glue (we'll break this rule)



Lab 1 - photo theremin



B1 1.5 volt battery

C1 0.1 uf capacitor

PC1 Cadmium Sulfide photocell

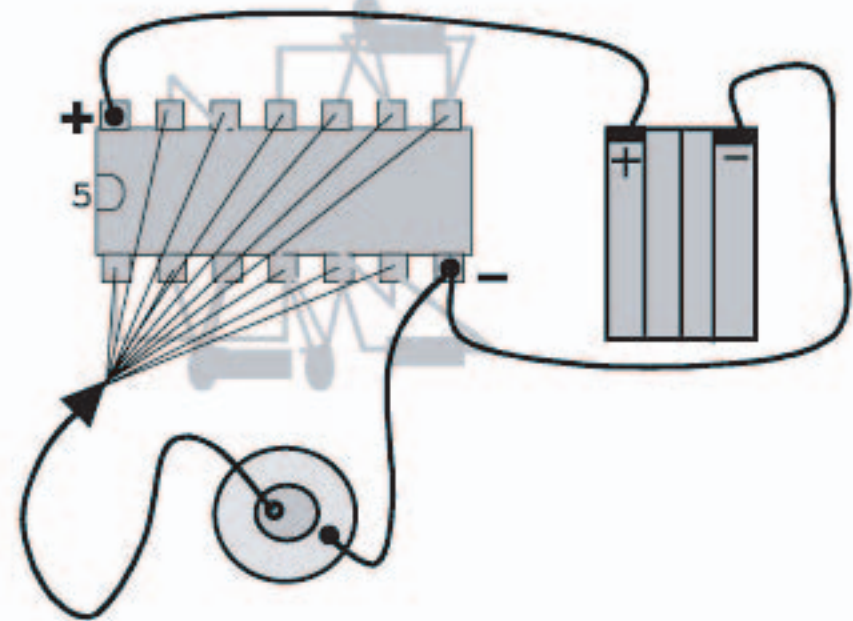
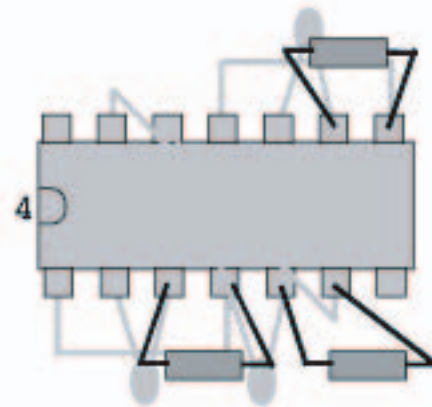
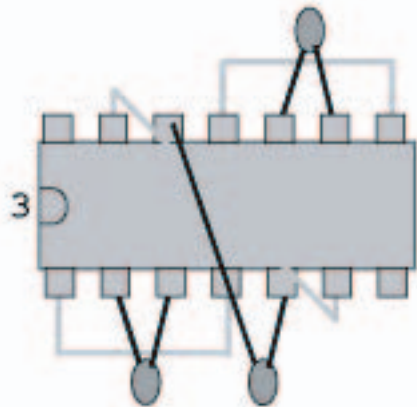
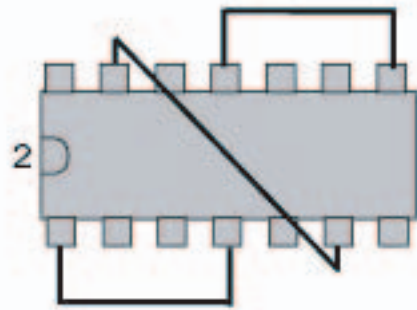
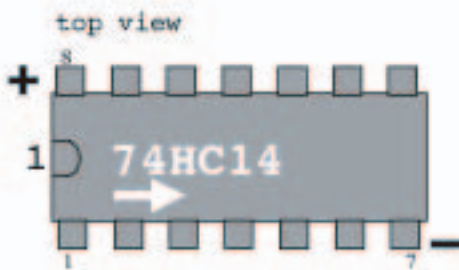
Q1 2N3904 NPN transistor

Q2 2N3906 PNP transistor

SPKR 8-ohm miniature speaker

J1 1/4" jack or 1/8" jack

Lab2 - free-standing solar powered chirper



check out the best connection

resistor 1K - 100K (kilo ohm)

capacitor 1uF - 47 uF (microfarad)

piezospeaker

IC hex-schmitt-inverter
74HC14 or CD40106

solar modul (minimum supply > 2,5 volt)