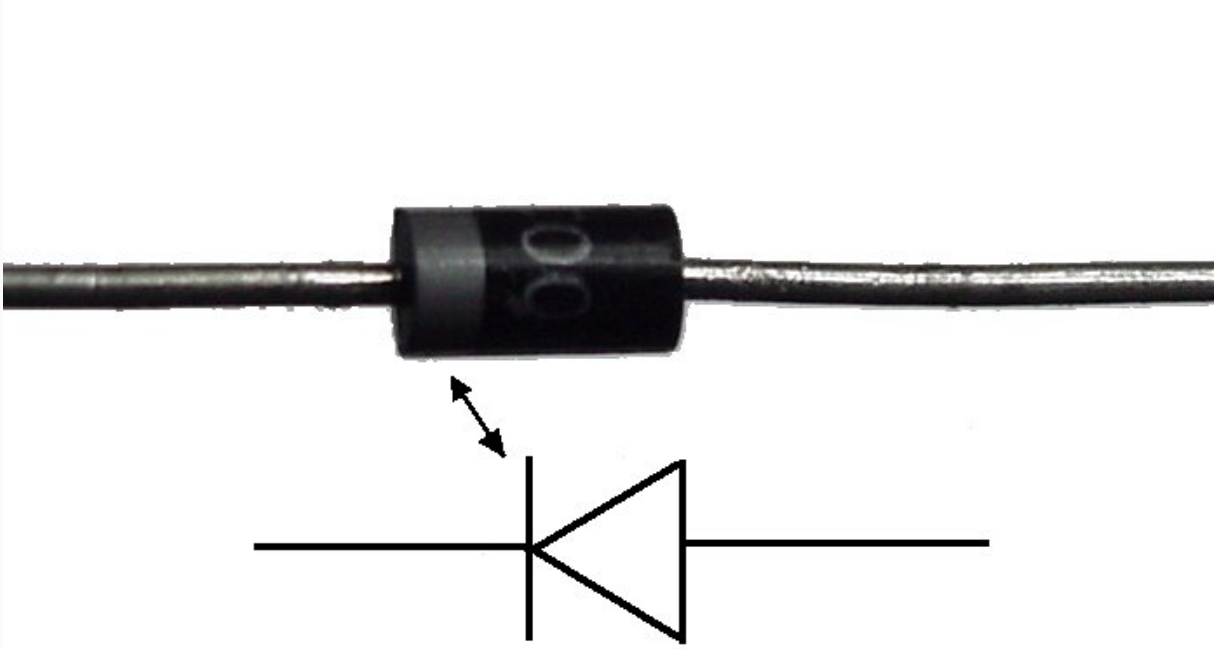
Ash's Electronics Class

Transistor Amplifiers and Circuitboard Etching

July 29, 2010

Outline

Diodes

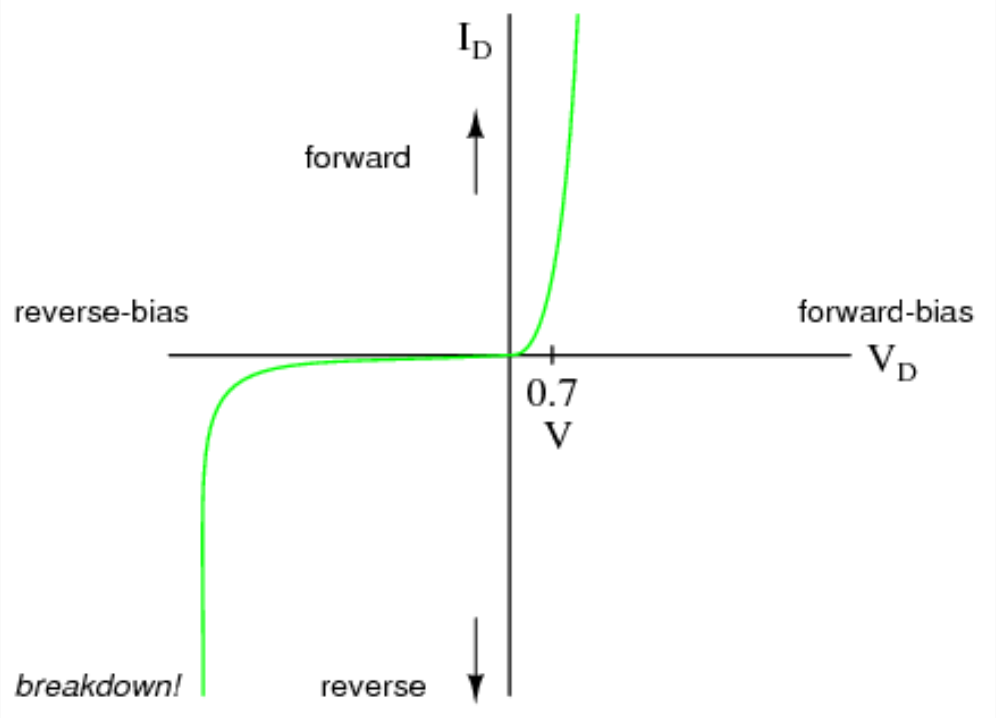


Diodes

You may recall...

- Diodes let current flow in one direction,
  impede flow in the other direction
- P-N Junction and the Depletion Layer
- Diode voltage drop, around 0.7v
  (required to squish down the depletion layer)
- Breakdown voltage (zener diodes)

Diodes



Transistors

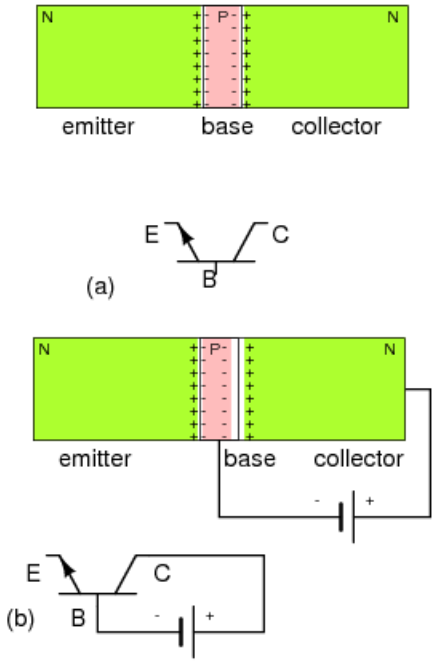
What they do

- Transistors are current-controlled valves
- Valves are amplifiers
- Large amounts of current flow (C-E)
  controlled by current through base (B-E)

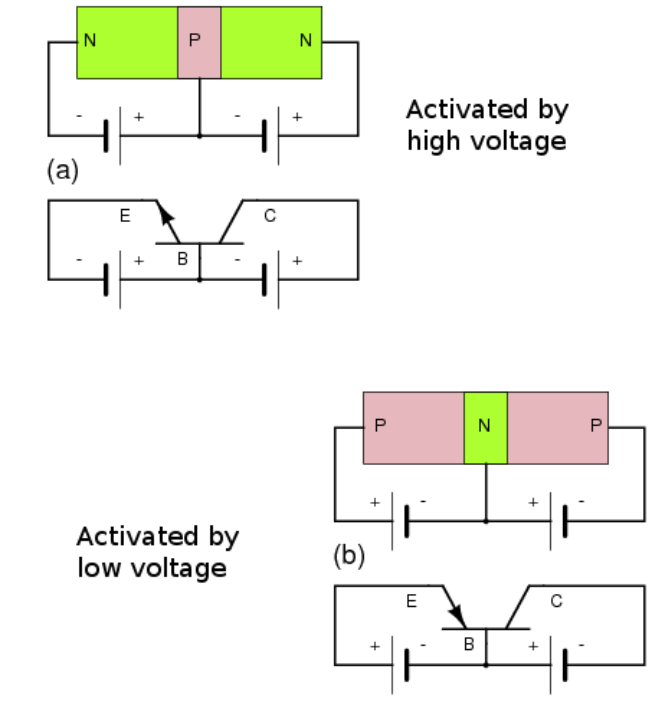
How they work

- Basically two P-N diodes back to back. (NPN)
- Current could easily flow from P to N,
  but blocked by NP part
- Inject current into the P section (at the base)
  and you smoosh the two depletion layers
  and current can flow through from the top

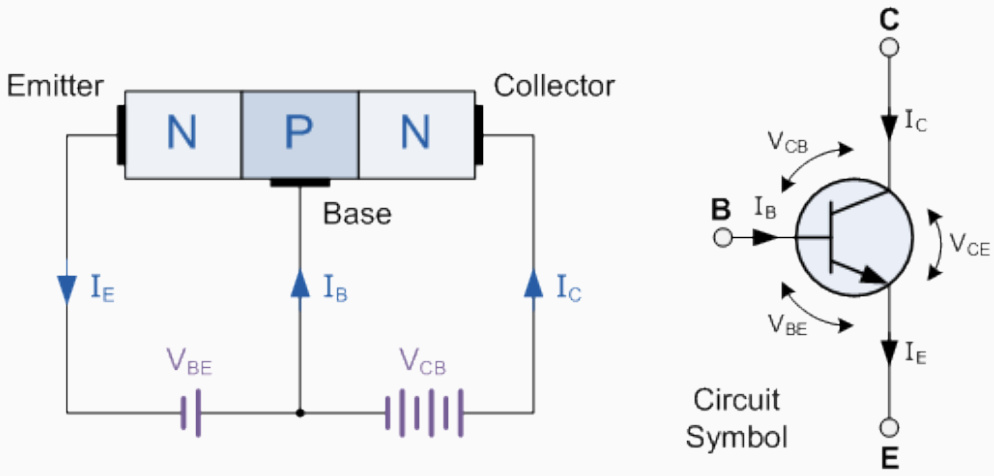
Transistors are Diodes?



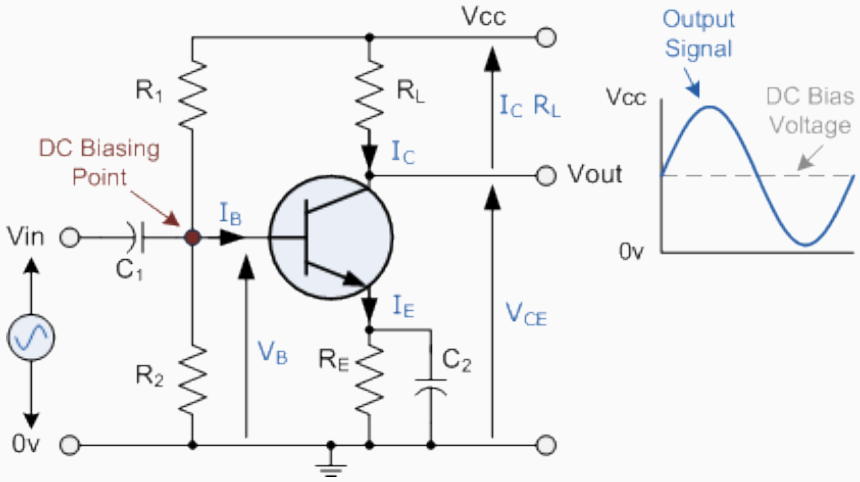
Transistors Come in two Flavors



Transistor Amplifier



Transistor Amplifier



Role of Parts in Transistor Amplifier

What it all does

- C_1 blocks DC from entering the circuit so that...
- R_1 and R_2 establish a bias voltage,
  and thus a bias current. (Don't forget the 0.7v diode drop.)
- R_L and R_E set the gain.
  Raise R_E to lower gain, lower current through C-E.
- C_2 is an optional high-frequency booster cap.
  It works by shorting out R_E at high frequencies.
- We might want another DC blocking cap on the output,
  or we can drive the load R_L directly as-is.

Transistor Amplifier Design Hints

Bias, DC-blocking, Frequency Gain

- Gain depends on ratio of resistors
- Add in extra high-frequency response with capacitor
- Bias to make sure transistor is always turned on
- Blocking capacitors: DC to AC

Resources for more on Transistor Amplifiers

Websites

- `www.allaboutcircuits.com/vol_3/chpt_2/8.html`
  Provides the theory behind how transistors work.
- `www.nerdkits.com/videos/sound_meter/`
  Includes a two-part video stepping you through the math behind picking component values.

Books

- The Art of Electronics, a great textbook.
  My favorite for this sort of thing.

Overview

Negative Process

- Start with copper-coated board
- Remove the parts you don't want
  (acid etching)
- Save the copper traces you do want
  by covering them with etch resist
- Many ways to get etch resist onto board:
  photo-sensitive resist
  draw with a sharpie
  toner-transfer

Secrets to a Good Toner Transfer

- Print onto lightweight, glossy paper.
  The New Yorker or Washington Post Magazine are good.
- Print as dark as you can, and watch out for econo modes.
- Try not to touch the toner with your hands,
  and clean the board of all grease
- For the iron, press hard and use as low heat as you can get away with. Too hot will smudge the print.
- The paper should dissolve in water in a couple minutes.
- Ziplock bags make great containers for the acid.

The End

◂ Outline