Ash's Electronics Class

Transistor Amplifiers and Circuitboard Etching

July 29, 2010

Outline

Transistor Amplifiers
Quick Review

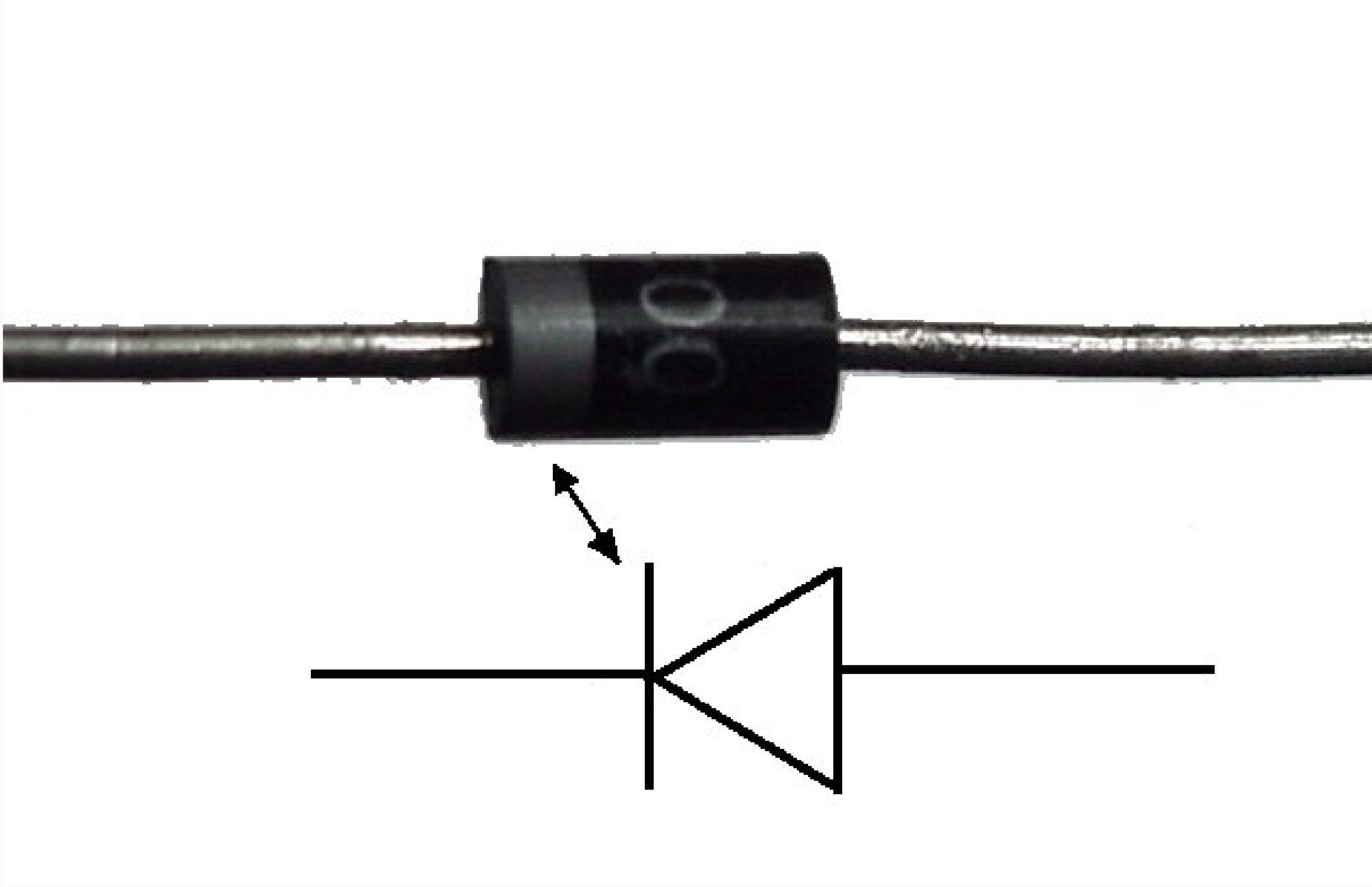
DIY Circuit Boards

Outline

Transistor Amplifiers
Quick Review

DIY Circuit Boards

Diodes



Diodes

You may recall...

- Diodes let current flow in one direction,
  impede flow in the other direction

Diodes

You may recall...

- Diodes let current flow in one direction, impede flow in the other direction
- P-N Junction and the Depletion Layer

Diodes

You may recall...

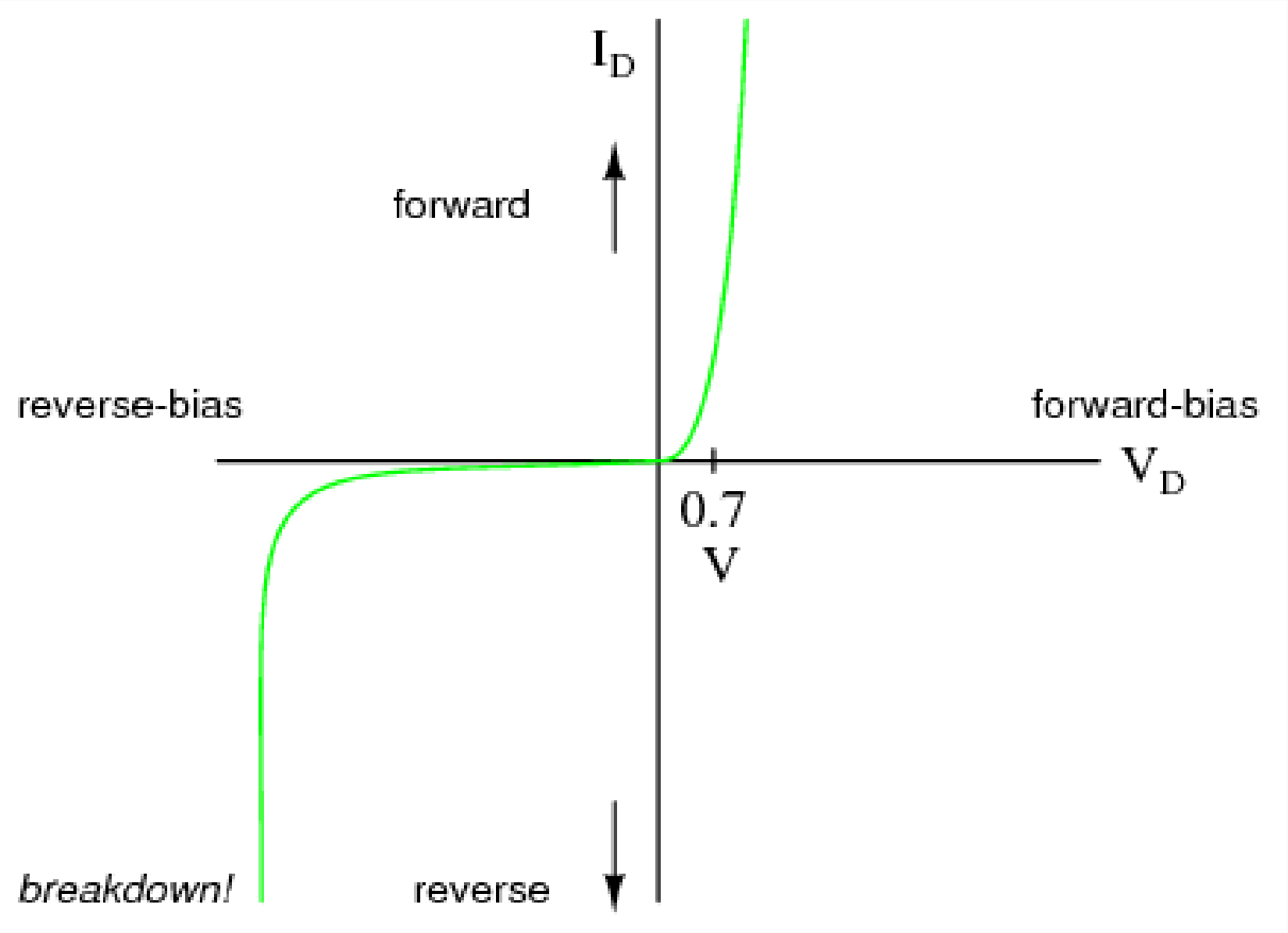
- Diodes let current flow in one direction, impede flow in the other direction
- P-N Junction and the Depletion Layer
- Diode voltage drop, around 0.7v (required to squish down the depletion layer)

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


I_D
forward
reverse-bias
forward-bias
V_D
0.7
V
breakdown!
reverse

Transistors

What they do

- Transistors are current-controlled valves

Transistors

What they do

- Transistors are current-controlled valves
- Valves are amplifiers

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)

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)

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)

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

Transistors

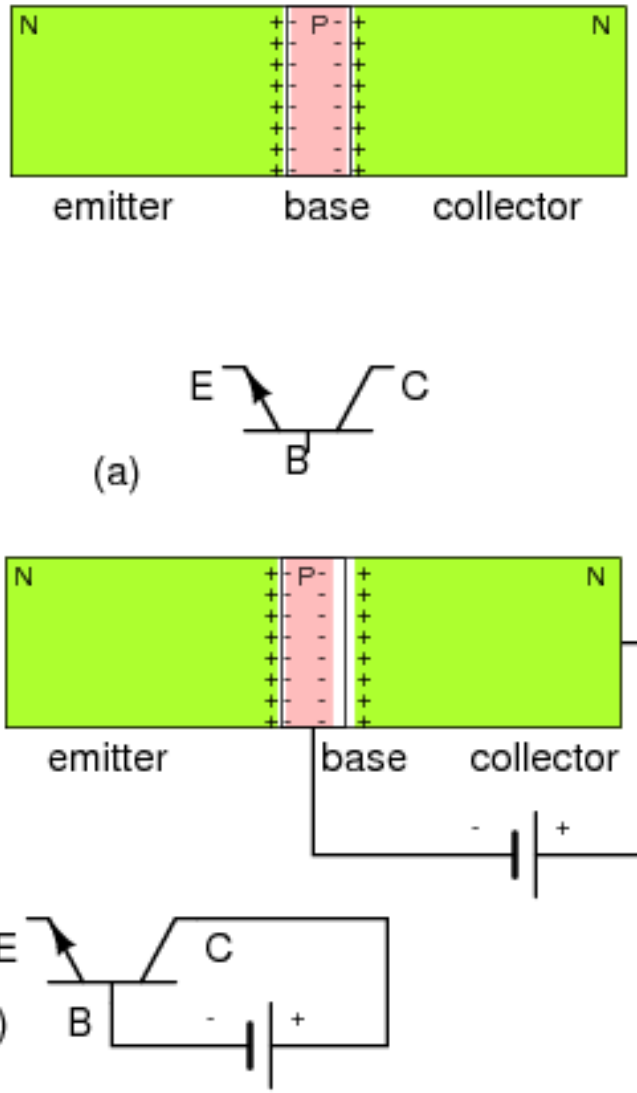
What they do

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

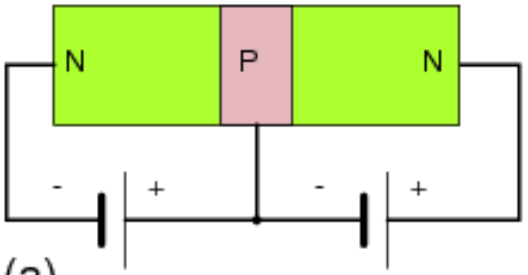
How they work

- 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

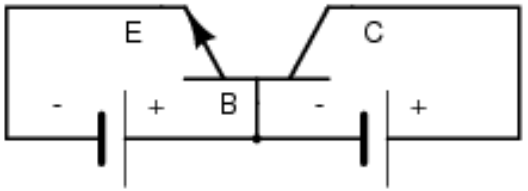
Transistors are Diodes?



Transistors Come in two Flavors

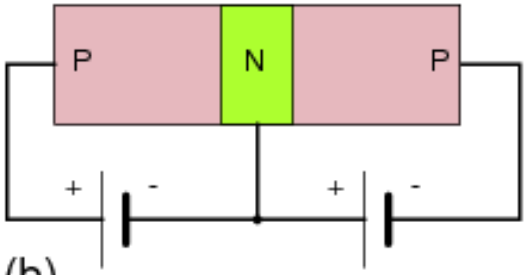


(a)

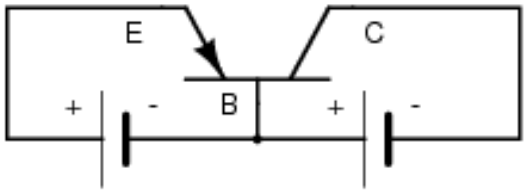


Activated by high voltage

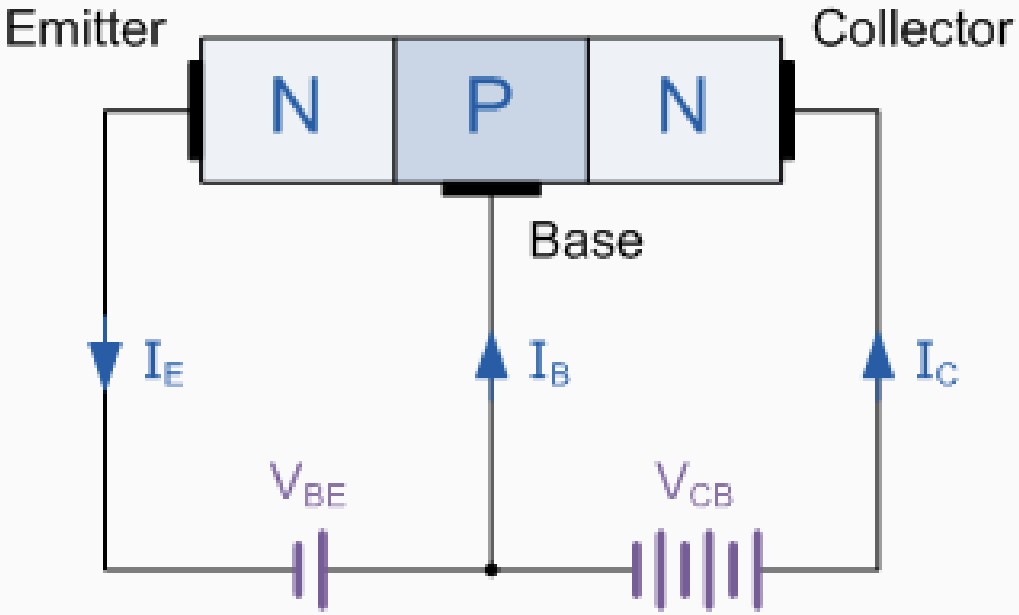
Activated by low voltage

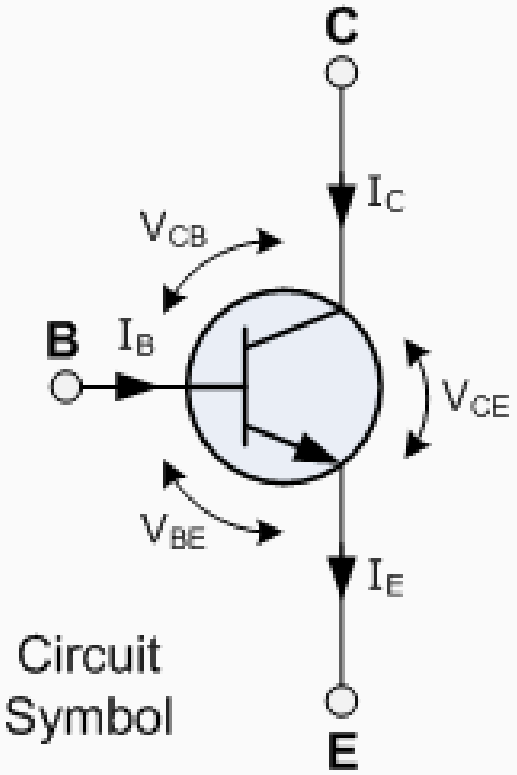


(b)



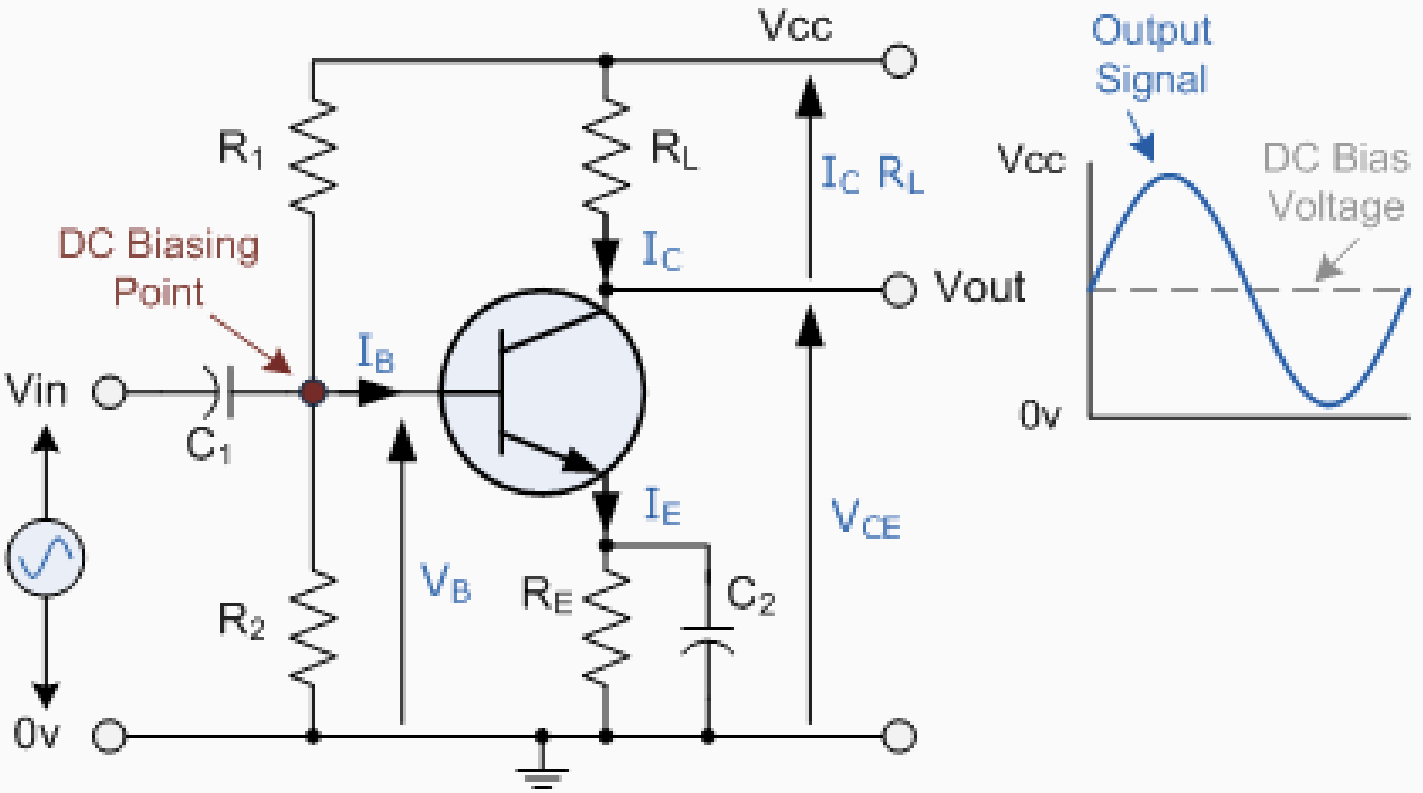
Transistor Amplifier





Circuit Symbol

Transistor Amplifier



Transistor Amplifier Design Hints

Bias, DC-blocking, Frequency Gain

- Gain depends on ratio of resistors

Transistor Amplifier Design Hints

Bias, DC-blocking, Frequency Gain

- Gain depends on ratio of resistors
- Add in extra high-frequency response with capacitor

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

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.

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.

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.

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.

Outline

Transistor Amplifiers
Quick Review

DIY Circuit Boards

Overview

Negative Process

- Start with copper-coated board

Overview

Negative Process

- Start with copper-coated board
- Remove the parts you don't want (acid etching)

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

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.

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.

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

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.

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.

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