Analog Circuits Design

Electronics Club, IIT Kanpur

Outline

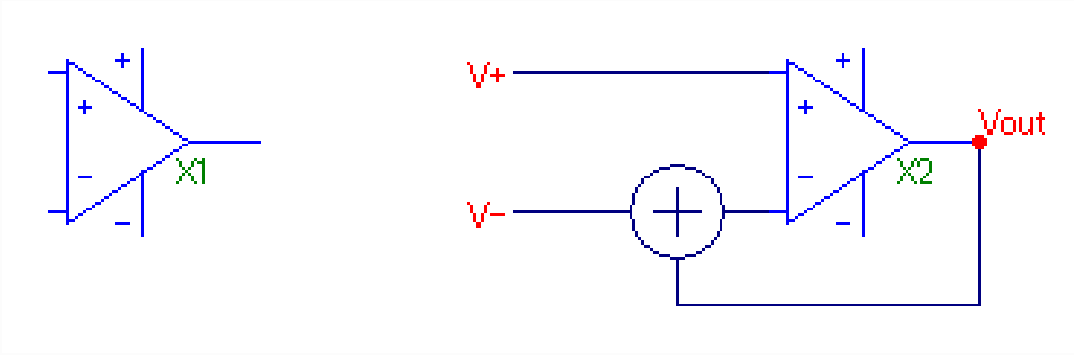
- Op-amp
  - Basics
  - Amplifiers
  - Adder and subtractor
  - Filters
  - Schmidt Trigger
- BJT
  - Inverter
  - CE amplifier

Op-amp

- An ideal op-amp
  - Infinite differential gain
  - Zero common mode gain
  - Infinite input impedance
  - Zero output impedance
  - Infinite bandwidth
- Some non-idealities
  - Finite gain
  - Offset voltage
  - Finite output voltage
  - Finite bandwidth

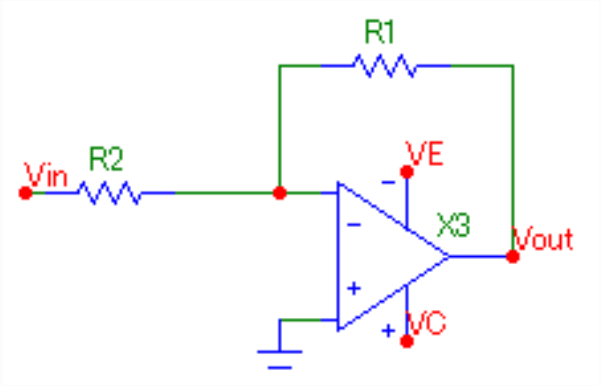
Op-amp

- An almost ideal black box.
- Very high differential gain and input impedance.
- Gain control through negative feedback.
- **Virtual Short**

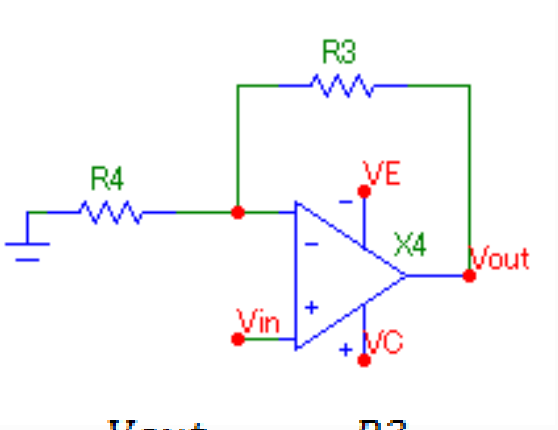


Op-amp Amplifier

- Negative feedback through resistors.
- Inverting amplifier.
- Non-inverting amplifier.
- Buffer



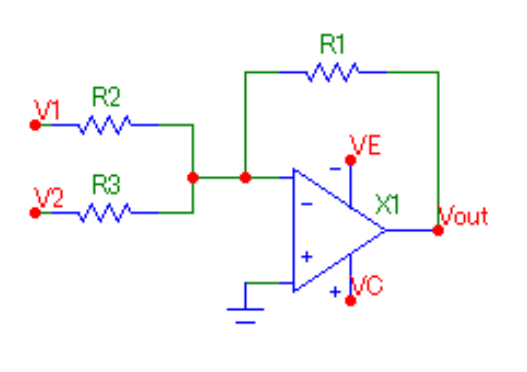
$$\frac{Vout}{Vin} = -\frac{R1}{R2}$$



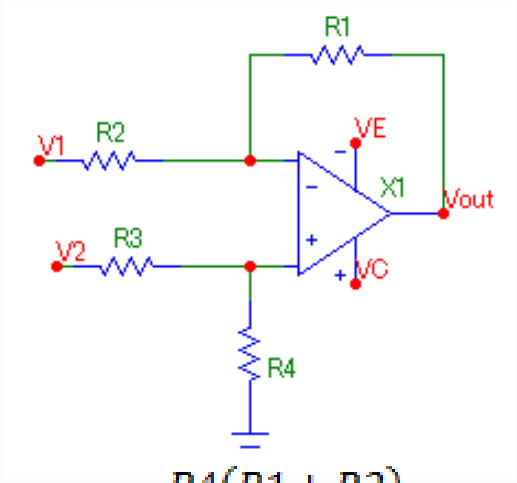
$$\frac{Vout}{Vin} = 1 + \frac{R3}{R4}$$

Op-amp adder

- Analysis is similar to an inverting or non-inverting amplifier.



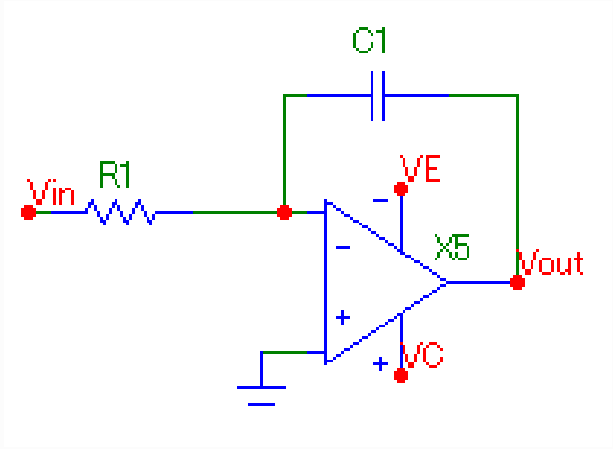
$$Vout = -\frac{R1}{R2}(V1 + V2)$$

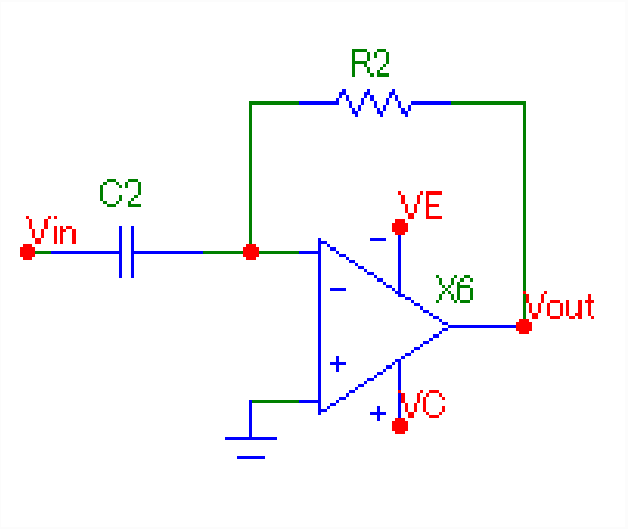


$$Vout = V2\frac{R4(R1+R2)}{R2(R3+R4)} - V1\frac{R1}{R2}$$

Op-amp Filters

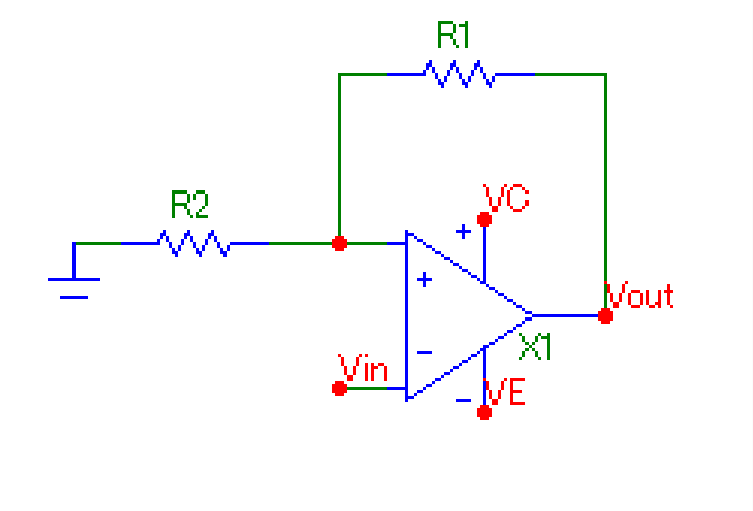
- Filters – Low pass, High pass, and Band pass
- Integrator
- Differentiator





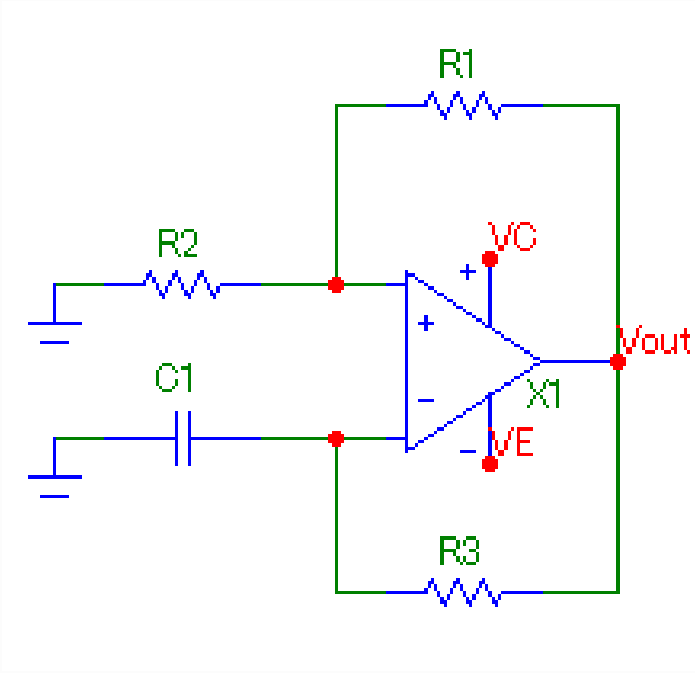
Op-amp

- Positive feedback
- Schmitt trigger



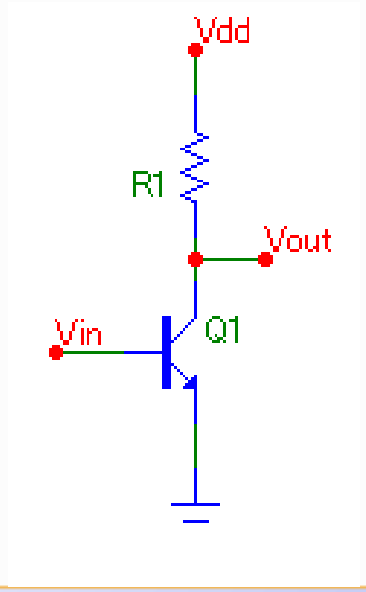
Schmitt trigger multi-vibrator

- Made using a Schmitt trigger



Bipolar Junction Transistor

- Most basic operation is a switch.
- Can be used to make a simple inverter.
- Also can be used as an amplifier.



Thank You…

Electronics Club

http://students.iitk.ac.in/eclub/