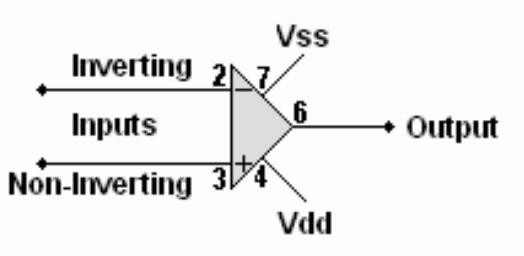
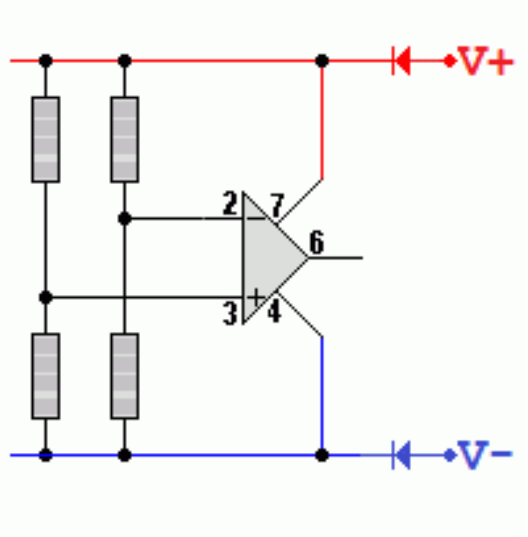
Op Amps - Key Facts

Ideal Op Amp



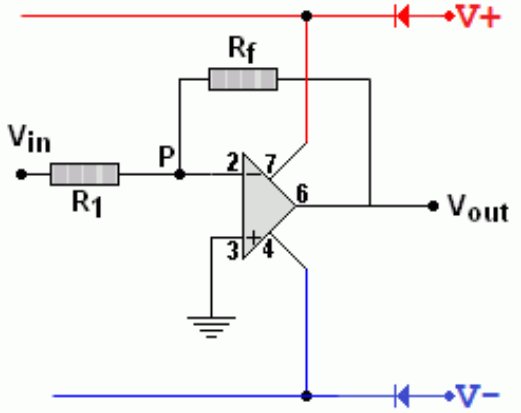
Gain	Infinity
Input resistance	Infinity
Output resistance	Zero
Gain Bandwidth Product (GBP)	Infinity Gain x Frequency = GBP

Comparator



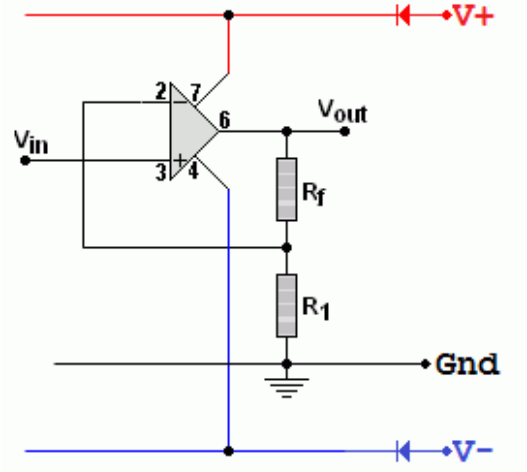
Gain	Infinity
Output	Always saturated high or low
Input Resistance	Infinity
Comparisons	• If V+ is greater than V- then the output is high. • If V+ is less than V- then the output is low.

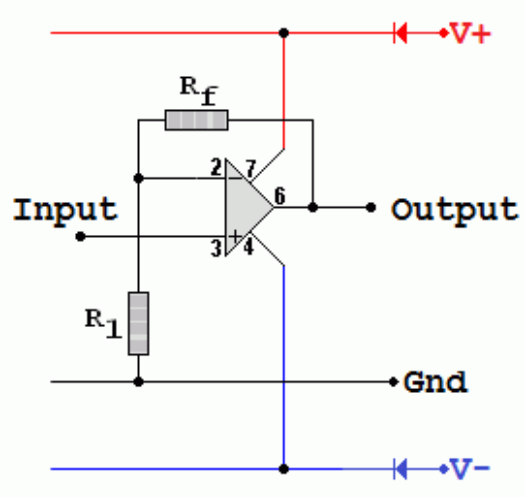
Inverting Amplifier



Gain	• Gv = -Rf / R1 • Gv = Vout / Vin
Input resistance	R1
Virtual Earth	Point P Op Amps have a very high open loop gain so if the output is a few volts, the inverting input voltage will be a few microvolts. This is so close to zero, it is called a virtual earth.

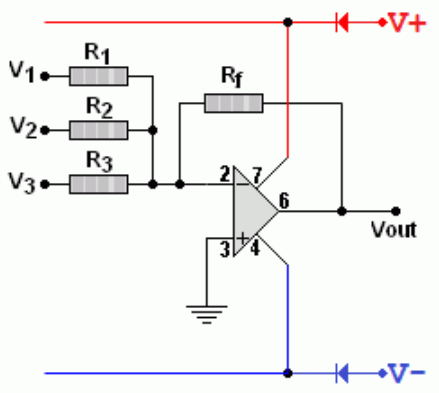
Non Inverting Amplifier - Two Ways to Draw the Diagram





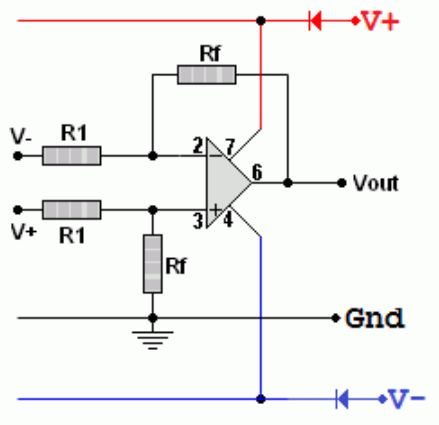
Gain	• Gv = 1 + Rf / R1 • Gv = Vout / Vin
Input resistance	The input resistance of the op amp which is roughly infinity.

Summing Amplifier



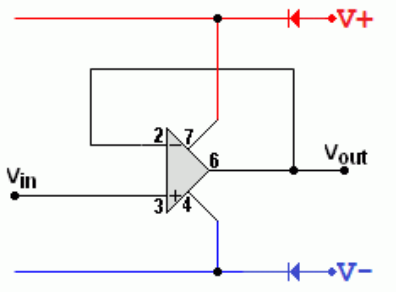
Calculate Vout	Vout = - Rf (V1/R1 + V2/R2 + V3/R3)
Input resistance	It's R1 for the V1 input and R2 for the V2 input etc.
Virtual Earth	The point P is the virtual earth.

Difference Amplifier



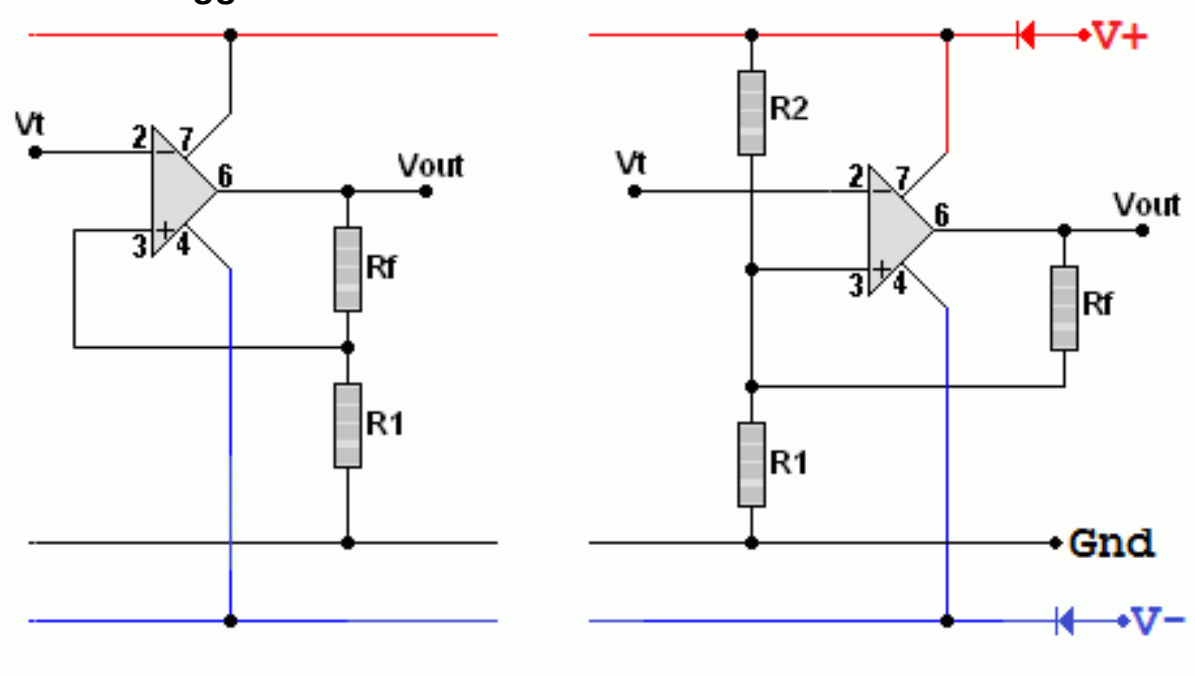
Calculate Vout	Vout = (V+ - V-) x (Rf / R1)
Input Resistance	2 x R1

Voltage Follower



Voltage Gain	The voltage gain is ONE.
Power and Current Gain	This can be very large.
Input resistance	Infinity
Output resistance	Small so usefully large currents can be provided.

Schmitt Trigger



- On the left, a simple version with positive feedback giving different on and off reference voltages.
- On the right is a comparator with one extra resistor giving positive feedback to give different on and off reference voltages.