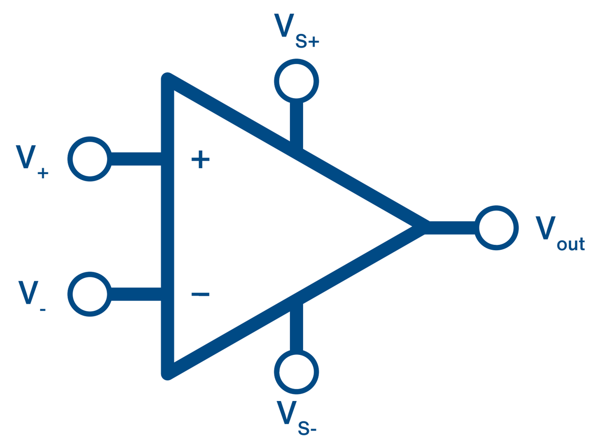
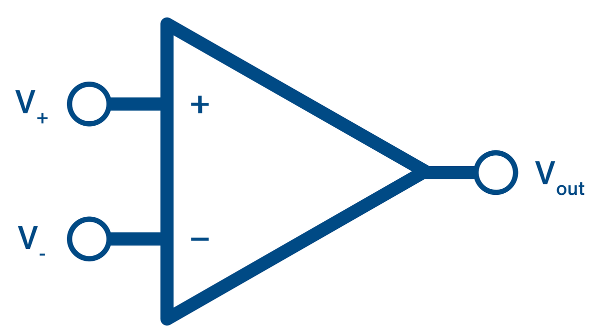
Operational amplifiers reference guide

MOUSER ELECTRONICS

Circuit symbol





Basic properties

The two basic configurations of operational amplifiers are “inverting” and “non-inverting”

The elementary operational amplifier is a 3-terminal device, with 2 inputs and 1 output, (excluding power connections)

One of the inputs is called the inverting input, marked with a minus sign, the other input is the non-inverting Input, marked with a plus.

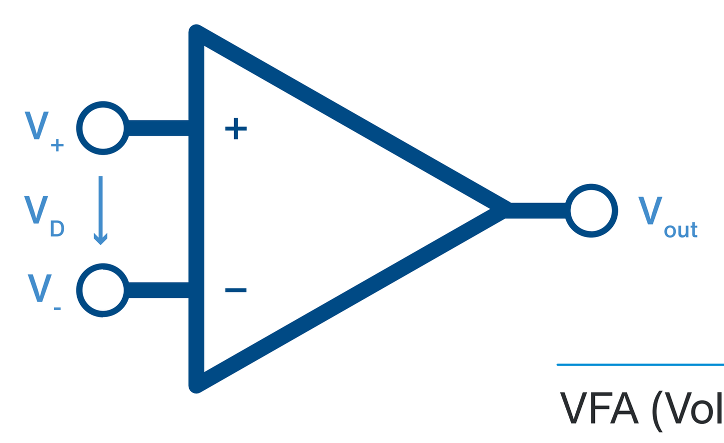
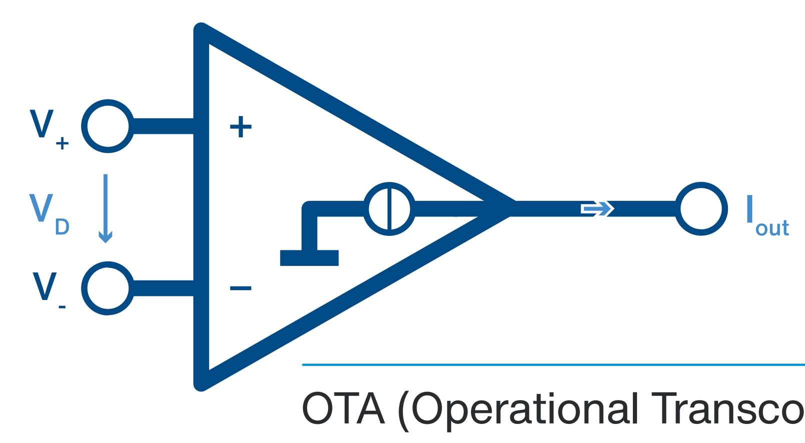
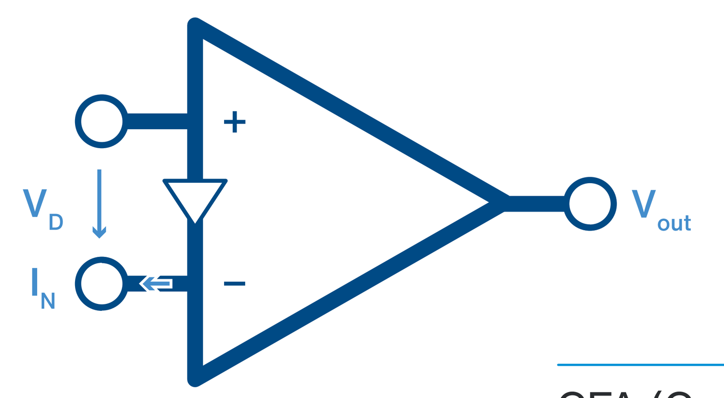
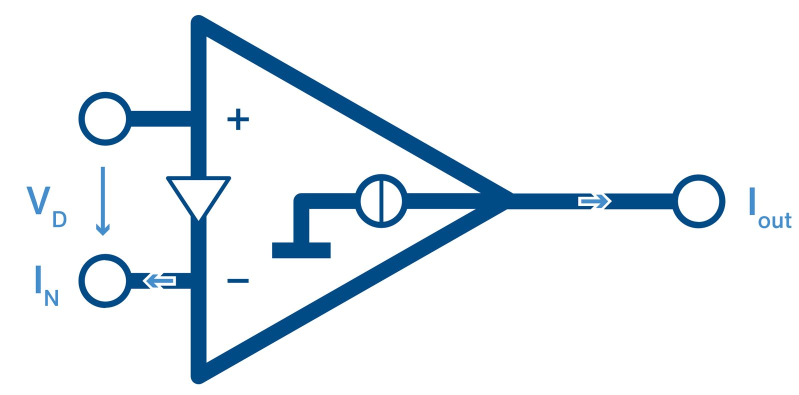
The output port can both sink and source either a voltage or a current

The ideal operational amplifier has infinite input impedance (ZIN = ∞), meaning that no current flows into either of its two inputs

The ideal operational amplifier has zero output impedance (ZOUT = 0)

The ideal operational amplifier has zero input offset voltage V1 = V2

Op-amp configurations

	Output: Voltage	Output: Current
Input: Voltage	 VFA (Voltage Feedback Amplifier)	 OTA (Operational Transconductance Amplifier)
Input: Current	 CFA (Current Feedback Amplifier)	 Current Amplifier

Additional properties

Every op-amp has two inputs (+) and (-) and one output. Generally, it detects the difference between the input voltages VD = V+ - V-

If V+ > V- then Vout increases, if V+ < V- then Vout decreases.

v<0: inverting, v>0 non-inverting

VFA: V+ and V- are high impedance voltage inputs, the output Vout behaves like a low impedance voltage source. Example:
Texas Instruments OPA2356-EP

CFA: inverting input is low impedance, output Vout is a low-impedance voltage source.
Example:
Analog Devices AD8014ARTZ-REEL7

OTA: Both inputs high impedance, output high impedance current source. Example:
ON Semiconductor NE5517DR2G

Current amplifier: low impedance inverted current input, high impedance current output

Key values of op-amps

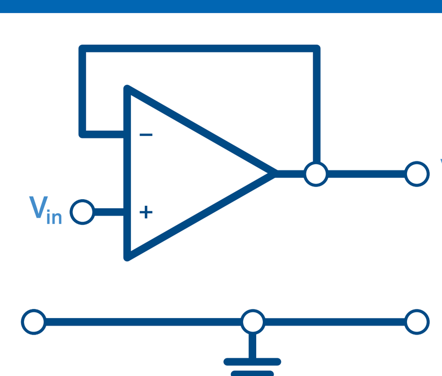
Open Loop Gain: $v_{oL} = V_{out}/V_{in}$

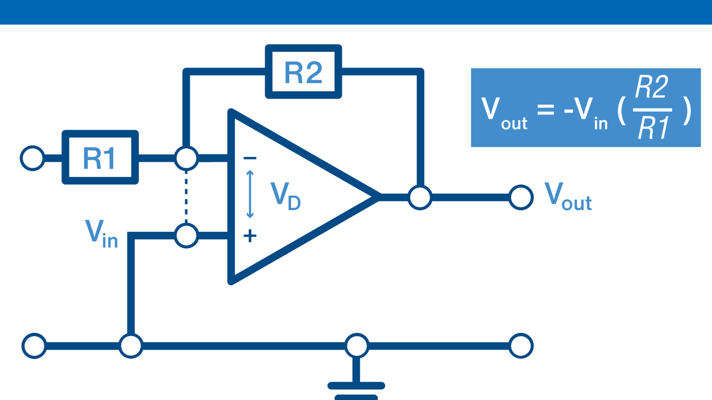
Common Mode Voltage: $V_{CM} = (V_+ + V_-)/2$

Common Mode Gain: $vCM = \Delta U_{out}/V_{CM}$

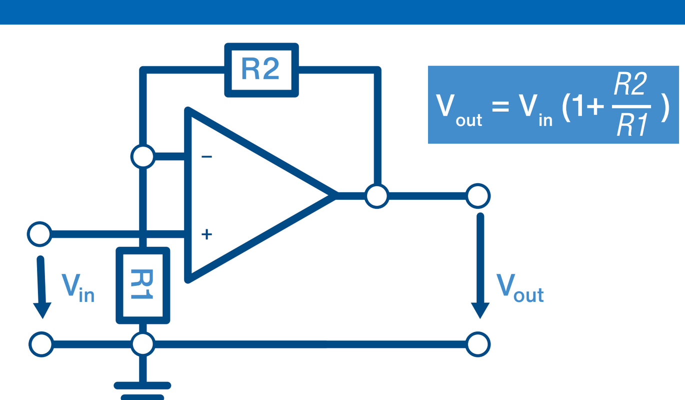
Common Mode Rejection Ratio: $CMRR = 20 \log(v_{oL} / v_{CM})$

Basic circuits

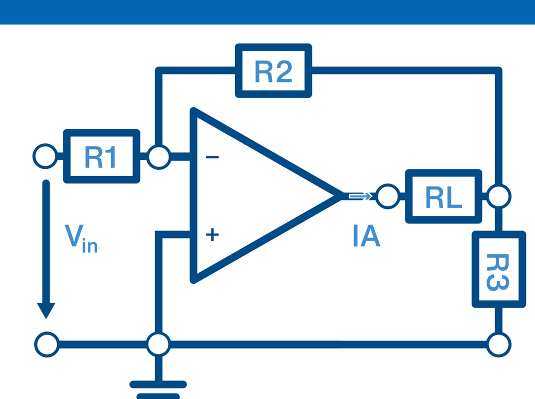

Voltage Follower

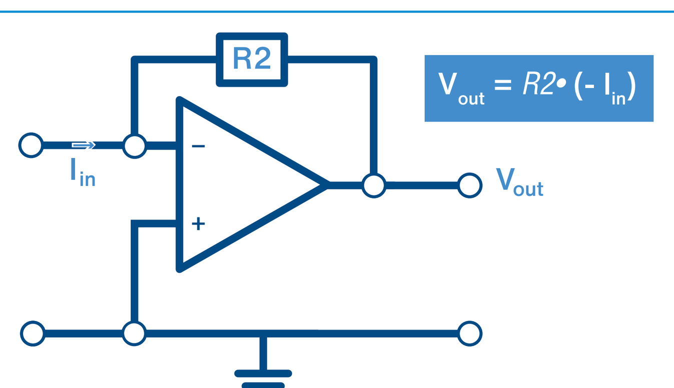


Inverting Amplifier

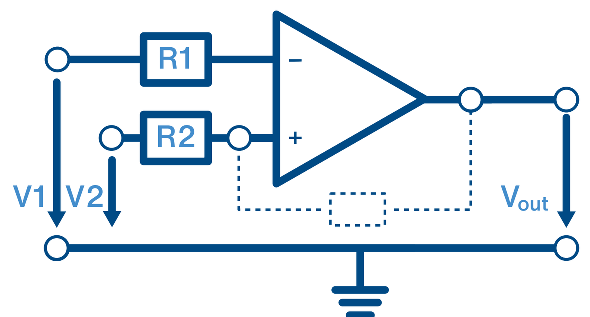


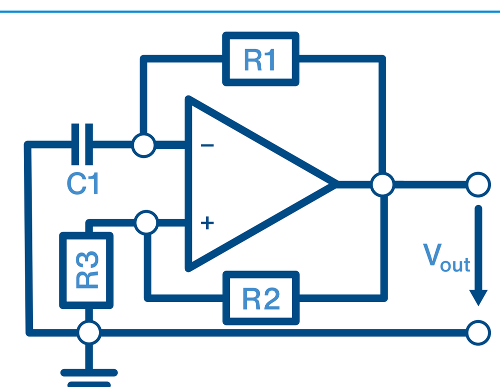
Non-inverting Amplifier

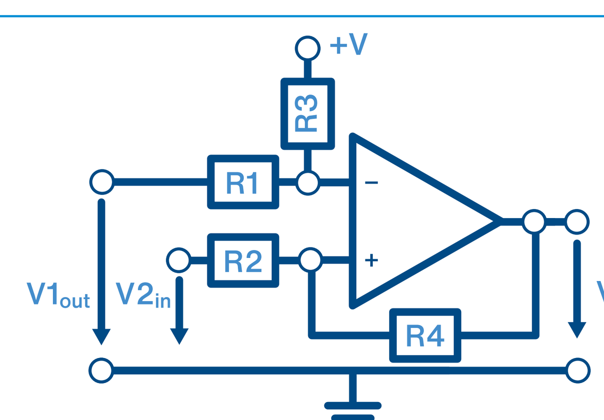

Voltage/Current Converter



Current/Voltage Converter


Voltage Comparator


Astable Multivibrator


Flip-Flop