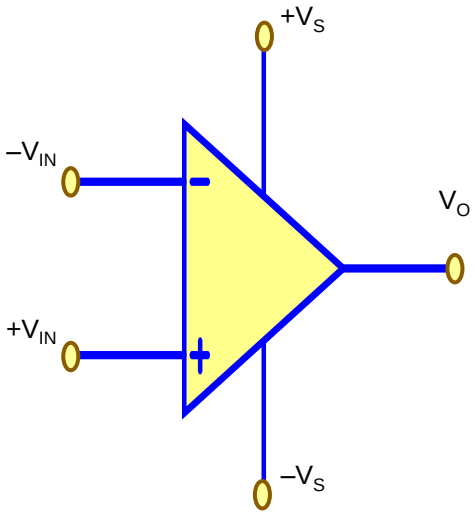
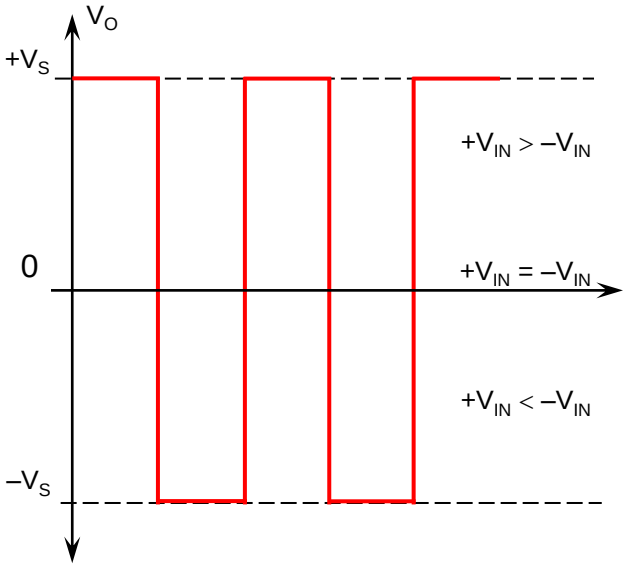
Feedback

- No feedback : Open loop (used in comparators)
- Negative feedback : Feedback to the inverting input (Used in amplifiers)
- Positive feedback : Feedback to the non inverting input (Used in oscillators)

OP AMP as a Comparator (compares 2 voltages and produces a signal to indicate which is greater)



(a) Comparator Circuit



(b) Comparator Output

Applications of Comparators

- Analog to digital converters (ADC)
- Counters (e.g. count pulses that exceed a certain voltage level).
- Cross Over Detectors

OP-AMPS WITH NEGATIVE FEEDBACK

The two basic amplifier circuits with negative feedback are:

- The non-inverting Amplifier.
- The inverting Amplifier

(Note: Negative feedback is used to limit the gain)

NON-INVERTING AMPLIFIER

- The input signal is applied to the non-inverting input (+VIN). The output is fed back to the inverting input through resistor RF.

$$V_O = \left(\frac{R_{IN} + R_F}{R_{IN}} \right) V_F$$

$$A_{NI} = \frac{V_O}{V_F} = 1 + \frac{R_F}{R_{IN}}$$

Where;
V_O = Output voltage
V_{in}= Input voltage= Vf
A_{NI} = Noninverting Gain

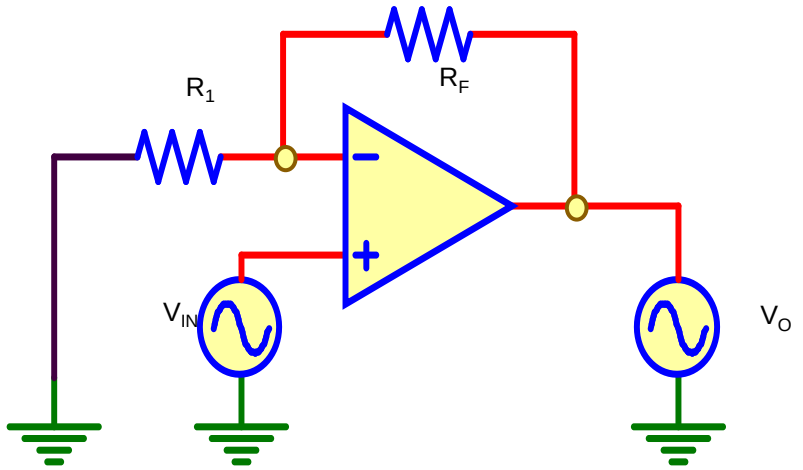


Figure 11 Closed-Loop Noninverting Amplifier Circuit

INVERTING AMPLIFIER

- The input signal is applied through a series input resistor RI to the inverting input. Also, the output is fed back through RF to the same input. The noninverting input is grounded.

$$V_O = -\left(\frac{R_F}{R_{IN}}\right) V_{IN}$$

$$A_I = \frac{V_O}{V_F} = -\left(\frac{R_F}{R_{IN}}\right)$$

Where;
V_O = Output voltage
V_{IN} = Input voltage
A_I = Inverting Gain