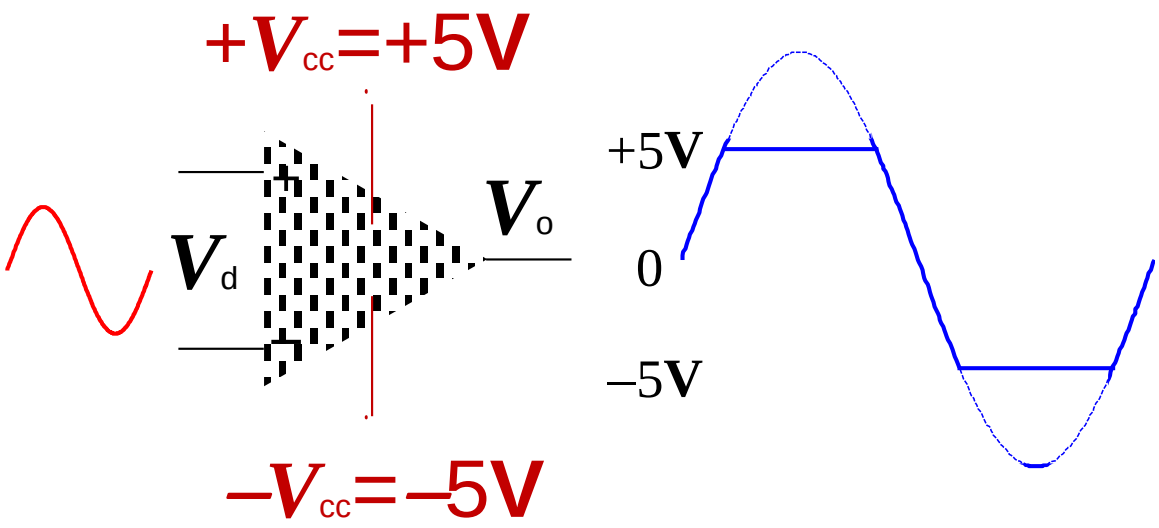
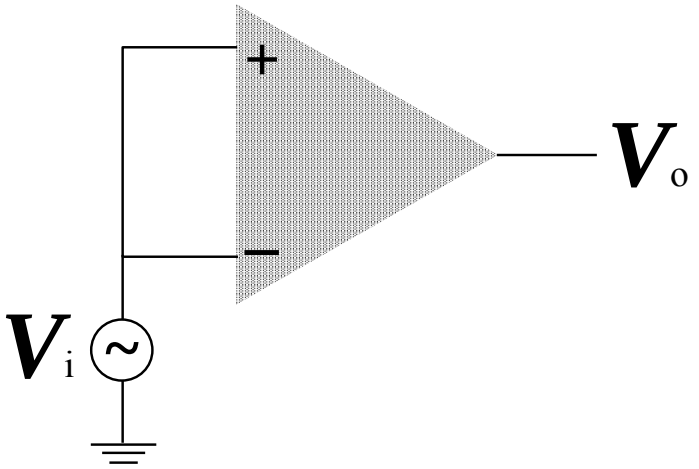
Distortion



The output voltage never excess the DC voltage supply of the Op-Amp

Common-Mode Operation

- Same voltage source is applied at both terminals
- Ideally, two input are equally amplified
- Output voltage is ideally zero due to differential voltage is zero
- Practically, a small output signal can still be measured



Note for differential circuits:
Opposite inputs : highly amplified
Common inputs : slightly amplified

$\Rightarrow$ Common-Mode Rejection

Common-Mode Rejection Ratio (CMRR)

Differential voltage input :

$$V_d = V_+ - V_-$$

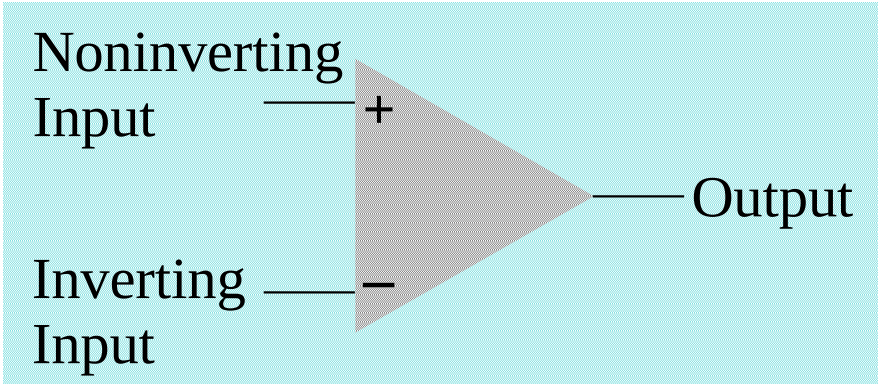
Common voltage input :

$$V_c = \frac{1}{2}(V_+ + V_-)$$

Output voltage :

$$V_o = G_d V_d + G_c V_c$$

G_d : Differential gain
G_c : Common mode gain



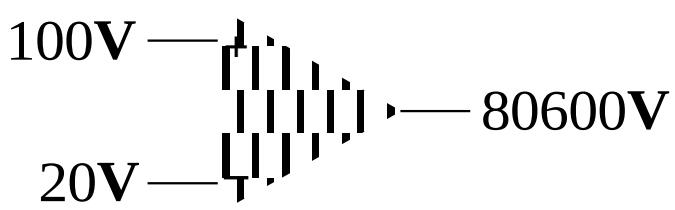
Common-mode rejection ratio:

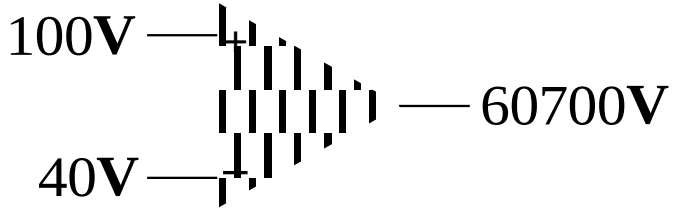
$$\mathrm{CMRR} = \frac{G_d}{G_c} = 20\log_{10}\frac{G_d}{G_c}(\mathrm{dB})$$

Note:
When $G_d >> G_c$ or CMRR $\to\infty$
$\Rightarrow V_o = G_d V_d$

CMRR Example

What is the CMRR?





Solution :

$$\left.\begin{aligned} V_{d1} &= 100-20 = 80\mathbf{V} \\ V_{c1} &= \frac{100+20}{2} = 60\mathbf{V} \end{aligned}\right\} (1) \qquad \left.\begin{aligned} V_{d2} &= 100-40 = 60\mathbf{V} \\ V_{c2} &= \frac{100+40}{2} = 70\mathbf{V} \end{aligned}\right\} (2)$$

From (1) $V_o = 80G_d + 60G_c = 80600\mathbf{V}$

From (2) $V_o = 60G_d + 70G_c = 60700\mathbf{V}$

$G_d = 1000$ **and** $G_c = 10$ $\Rightarrow \mathbf{CMRR} = 20\log(1000/10) = 40\mathbf{dB}$

NB: This method is Not work! Why?