Difference Amplifier

Friday, September 14, 2007
11:32 AM

1) Observation:

$$A_v \text{ non inverting Amp} = 1 + \frac{R_2}{R_1}$$

2) $$A_v \text{ inverting Amp} = -\frac{R_2}{R_1}$$

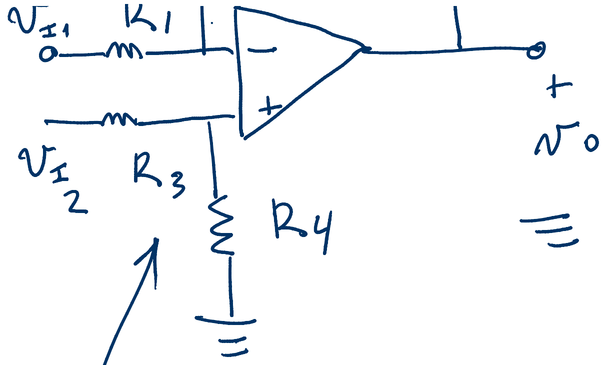
Combine (1) + (2) to design an

Difference Amplifier

But we must make the two gain magnitude equal so common mode signals are rejected: Idea

Attenuate to gain of the positive path from $\boxed{1 + \frac{R_2}{R_1} \rightarrow \frac{R_2}{R_1}}$

Based on Fig (1)



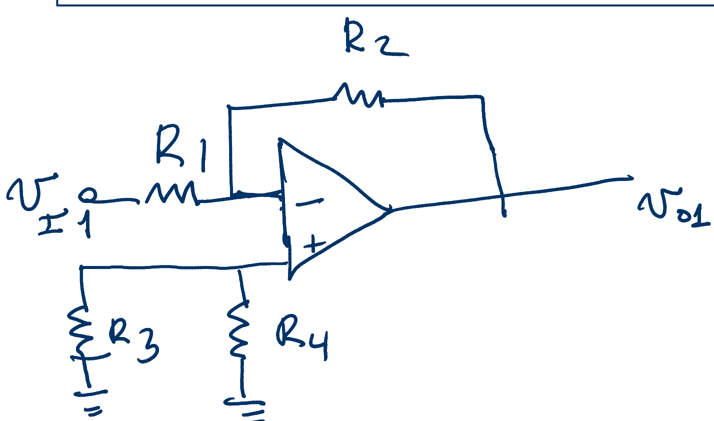
$$\frac{R_4}{R_4+R_3}\underbrace{\left(1+\frac{R_2}{R_1}\right)}_{\text{non inverting Gain}} = \frac{R_2}{R_2} \qquad (1)$$

Apply superposition principle:

i.e add solutions separately

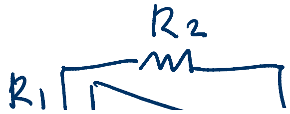
(a)

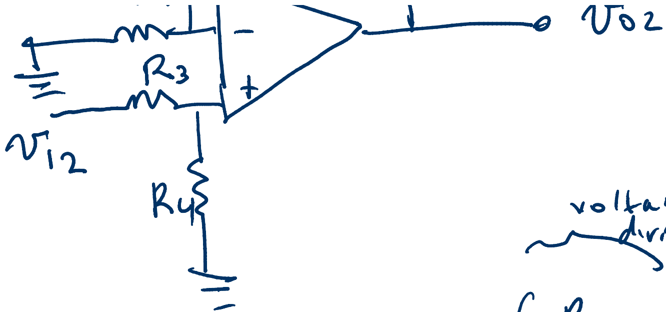
ground $v_{I2} \Rightarrow$ inverting configuration solution



$$v_{o1} = -\frac{R_2}{R_1} v_{I1} \qquad (2)$$

(b) Ground $v_{I1} \Rightarrow$ non inverting configuration solution





voltage divider — non-inverting gain

$$v_0 = v_{I2}\left(\frac{R_4}{R_4+R_3}\right)\left(1+\frac{R_2}{R_1}\right) \quad (3)$$

but

$$= \left(\frac{R_2}{R_1}\right) v_2 \quad (4)$$

(in order to make equal the two gain amplitudes).

Eq(1) can be put in the form: $\frac{R_4}{R_4+R_3} = \frac{R_2}{R_2+R_1}$ $\boxed{\text{where } R_4 = R_2,\ R_3 = R_1}$

Based on superposition principle.

$$v_0 = \frac{R_2}{R_1}\left(v_{I2} - v_{I1}\right)$$

$$= \frac{R_2}{R_1}\left(v_{Id}\right)$$