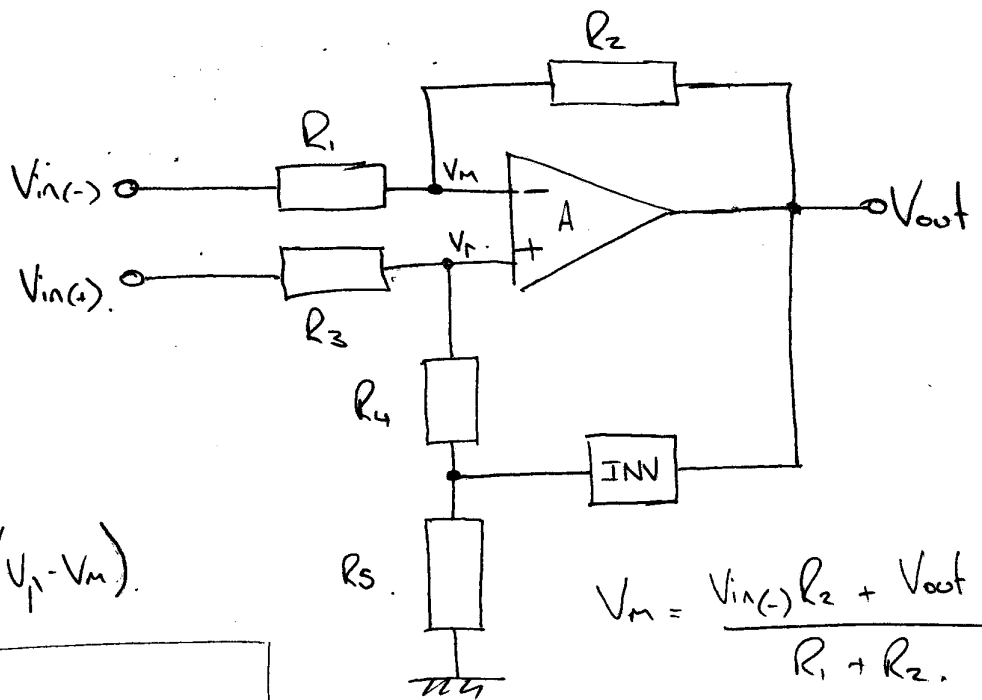


Modified Difference Amplifier

①



$$V = IR$$

$$\frac{V}{I} = R$$

$$\frac{V}{R} = I$$

$$V_{out} = A(V_p - V_m)$$

$$V_m = \frac{V_{in(-)} R_2 + V_{out} R_1}{R_1 + R_2} \quad (\text{From Difference Amp})$$

$$V_p = I_{R3} \cdot R_4 - V_{out}$$

$$I_{R3} = \frac{V_{in(+)} + V_{out}}{R_3 + R_4}$$

$$V_p = \frac{V_{in(+)} + V_{out}}{R_3 + R_4} \cdot R_4 - V_{out}$$

$$V_p = \frac{R_4 \cdot V_{in(+)} + R_4 \cdot V_{out}}{R_3 + R_4} - V_{out}$$

$$V_{out} = \frac{R_4 \cdot V_{in(+)} + R_4 \cdot V_{out}}{R_3 + R_4} - \frac{V_{in(-)} \cdot R_2 + V_{out} \cdot R_1}{R_1 + R_2}$$

$$V_{out} = \frac{R_4 \cdot V_{in(+)}}{R_3 + R_4} + \frac{R_4 \cdot V_{out}}{R_3 + R_4} - \frac{V_{in(-)} \cdot R_2}{R_1 + R_2} - \frac{V_{out} \cdot R_1}{R_1 + R_2}$$

$$V_{out} = \frac{R_4 \cdot V_{out}}{R_3 + R_4} + \frac{V_{out} R_1}{R_1 + R_2} = \frac{R_4 \cdot V_{in(+)}}{R_3 + R_4} - \frac{V_{in(-)} \cdot R_2}{R_1 + R_2}$$

$$V_{out} = A \left(\frac{R_4 \cdot V_{in(+)} + R_4 \cdot V_{out}}{R_3 + R_4} - V_{out} - \frac{V_{in(-)} \cdot R_2 + V_{out} \cdot R_1}{R_1 + R_2} \right)$$

$$A \rightarrow \infty \therefore \frac{V_{out}}{A} \rightarrow 0$$

$$\frac{V_{out}}{A} = \frac{R_4 \cdot V_{in(+)} + R_4 \cdot V_{out}}{R_3 + R_4} - V_{out} - \frac{V_{in(-)} \cdot R_2 + V_{out} \cdot R_1}{R_1 + R_2}$$

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$$V_{out} = \frac{V_{out} R_4}{R_3 + R_4} + \frac{V_{out} R_1}{R_1 + R_2} = \frac{V_{in(+)} R_4}{R_3 + R_4} - \frac{V_{in(-)} R_2}{R_1 + R_2}$$

$$V_{out} \left(\frac{R_4}{R_3 + R_4} + \frac{R_1}{R_1 + R_2} \right) = \frac{V_{in(+)} R_4 (R_1 + R_2) - V_{in(-)} R_2 (R_3 + R_4)}{(R_1 + R_2) (R_3 + R_4)}$$

$$1 - \frac{R_4}{R_3 + R_4} + \frac{R_1}{R_1 + R_2} = \frac{V_{in(+)} R_4 (R_1 + R_2) - V_{in(-)} R_2 (R_3 + R_4)}{V_{out} (R_1 + R_2) (R_3 + R_4)}$$

$$1 + \frac{R_1 (R_3 + R_4) - R_4 (R_1 + R_2)}{(R_1 + R_2) (R_3 + R_4)} =$$

$$1 + \frac{R_1 R_3 + R_1 R_4 - R_1 R_4 - R_2 R_4}{(R_1 + R_2) (R_3 + R_4)} =$$

$$1 + \frac{R_1 R_3 - R_2 R_4}{(R_1 + R_2) (R_3 + R_4)} =$$

$$\frac{R_1 R_3 + R_1 R_4 + R_2 R_4 + R_2 R_4}{(R_1 + R_2) (R_3 + R_4)}$$

$$\frac{R_1 R_3 - R_2 R_4 + (R_1 + R_2) (R_3 + R_4)}{(R_1 + R_2) (R_3 + R_4)} =$$

$$\frac{R_1 R_3 + R_1 R_4 + R_2 R_4 + R_2 R_3}{(R_1 + R_2) (R_3 + R_4)} =$$

$$\frac{R_1 (R_3 + R_4) + R_2 (R_1 + R_2)}{(R_1 + R_2) (R_3 + R_4)} =$$

$$\frac{R_1}{R_1 + R_2} + \frac{R_2}{R_3 + R_4} =$$

$$\frac{R_1}{R_1+R_2} + \frac{R_3}{R_3+R_4} = \frac{V_{in(+)} R_4 (R_1+R_2) - V_{in(-)} R_2 (R_3+R_4)}{V_{out} (R_1+R_2) (R_3+R_4)}$$

$$R_1 (R_3+R_4) + R_3 (R_1+R_2) = \frac{V_{in(+)} R_4 (R_1+R_2) - V_{in(-)} R_2 (R_3+R_4)}{V_{out}}$$

$$\frac{R_1 (R_3+R_4) + R_3 (R_1+R_2)}{V_{in(+)} R_4 (R_1+R_2) - V_{in(-)} R_2 (R_3+R_4)} = \frac{1}{V_{out}}$$

$$\frac{V_{in(+)} R_4 (R_1+R_2) - V_{in(-)} R_2 (R_3+R_4)}{R_1 (R_3+R_4) + R_3 (R_1+R_2)} = V_{out}$$

$$V_{in} = V_{in(+)} = -V_{in(-)}$$

$$\frac{V_{in} R_4 (R_1+R_2) + V_{in} R_2 (R_3+R_4)}{R_1 (R_3+R_4) + R_3 (R_1+R_2)} = V_{out}$$

$$\frac{R_4 (R_1+R_2) + R_2 (R_3+R_4)}{R_1 (R_3+R_4) + R_3 (R_1+R_2)} = \frac{V_{out}}{V_{in}}$$

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