Dr Satvir Singh

LINEAR INTEGRATED CIRCUITS

3-02

Instrumentation Amplifier

Instrumentation Amplifier

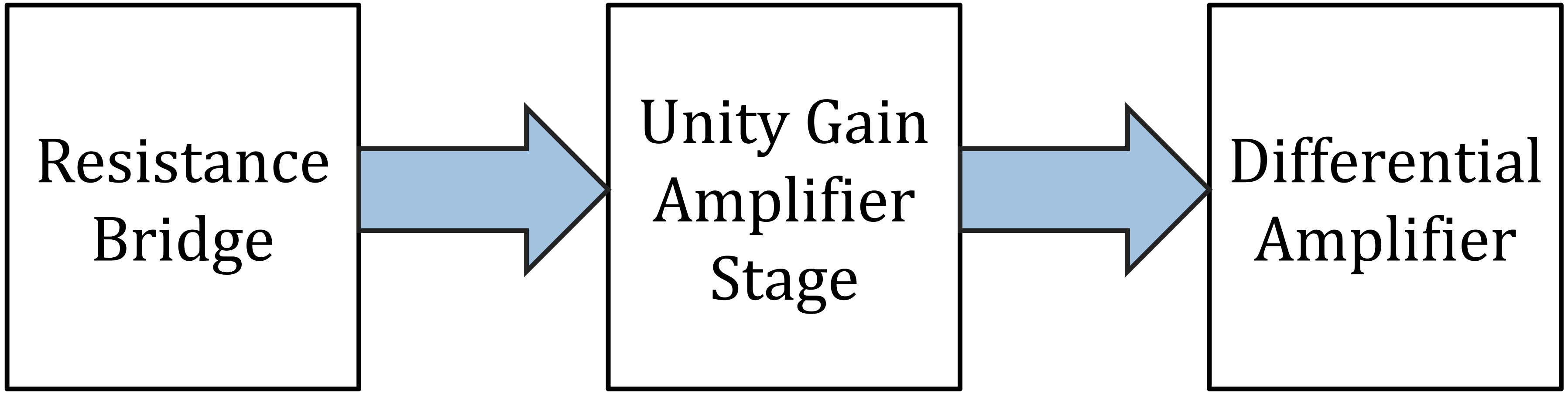
Most of home & industrial appliances involve measurements of physical parameters for auto-control of processes. Such instruments uses transducers to convert physical quantities into electrical signals, which usually need to be amplified.

For example, strain gauge undergoes change in **resistance** (an electrical parameter) when subjected to **pressure** (a physical parameter). Corresponding voltage signals are very small that need to be amplified.

Many a times amplifications are also required to activate next stages of processes.

Op-Amp based differential amplifier preferred amplifier to amplify very weak signals due to its high gain and capability of suppression of ambient noise.

Block Diagram



Instrumentation Amplifier

R_T is the transducer resistance under normal conditions. It observes change ΔR when subjected to physical changes.

Under unbalance condition

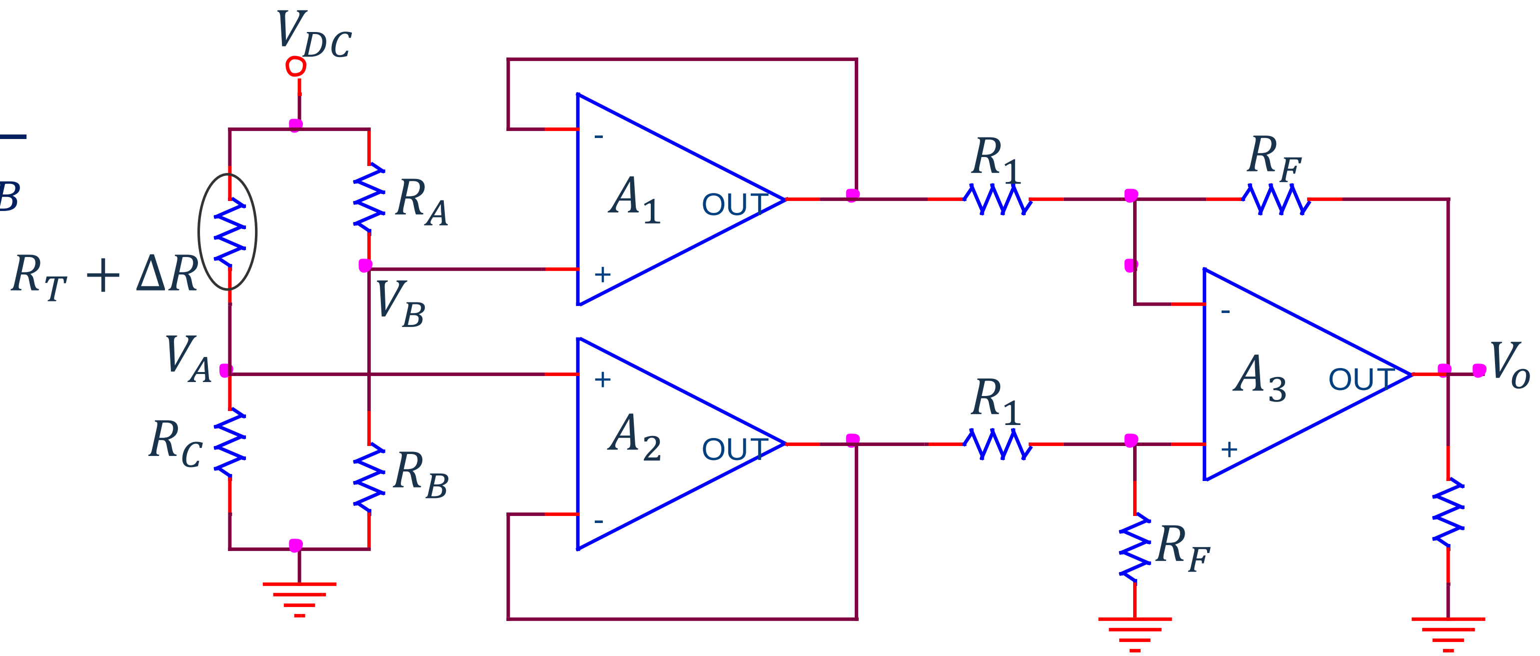
$$V_d = V_A - V_B \neq 0$$

$$V_d = \frac{(R_T + \Delta R)V_{DC}}{R_T + \Delta R + R_C} - \frac{R_B V_{DC}}{R_A + R_B}$$

For simplicity, assume

$$R_A = R_B = R_C = R_T = R$$

$$V_d = \frac{\Delta R V_{DC}}{2(2R + \Delta R)}$$



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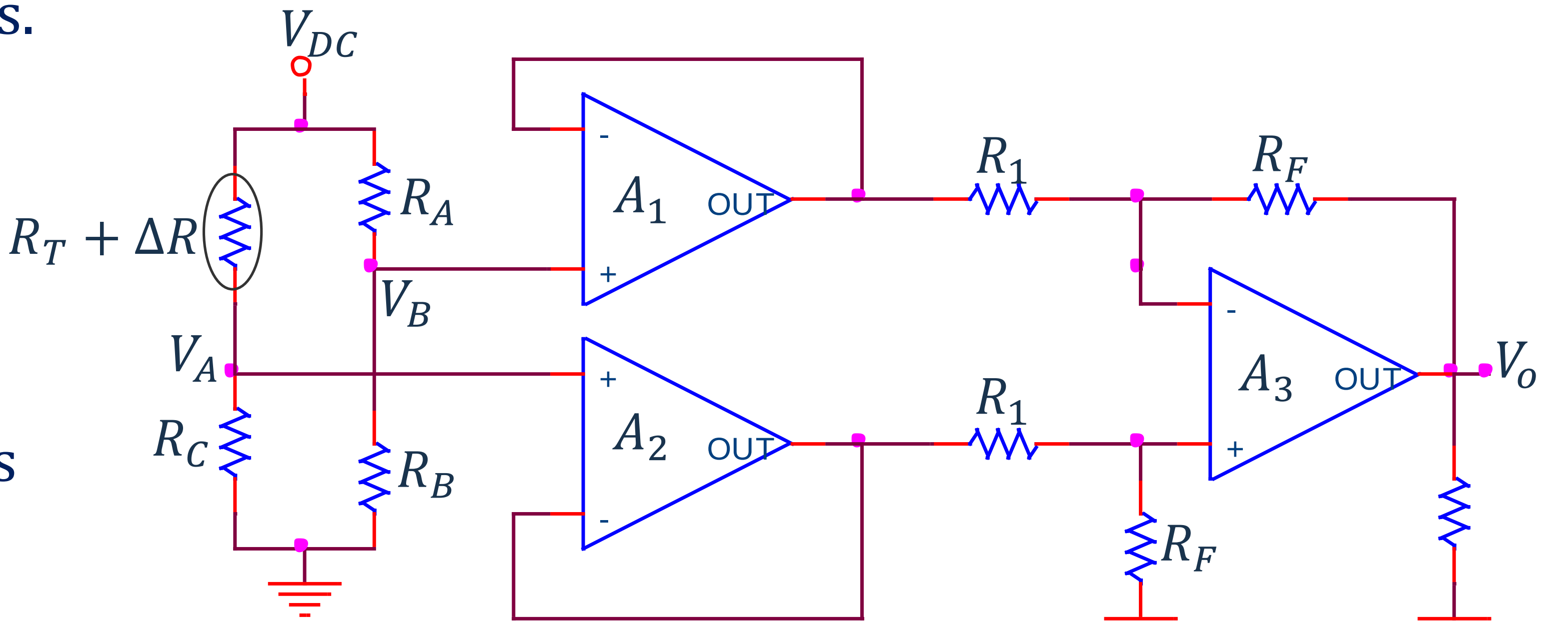
A_1 and A_2 are unity gain non-inverting amplifiers with high input impedance and draw negligible current from transducer, hence provide isolation.

Next stage is differential amplifier A_3 that suppresses common noise and amplifies the difference between both inputs.

$$V_o = \frac{R_F}{R_1}\frac{\Delta R V_{DC}}{2(2R+\Delta R)}$$



Since, $2R + \Delta R \approx 2R$, Output of Instrumentation Amplifier is

$$V_o = \frac{\Delta R}{4R}\frac{R_F}{R_1}V_{DC}$$

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Thank You