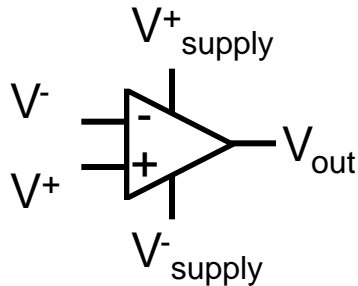


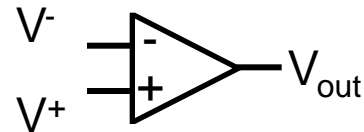
Dagens forelesning

- Op-amp repetisjon fra tidligere kurs
- Forsterkere og signalkondisjonering
Fraden kap 5
- Sidespor til tilbakekobling og blokkdiagram
Kompendiet
- Skjerming for kapasitive sensorer
Fraden avsnitt 3.2
- Sidespor til første ordens systemer

Operasjons forsterker (opamp)



eller



$$I_{in} = \frac{(V^+ - V^-)}{Z_{in}}$$

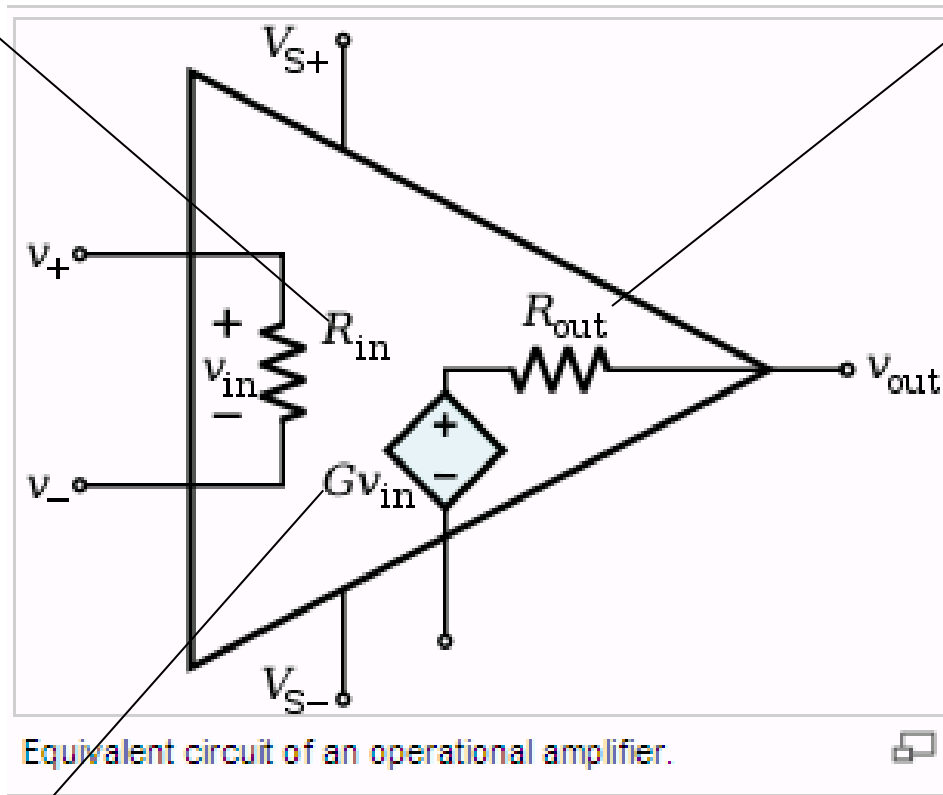
$$V_{out} = (V^+ - V^-)A_{OL} + \frac{1}{2}(V^+ + V^-)A_{CM} - I_{out}Z_{out}$$

		Typisk	Ideelt
Open loop gain:	A_{OL}	100 000	∞
Common mode gain:	A_{CM}	0.001	0
Utgangsimpedans:	Z_{out}	100 Ω	0
Inngangsimpedans:	Z_{in}	1M Ω	∞

From wikipedia

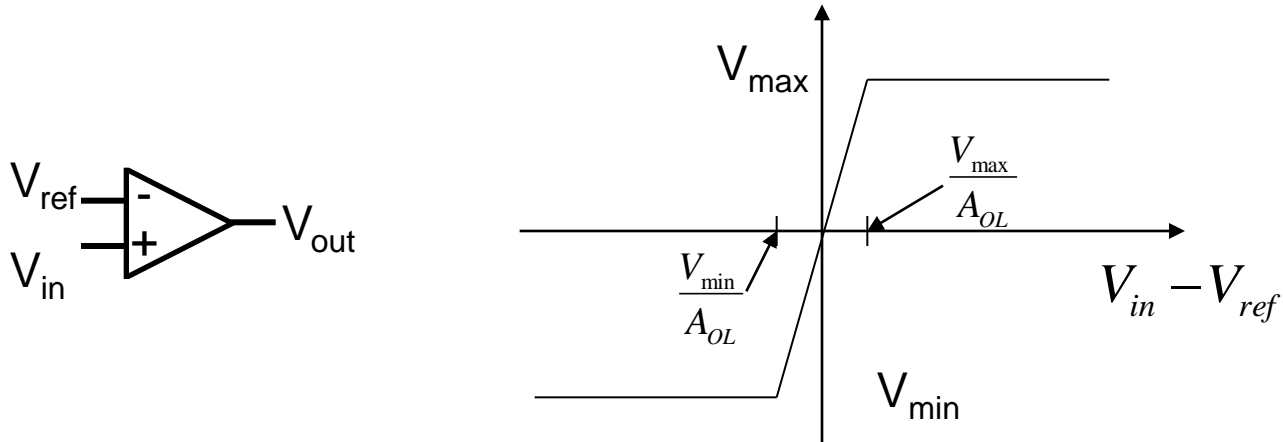
Z_{in}

Z_{out}



A_{OL}

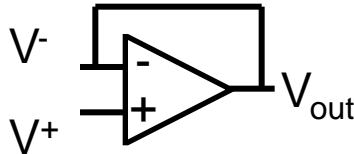
Komparator



For en ideell opamp er

$$V_{out} = V_{max} \quad \text{for} \quad V_{in} > V_{ref}$$
$$V_{out} = V_{min} \quad \text{for} \quad V_{in} < V_{ref}$$

Negativ tilbakekopling av opamp



$$V_{out} = A_{OL} (V^+ - V^-) = V^- \Rightarrow$$

$$V^+ = V^- \left(1 + \frac{1}{A_{OL}} \right) \Rightarrow$$

$$V^- = V^+ \left(1 + \frac{1}{A_{OL}} \right)^{-1} \Rightarrow$$

$$V^- \approx V^+$$

En negativ tilbakekopling tvinger negativ inngang til samme verdi som den positive inngangen

Spenningsfølger

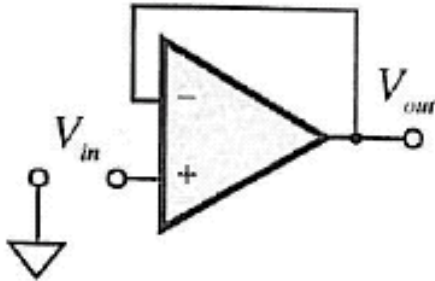
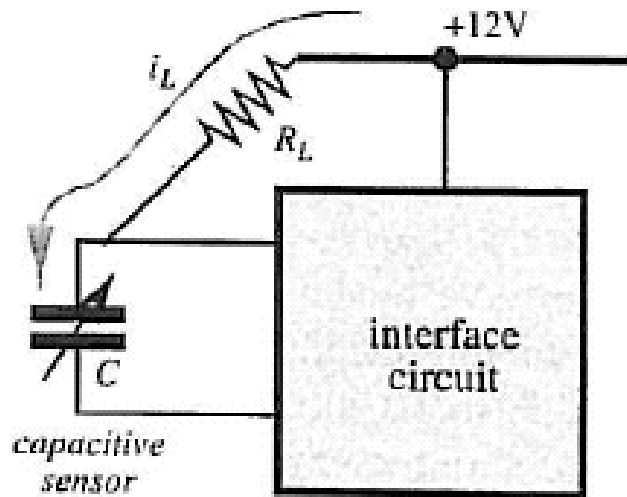


Fig. 5.7. Voltage follower with an operational amplifier.

- Konverterer "ned" utgangsimpedansen fra en sensor.

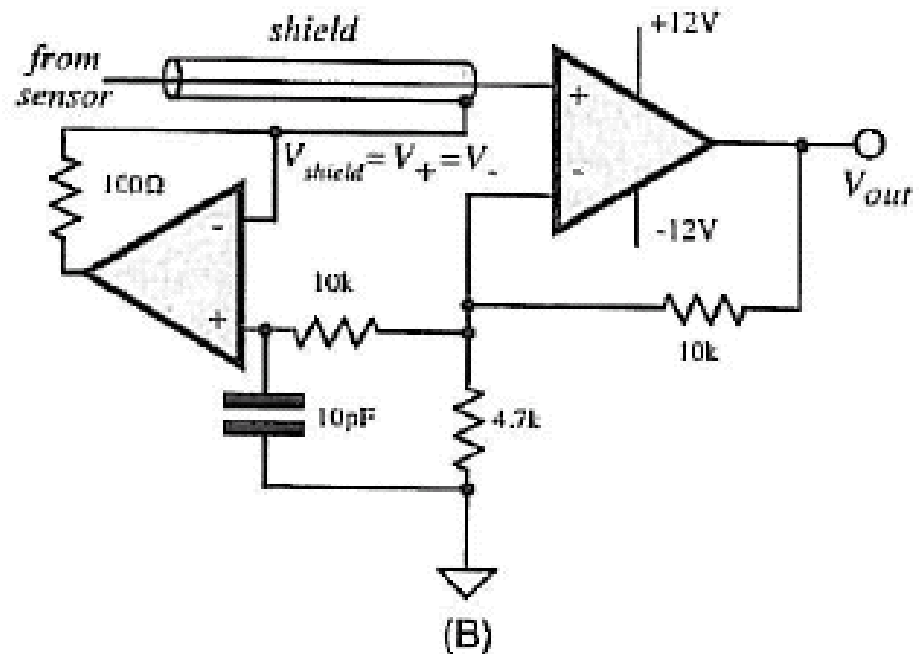
Drevet skjerm (driven shield)

Problem:



(A)

Løsning:



(B)

Fig. 5.4. Circuit board leakage affects input stage (A); driven shield of the input stage (B).

Essensen er å holde skjermen på samme potensial som signalet for å unngå lekkasjestrømmer. For å oppnå dette bruker vi en tilbakekopling.

Kretser med "driver" for skjerm (AD7747)

24-Bit Capacitance-to-Digital Converter with Temperature Sensor

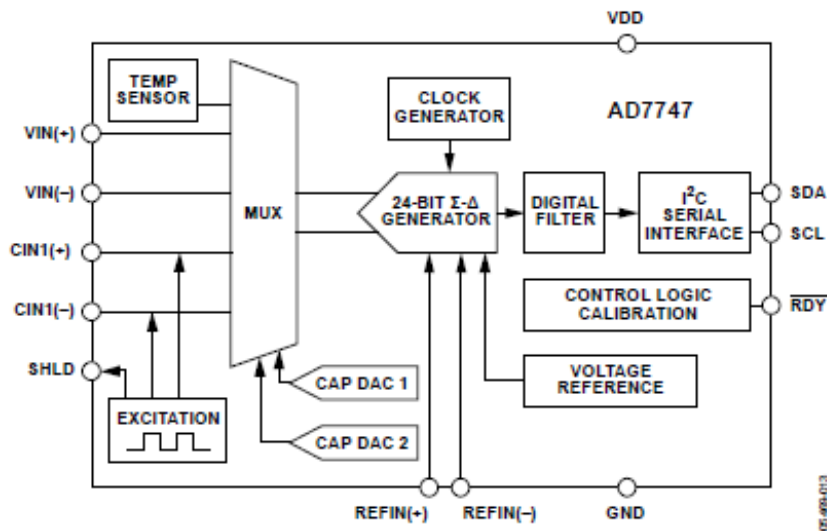


Figure 24. AD7747 Block Diagram

ACTIVE AC SHIELD CONCEPT

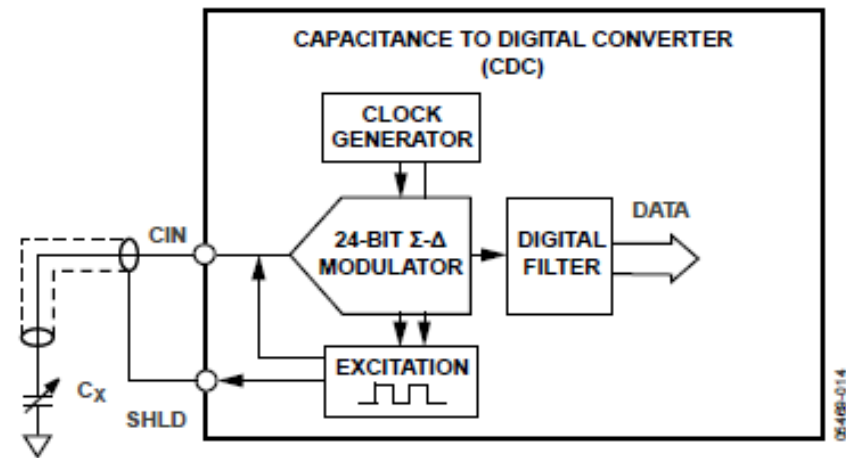
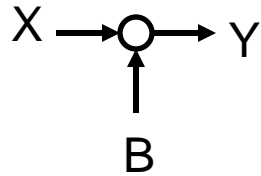


Figure 25. CDC Simplified Block Diagram

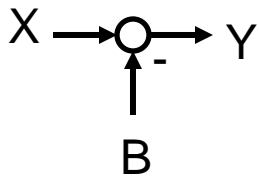
OVERVIEW

Blokkdiagram

Sum: $Y=X+B$



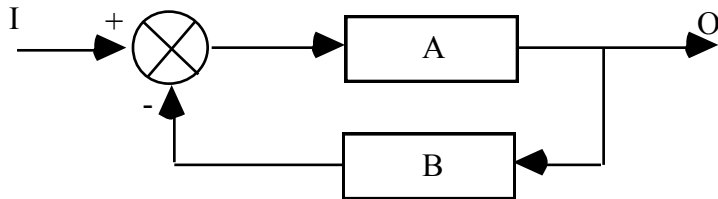
Differanse: $Y=X-B$



Multiplikasjon: $Y=AX$



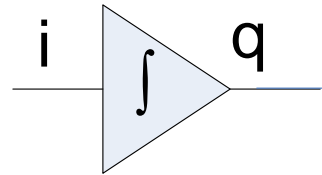
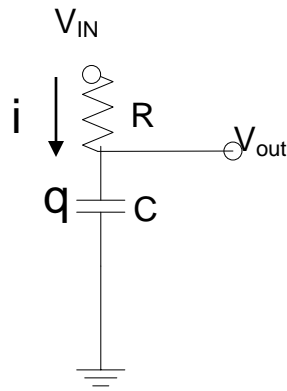
Negativ tilbakekobling i blokkdiagram



$$O = (I - BO)A$$

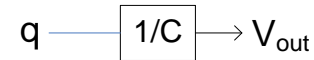
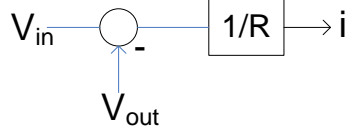
$$O = \frac{A}{1 + AB} I$$

Sidespor: Første ordens (filter) som blokk diagram

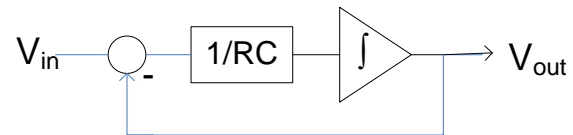
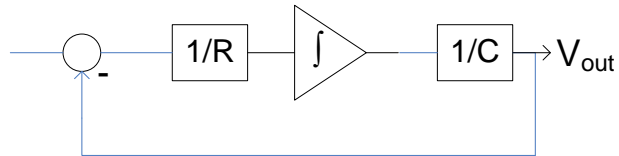
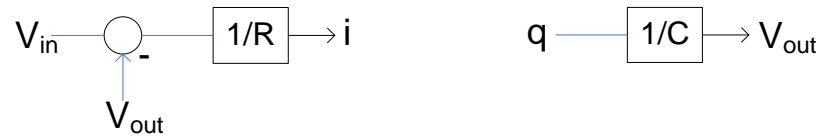
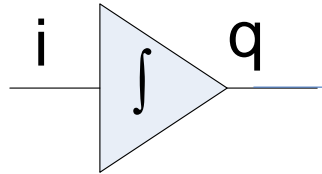


$$i = \frac{1}{R}(V_{in} - V_{out})$$

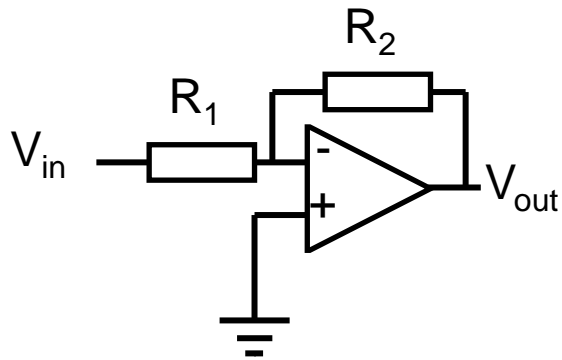
$$V_{out} = \frac{q}{C}$$



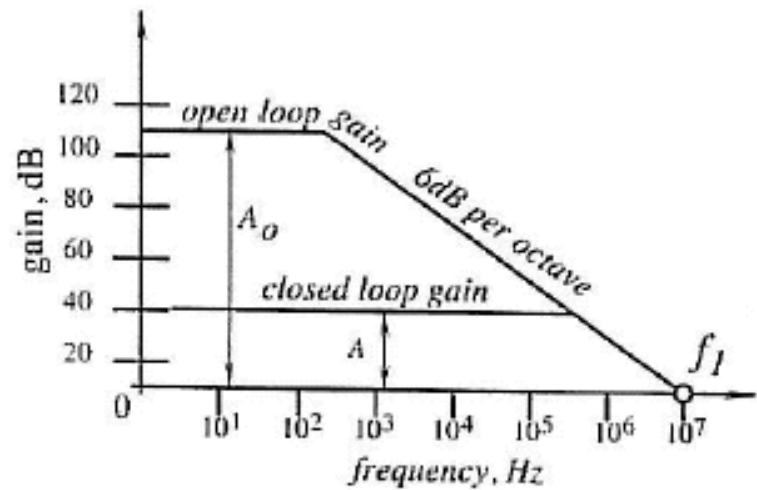
Sammenkopling



Inverterende forsterker

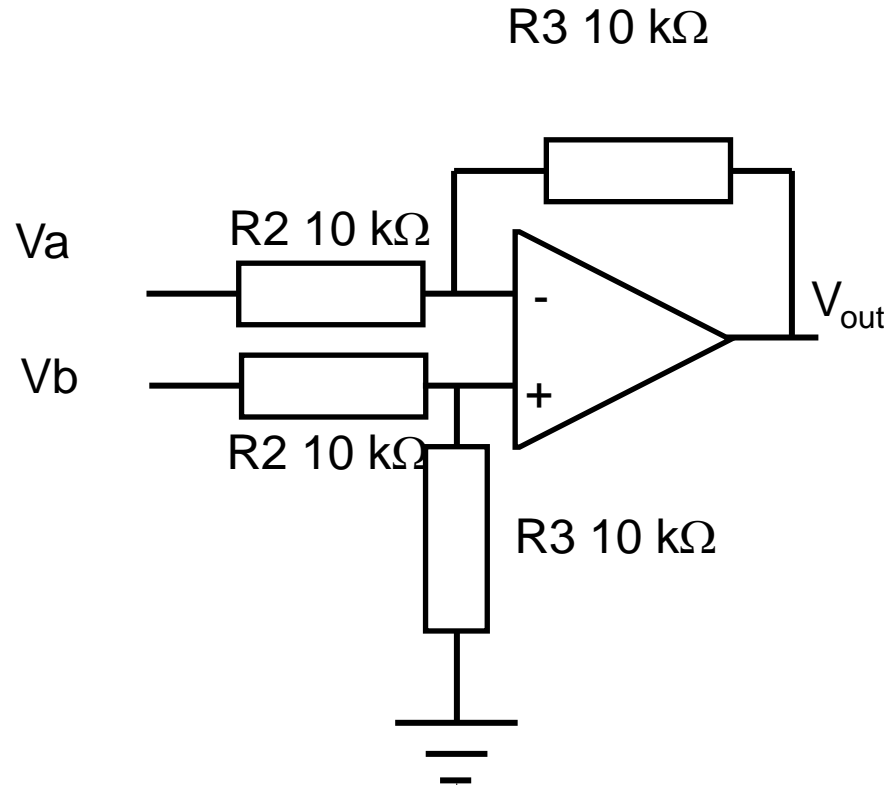


$$A_{CL} = -R_2/R_1$$



(B)

Subtraksjonskrets



Instrumenteringsforsterker

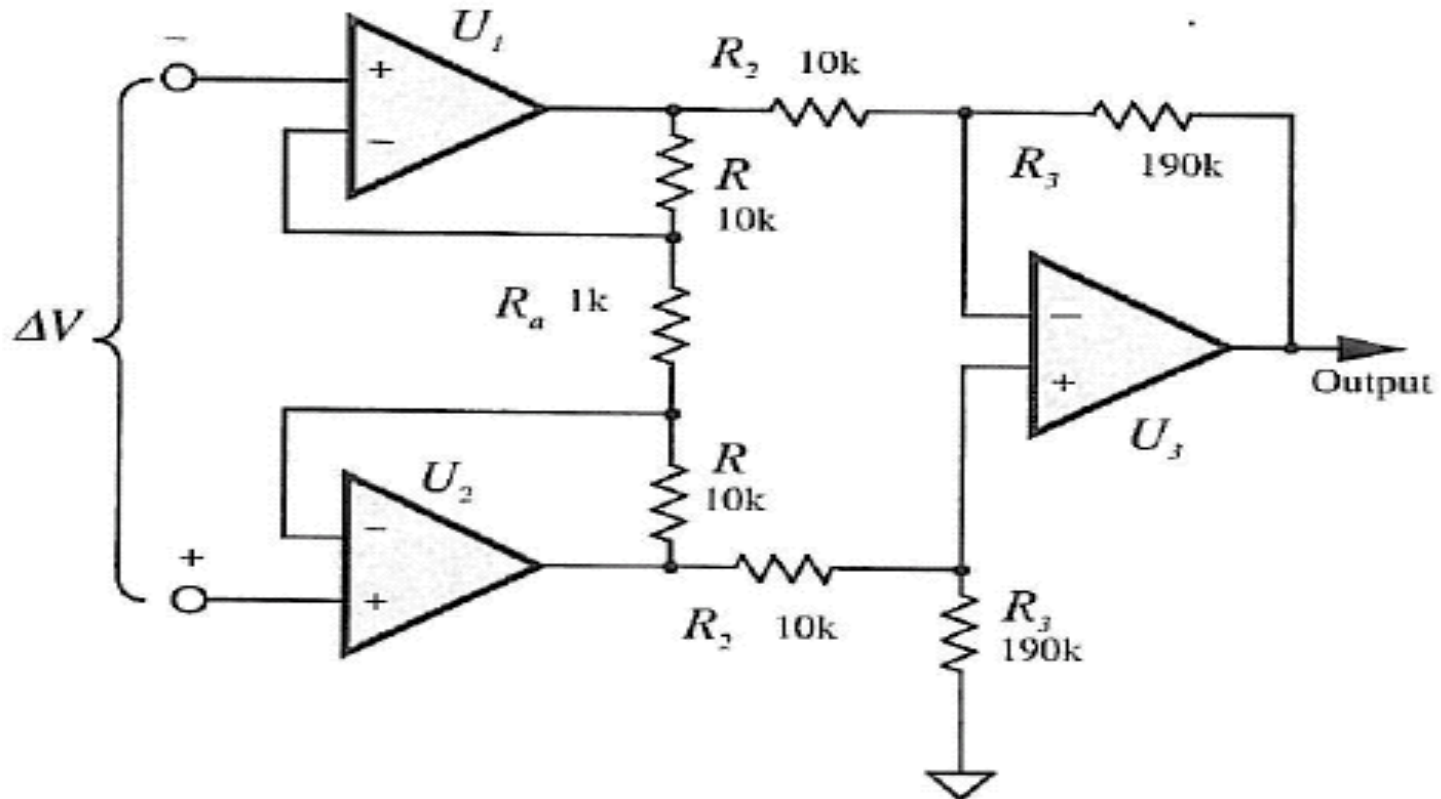
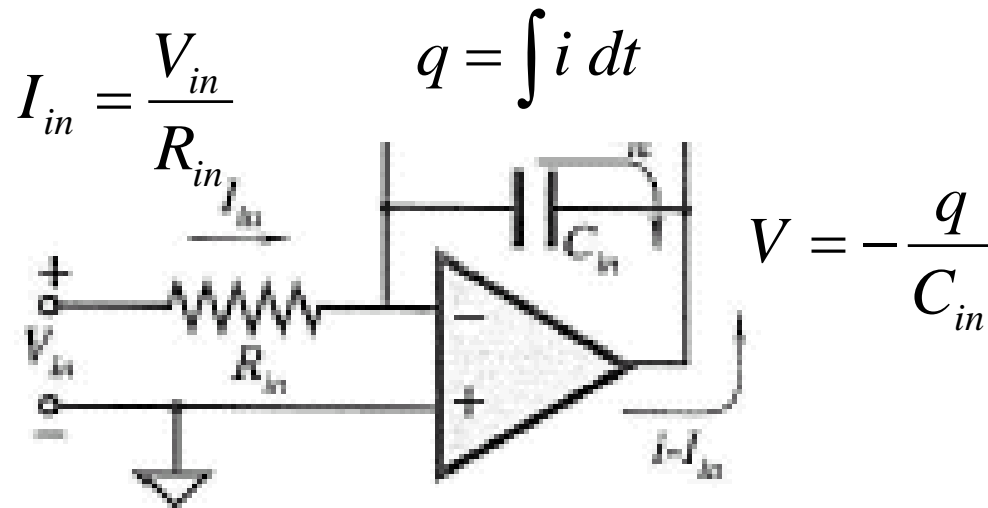


Fig. 5.8. Instrumentation amplifier with three operational amplifiers and matched resistors.

Integrator



$$V_{out} = \int \frac{V_{in}}{R_{in} C_{in}} dt$$