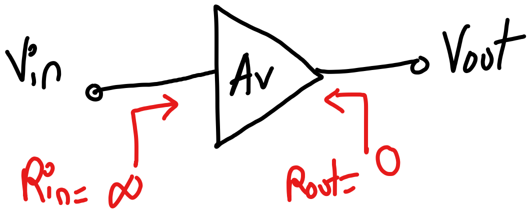
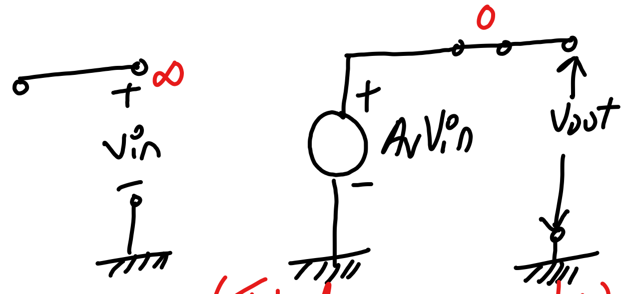
AEC lec 30 25/9/23

Models of 4 amplifier topologies:-

① Voltage amplifier

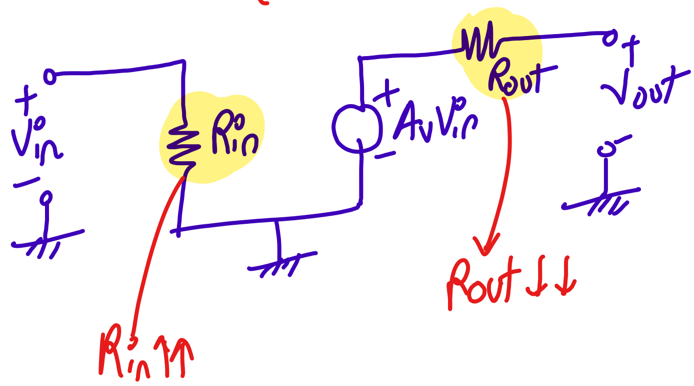


$$V_{out} = A_v V_{in}$$

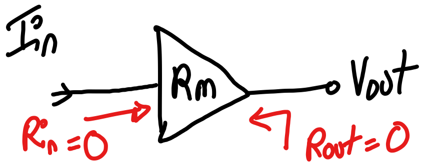


(Ideal case model)

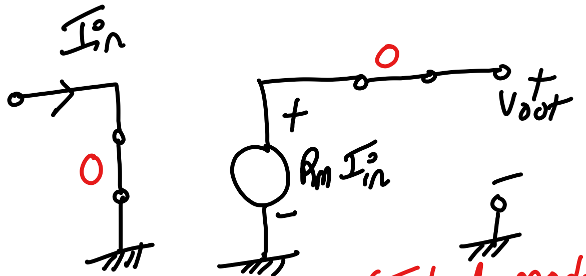
(Practical model of Voltage ampl^r)



② Transimpedance amplifier:

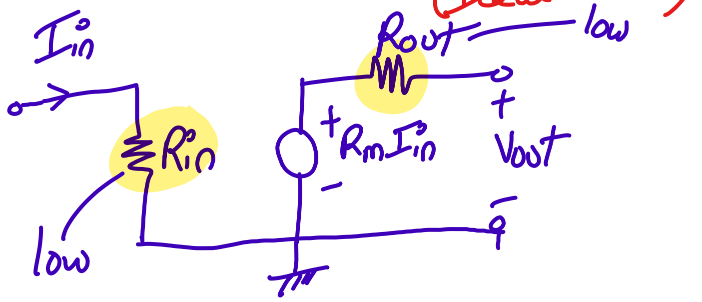


$$V_{out} = R_m I_{in}$$

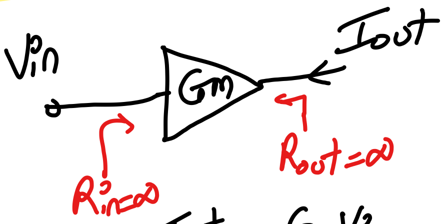


(Ideal model)

Practical model of TI ampl^r

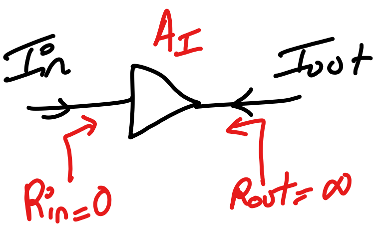


③ Transconductance ampl^r



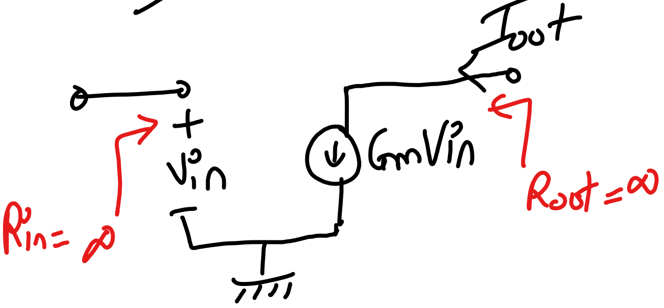
$$I_{out} = G_m V_{in}$$

④ Current ampl^r

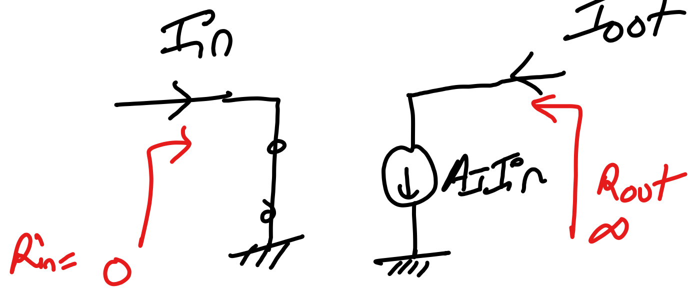


$$I_{out} = A_I I_{in}$$

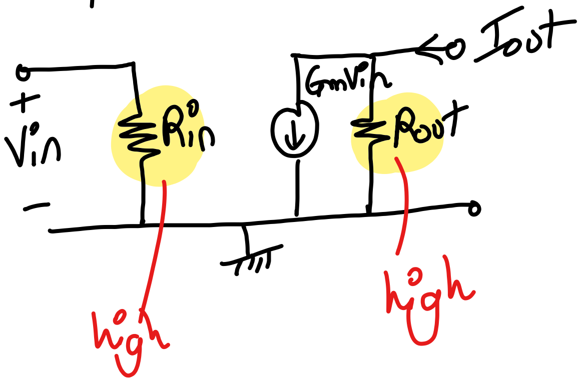
Ideal model



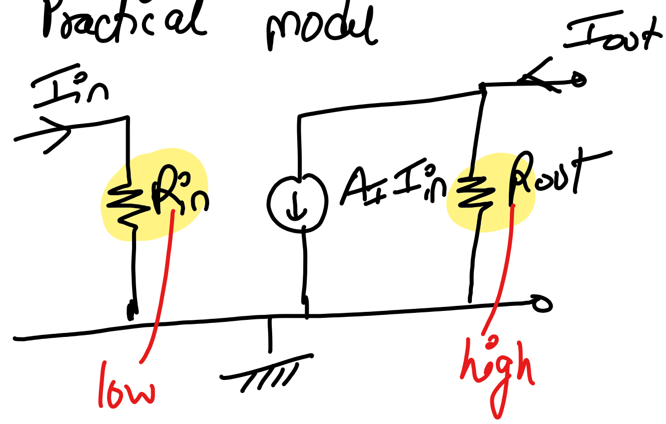
Ideal model



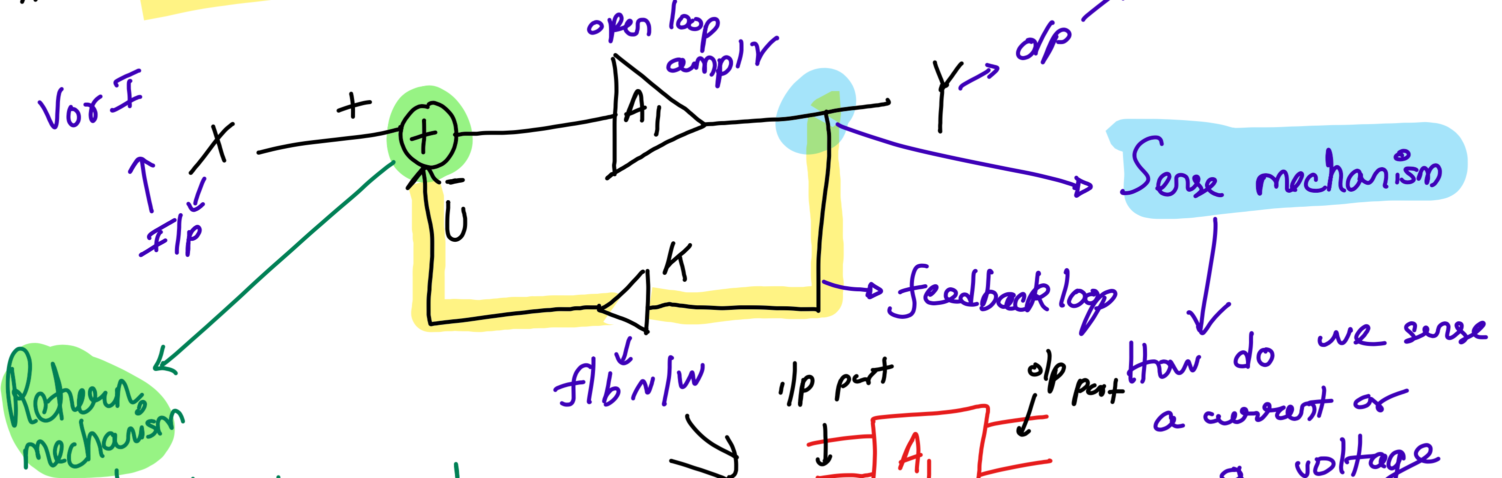
Practical model



Practical model

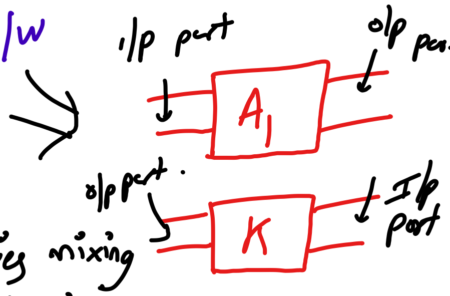


Sense & Return mechanism:



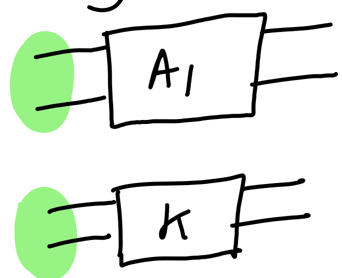
How do we sense a current or a voltage

How do we return a voltage or a current?



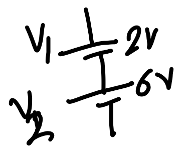
(Mixing) → Series mixing
→ Shunt mixing

Return mechanism:

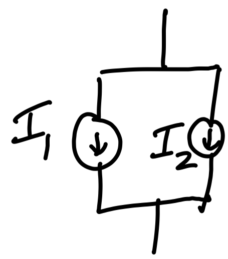


→ How to subtract two voltages or two currents

2V+6V

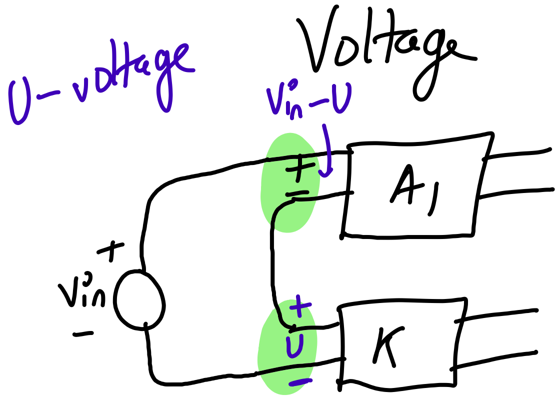


V_1 & V_2 are in series.



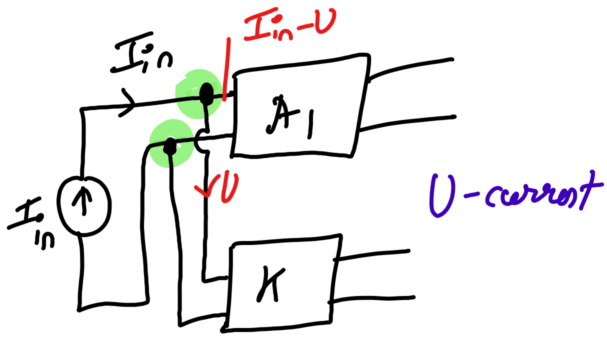
I_1 & I_2 are in parallel

Voltage



Returning a voltage at I/p

Current.

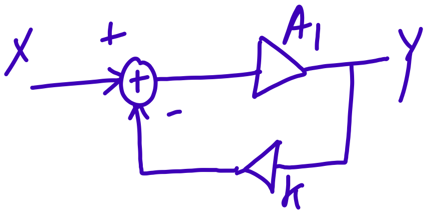


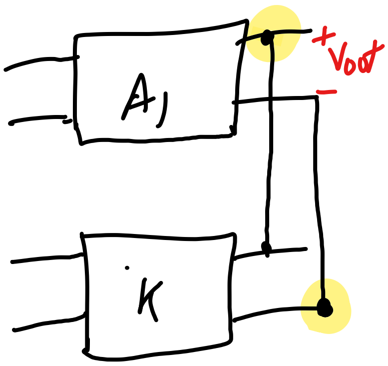
Returning a current at I/p

Sense mechanism:/Sampling

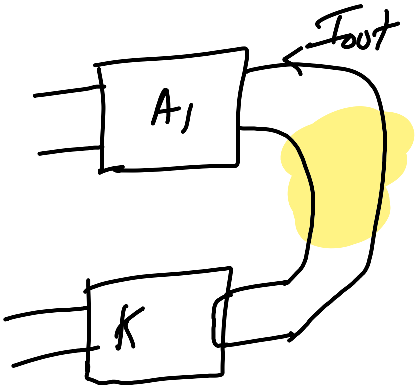
Voltage sense

Current sense





Sensing a voltage



Sensing a current

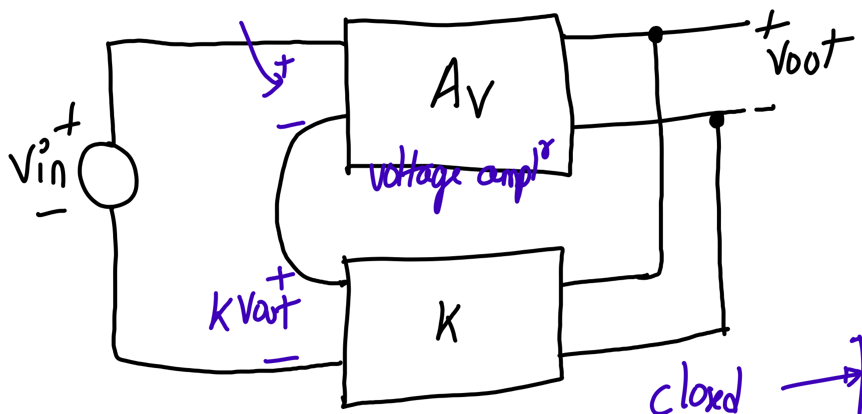
I/p X	o/p Y	feedback signal U	Feedback Topology
V	V	V	Voltage - Voltage f/b (sensing, returning) Shunt - series f/b Voltage - series f/b
I	V	I	Voltage - current f/b Shunt - shunt f/b Voltage - shunt f/b
V	I	V	Current - voltage f/b (sensing, return) Series - series f/b Current - series f/b
I	I	I	Current - Current f/b Series - shunt f/b Current - shunt f/b

4 -ve negative topologies: 'Af'

Aim → to find Closed-loop gain
& closed-loop i/p impedance (R_{inf})
& closed-loop o/p impedance (R_{outf})

Analysis of Voltage-series -ve f/b topology:

Voltage → o/p
series → I/p (voltage)



$$V_{out} = A_v(V_{in} - KV_{out})$$

$$V_{out} + A_v K V_{out} = A_v V_{in}.$$

$$V_{out}(1 + A_v K) = A_v V_{in}$$

$$\frac{V_{out}}{V_{in}} = \frac{A_v}{1+KA_v}$$

closed loop voltage gain → $\boxed{A_{vf} = \frac{A_v}{1+KA_v}}$