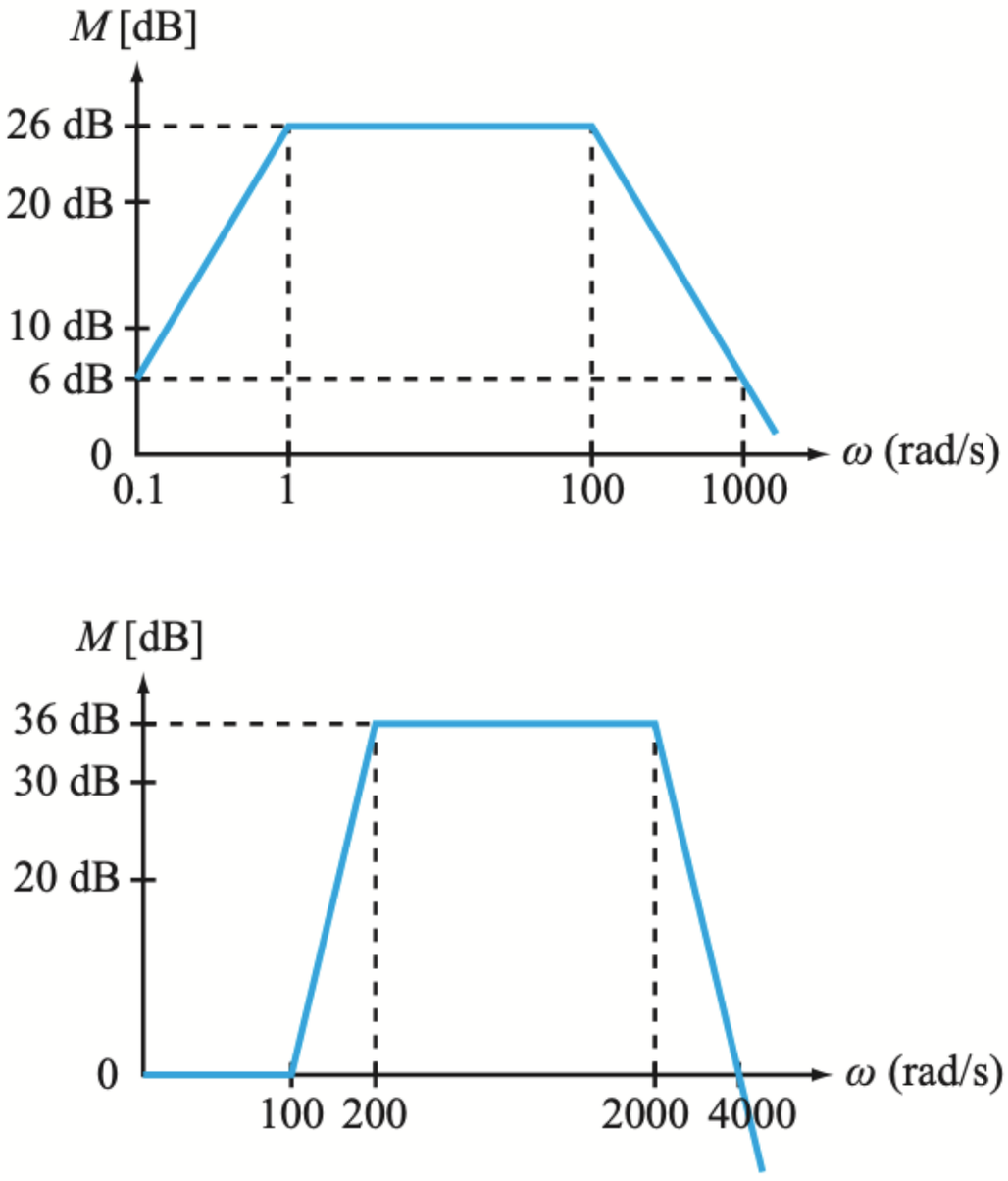
Last Class…

What is the gain K for the bode plots below



THE OHIO STATE UNIVERSITY

COLLEGE OF ENGINEERING

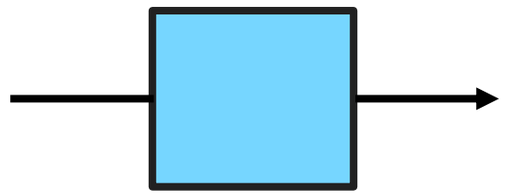
Intro to Operational Amplifiers

This Lecture…

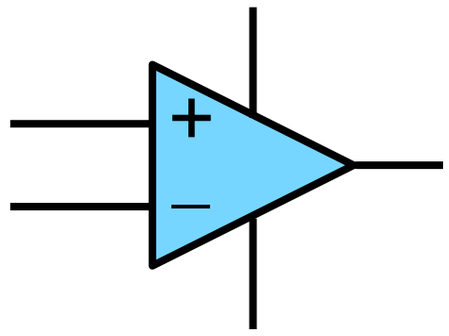
- Learning Objectives:
  - Describe the basic properties of an op amp and state the constraints of the ideal op-amp model.

Amplifiers

- Amplifier:

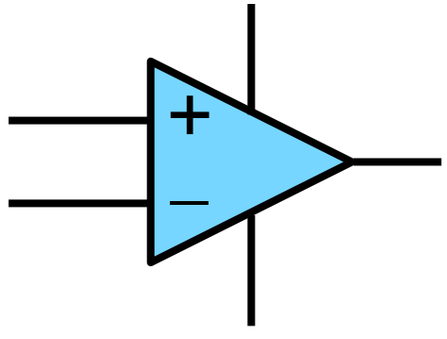


- Operational amplifier:



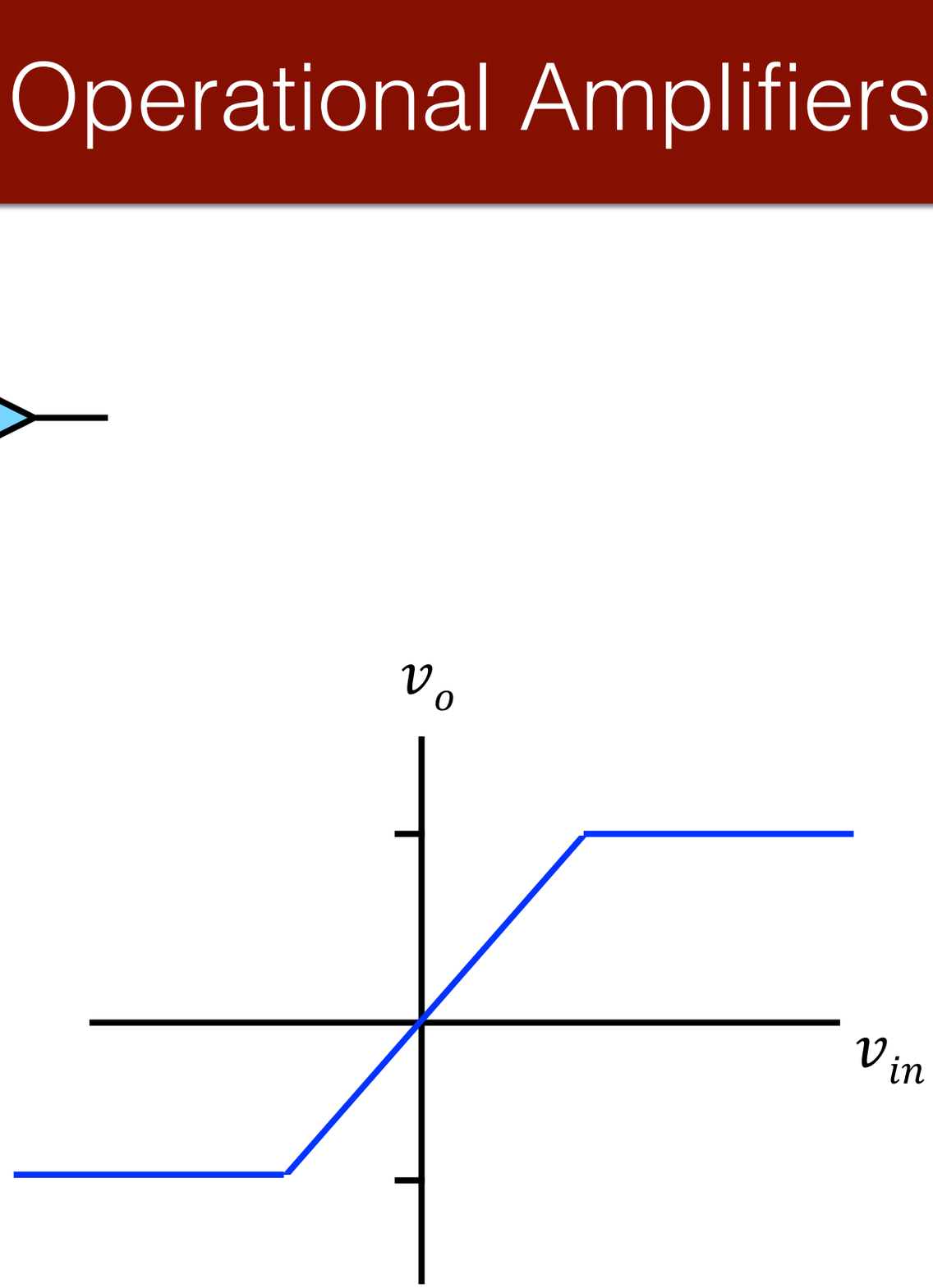
- It acquired the adjective operational because it is a versatile device capable not only of amplifying a signal but also inverting it (reversing its polarity), integrating it, or differentiating it.

Operational Amplifiers



Properties:

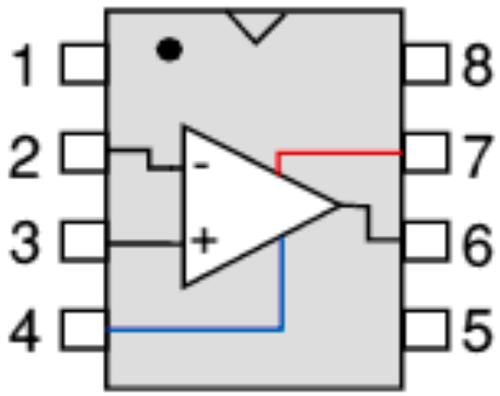
- High Gain: $A = 10^5 - 10^6$
- Differential input: $v_{in} = v_p - v_n$
- Linear operating range:
- Saturated by $+v_{cc}$ and $-v_{ee}$
- Usually $v_{ee} = -v_{cc}$



Operational Amplifiers

- Amplifier functions:
  - Signal Amplification.
  - Filtering.
  - Add, Subtract, Integrate, Differentiate.

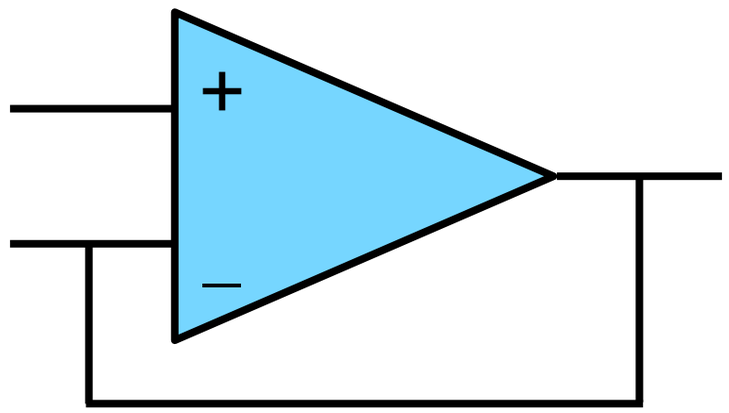
- Example amplifier applications:
  - Digital audio player.
  - Measurement sensors.
  - Feedback.

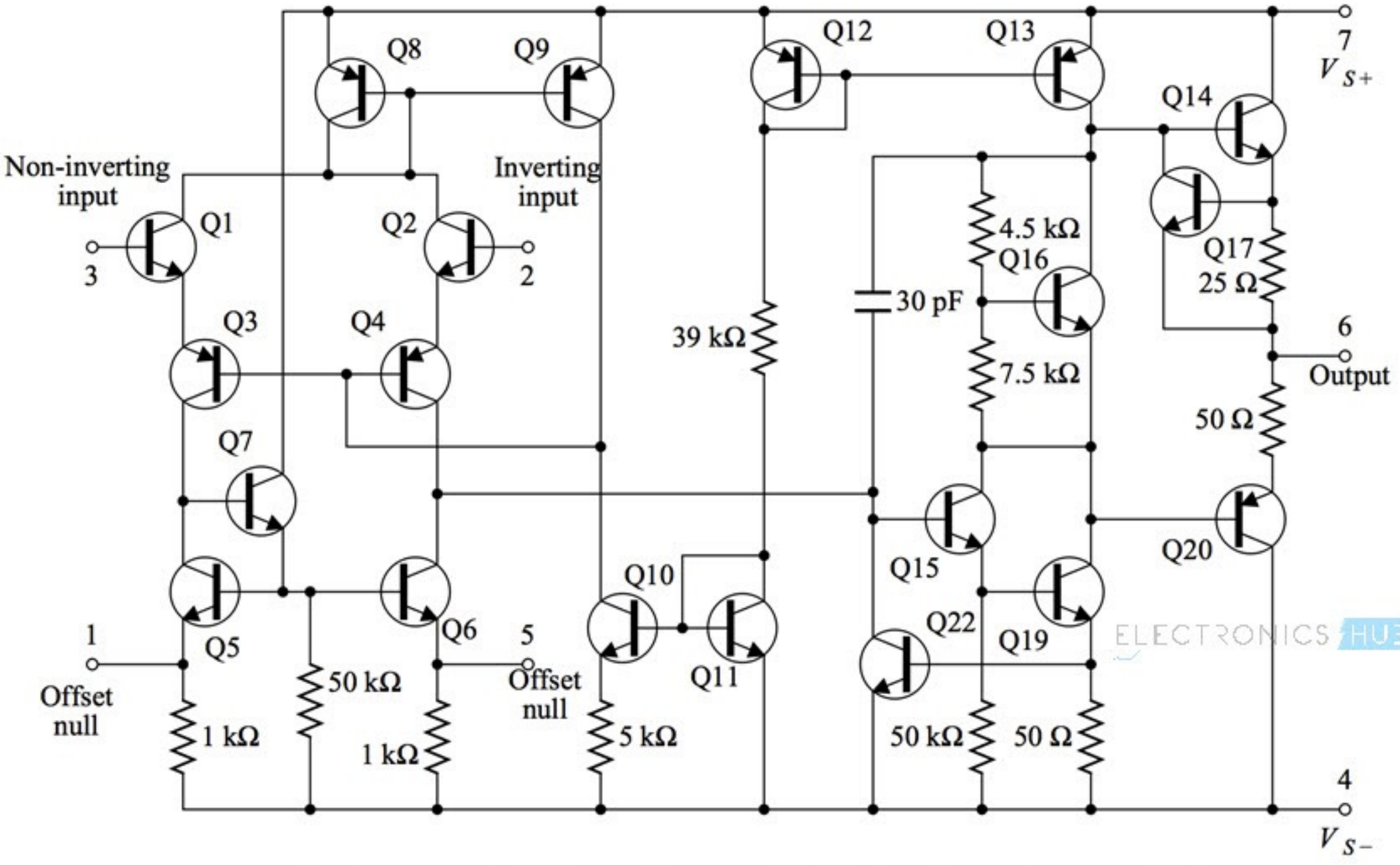


Feedback

- Process of using the output to reinforce (positive feedback) or inhibit (negative feedback) its input.
  - Open-loop mode if feedback is not used.
  - Closed-loop if feedback is used.

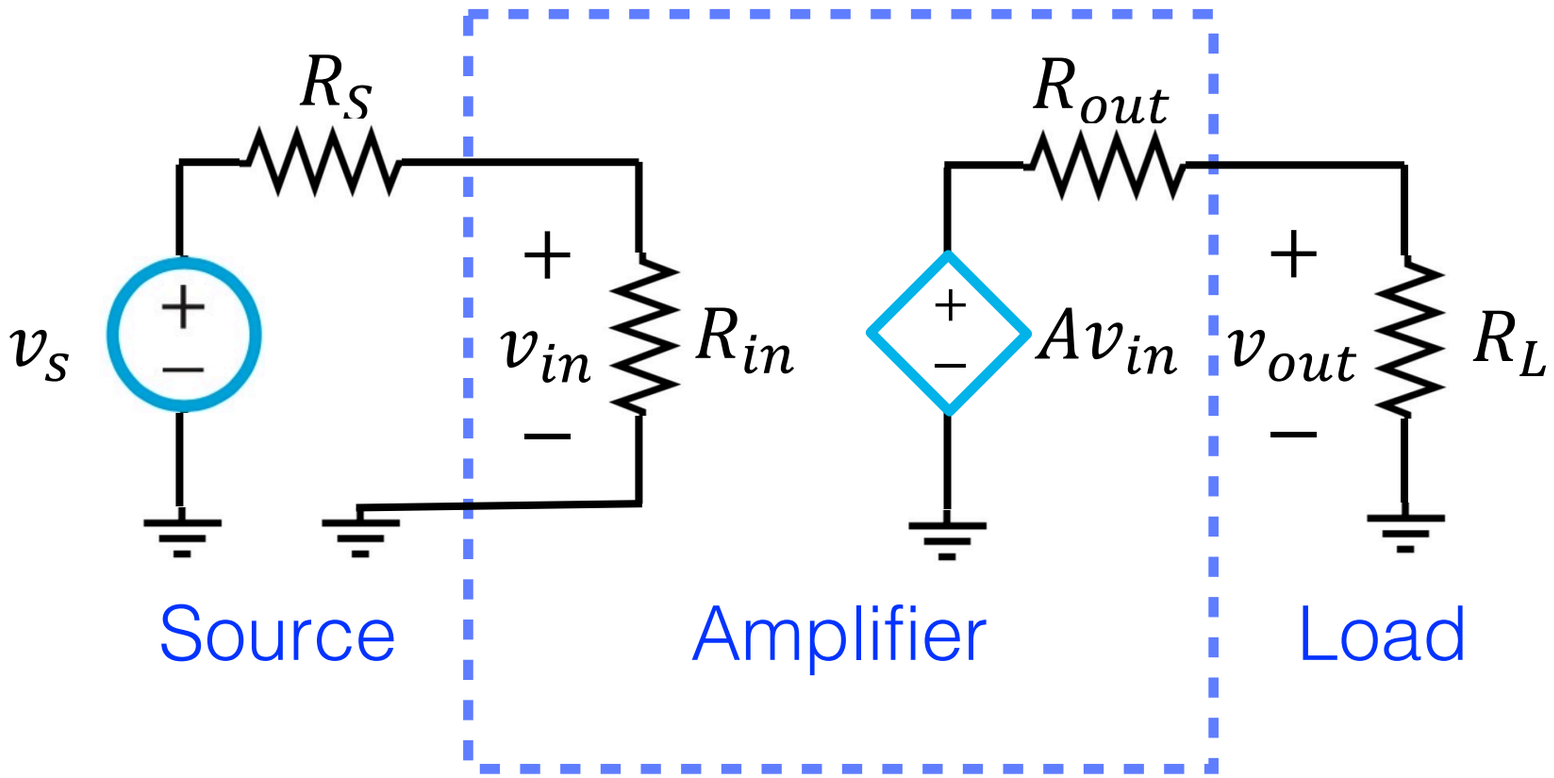
- Key benefits:
  - Decreased sensitivity to signal variations.
  - Increased bandwidth and linearity.
  - Increased signal-to-noise ratio.



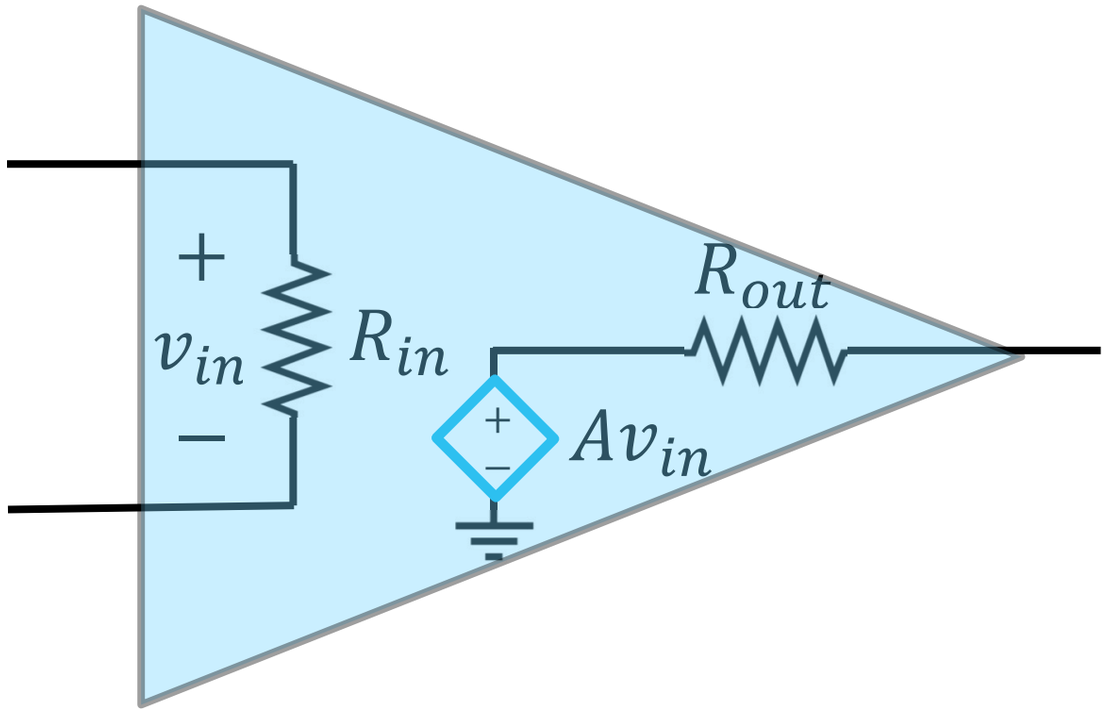


Internal Circutry of 741 Op-Amp IC

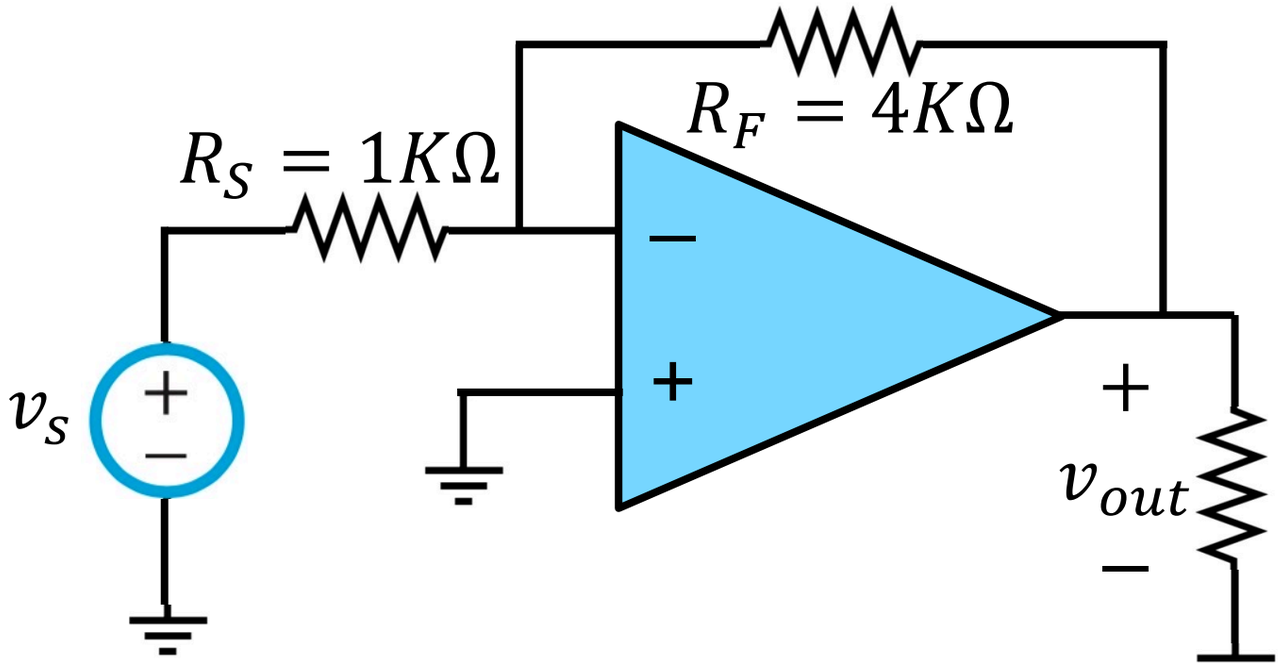
Amplifier Behavioral Model



Ideal Amplifier



Example



Find $\frac{v_{out}}{v_s}$ given that:

$R_{in} = 10^6\Omega$

$R_{out} = 100\Omega$

$A_{vol} = 10^6$