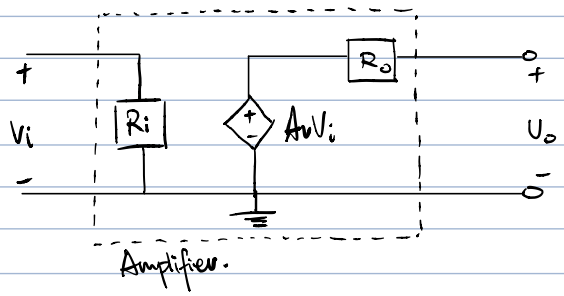
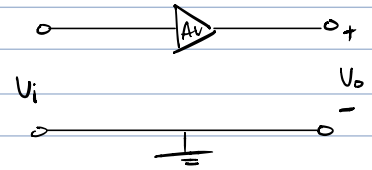
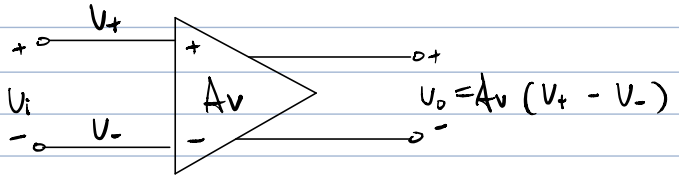
Amplifier.



Single-Ended Style of an Amplifier.



Differential.



$$\text{gain} = \frac{\text{output}}{\text{input}}$$:

- voltage gain. $= V_o/V_i$ (A_v)
- current gain. $= i_o/i_i$ (A_i)
- power gain $= \dfrac{V_o i_o}{V_i i_i} = A_v \cdot A_i$ (A_p)

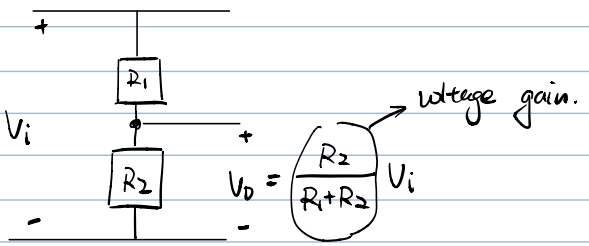
Decibel (dB)

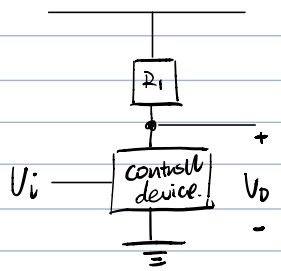
$20\log_{10}|A_v|$, $20\log_{10}|A_i|$, $10\log_{10}|A_p|$

eg. $A_v = 100$ $\quad 20\log_{10}100 = 40\,dB$

$A_v = 1$ $\quad 20\log_{10}1 = 0\,dB$

Simple Amplifier.

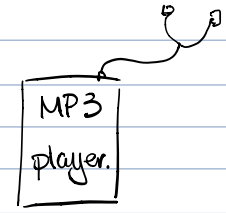




Passive amplifier: - output power ≤ input power.

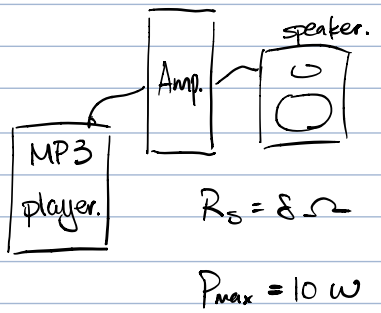
Active Amplifier: (external energy required to achieve) - output power > input power.

Design.



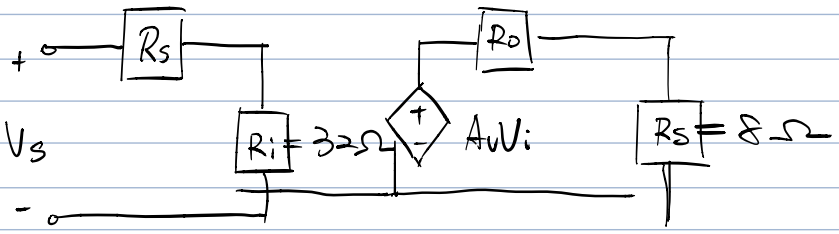
- impedance of 32 Ω

- max power of mp3 player.: 30mW.



$R_S = 8\,\Omega$

$P_{max} = 10\,W$

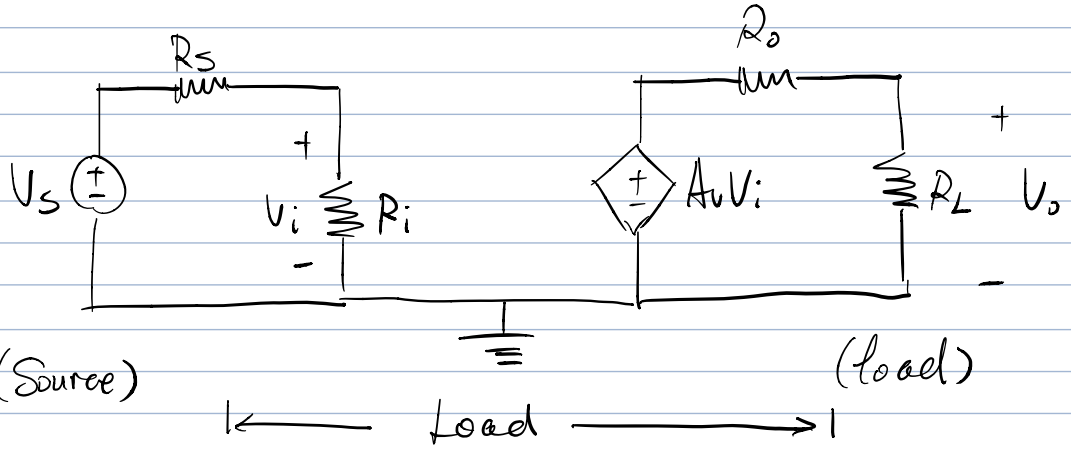


Amplifier Requirement.

$$\text{input power (30 mW)} = \frac{(V_i)^2}{R_i} \rightarrow V_i = \sqrt{(30mW)(32\Omega)} = 1V$$

$$\text{output power. (10 W)} = \frac{(V_o)^2}{R_S} \rightarrow V_o = \sqrt{(10W)(8\Omega)} = 9V$$

- voltage gain = $9V/1V = 9$
- power gain = $10W/30mW = 333.3$
- $10 \log 333.3 = 25\,dB$



$$\frac{V_i}{V_S} = \frac{R_i}{R_S + R_i}$$

$$V_o = A_v V_i \frac{R_L}{R_o + R_L} \Rightarrow \frac{V_o}{V_i} = \frac{R_L}{R_o + R_L} A_v$$

$$\frac{V_o}{V_i} \cdot \frac{V_i}{V_S} = \frac{V_o}{V_S} = A_v \frac{R_L}{R_o + R_L} \cdot \frac{R_i}{R_S + R_i}$$

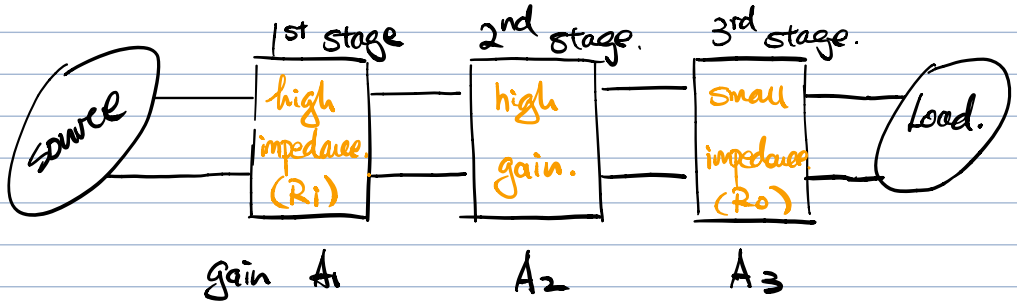
good w/t. amplifier. (large)

large. small. large.

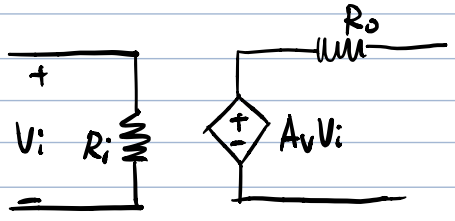
In Summary:

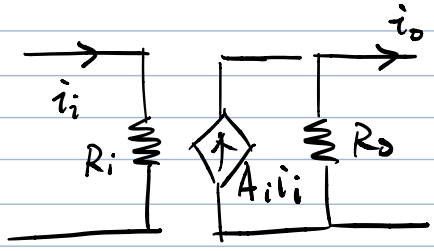
- large input impedance. (R_i)
- small output impedance. (R_o)
- large. gain (A_v)

multi-stage Amplifier.

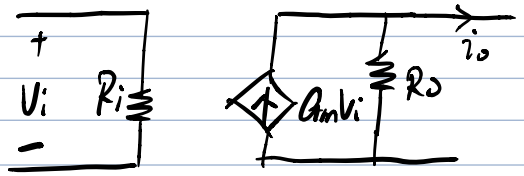


overall gain = $A_1 A_2 A_3$





trans conductance.



trans Resistance.