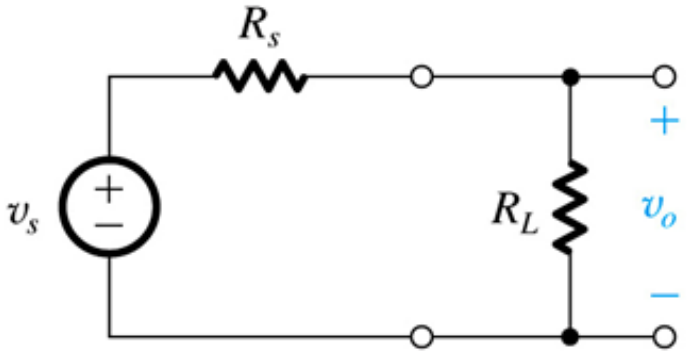
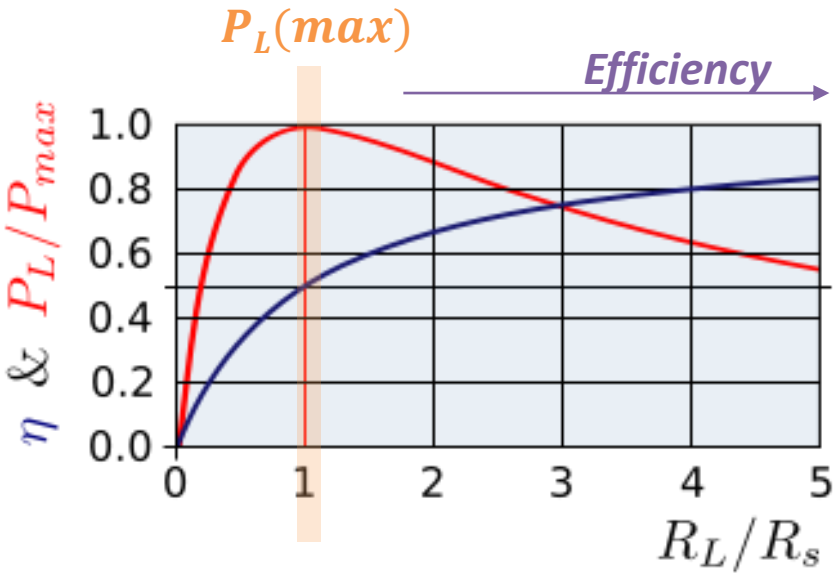
Last Lecture → Chapter 1.1

Concepts revisited…

- *electronics*
- *signal representation*
- *basic circuit analysis*
- *maximum power transfer*





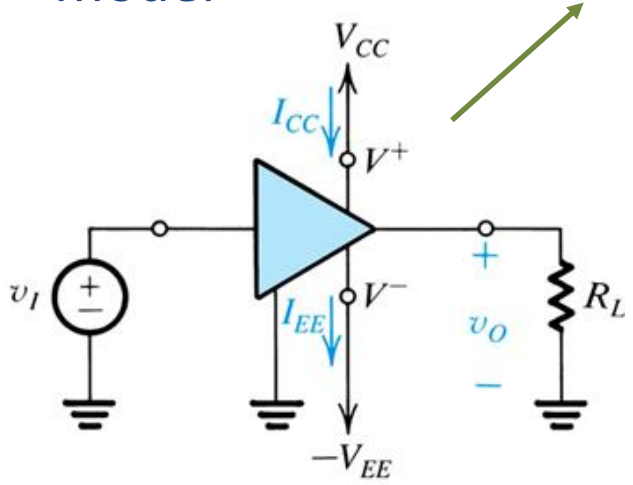
- *Power* $P_L = V_0 \cdot I_L = \frac{R_L}{(R_L + R_S)^2} V_s^2$
- *Efficiency* $\eta = \frac{P_L}{P_{supply}} = \frac{R_L}{R_L + R_S}$
- *Maximum Power*

$$\frac{\partial P_L}{\partial R_L} = 0 \quad @ \; R_L = R_S$$

Last Lecture → Chapter 1.2-1.5

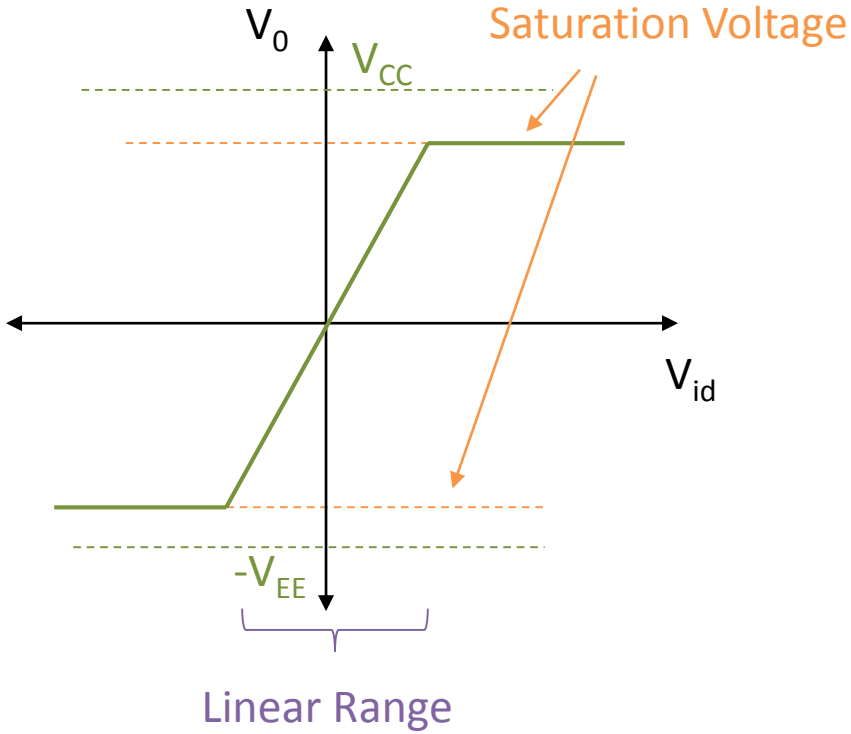
Concepts revisited…

- **Frequency spectrum**
- **Fourier series**
- **Amplifier basics**
  - *conservation of power*
  - *efficiency*
  - *model*



Voltage Gain

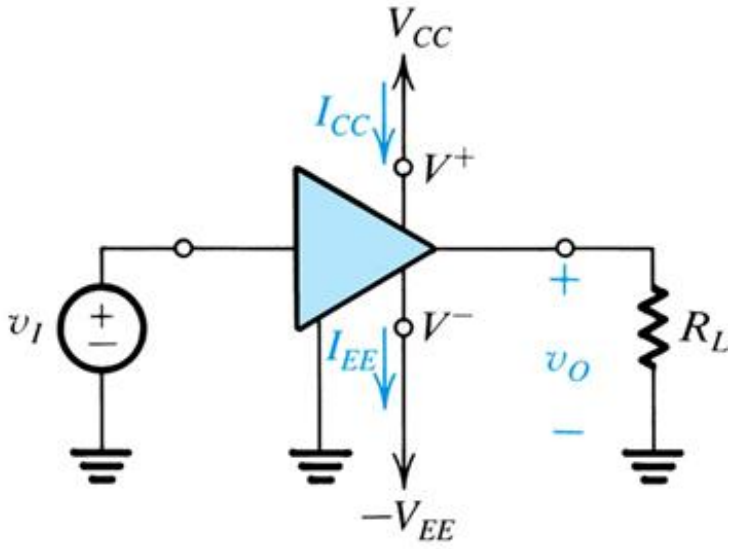
$$V_{out}(t) = A_V \cdot V_{in}(t)$$



- **Limited Linear Range**
- **Saturation Voltage**
- **Conservation of power** → $P_{V_I}+P_{V_{CC}}+P_{V_{EE}} = P_L + P_{amp}$
- **Efficiency** → $\eta = \frac{P_L}{P_{in}} = \frac{P_L}{P_{V_I}+P_{V_{CC}}+P_{V_{EE}}}$

Exercise 1.11

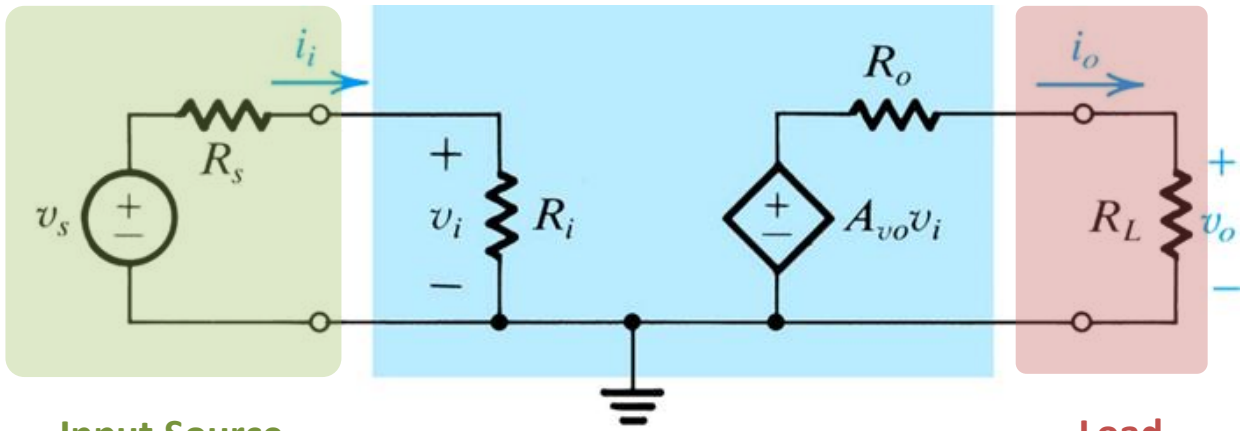
An amplifier operating from a single 15-V supply provides a 12-V peak-to-peak sine wave signal to a 1-kΩ load and draws negligible input current from the signal source. The dc current drawn from the 15-V supply is 8 mA. What is the power dissipated in the amplifier, and what is the amplifier efficiency?



Amplifier Circuit Model → Chapter 1.5

… is the description of the amplifier's terminal behavior, neglecting internal operation / transistor design

Voltage Amp. Circuit Model



$$v_o = A_{vo} v_s \underbrace{\frac{R_i}{R_i + R_s}}_{\text{Amp. Loading}} \underbrace{\frac{R_L}{R_L + R_o}}_{\text{Loading}} = \underbrace{A_{vo} v_s}_{\text{ideal model}}$$

non-ideal model

Ideal Assumptions…

- $R_i = \infty$ or $R_i >> R_s$
- $R_o = 0$ or $R_o << R_L$

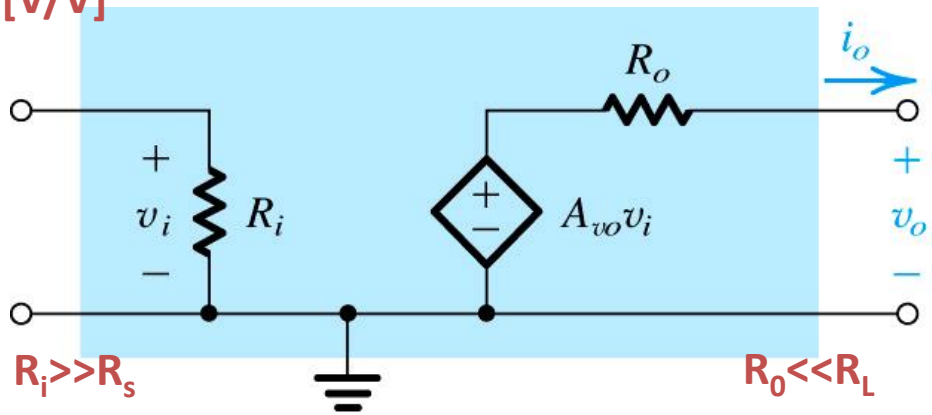
Different Types of Amplifiers

Voltage Amplifier

Gain → A_v [V/V]

$R_i = \infty$

$R_0 = 0$



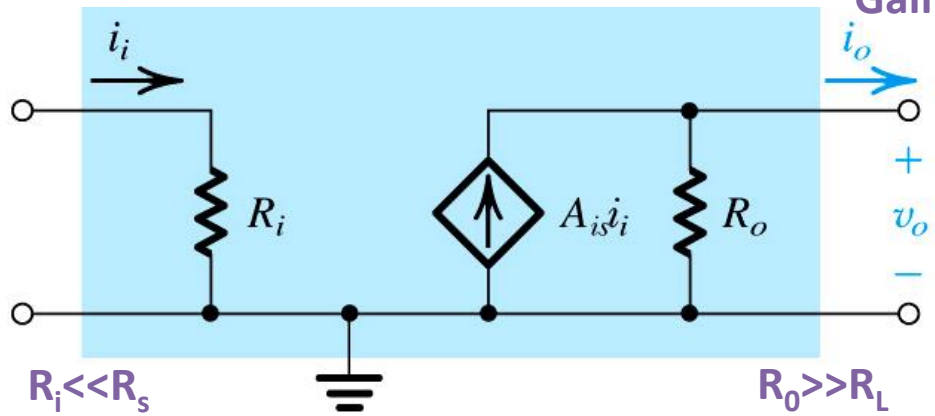
$R_i >> R_s$ $R_0 << R_L$

Current Amplifier

Gain → A_i [A/A]

$R_i = 0$

$R_0 = \infty$



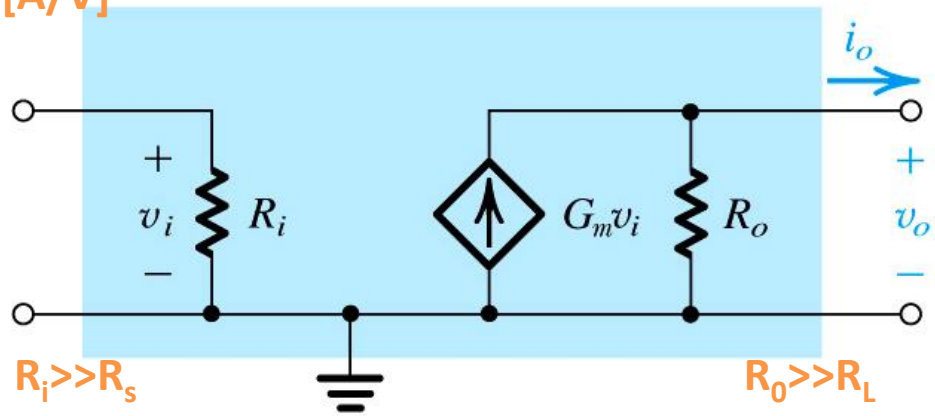
$R_i << R_s$ $R_0 >> R_L$

Trans-conductance Amplifier

Gain → A_v [A/V]

$R_i = \infty$

$R_0 = \infty$



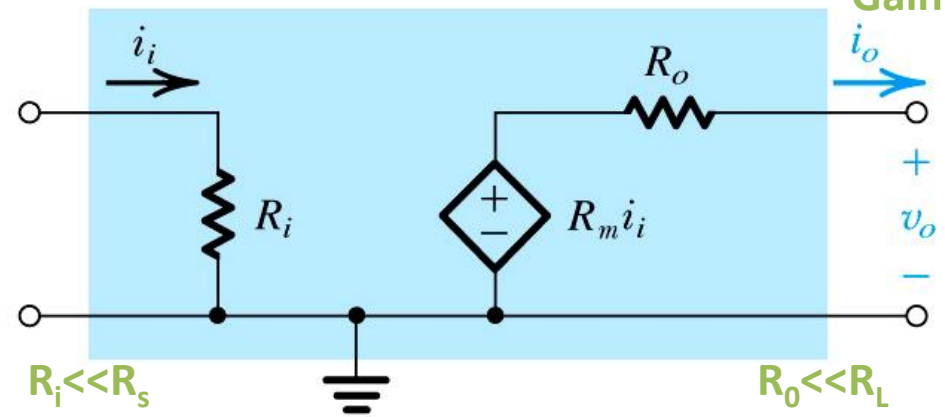
$R_i >> R_s$ $R_0 >> R_L$

Trans-resistance Amplifier

Gain → A_v [V/A]

$R_i = 0$

$R_0 = 0$

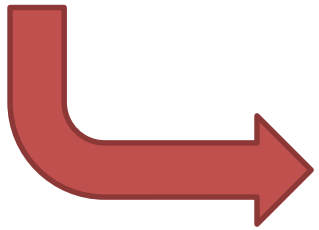


$R_i << R_s$ $R_0 << R_L$

Cascade Amplifiers

In real life, an amplifier is not ideal an will not have infinite input impedance or zero output impedance…

… cascading of amplifiers, however, may be used to emphasize desirable characteristics.



- **first amplifier** → high R_i, medium R_o
- **last amplifier** → medium R_i, low R_o
- **aggregate** → high R_i, low R_o

Example 1.3

Examine system of cascaded amplifiers….

a) **What is the overall voltage gain?**
b) **What is the overall current gain?**
c) **What is the overall power gain?**