

# Output Stages and Power Amplifiers

Chapter 14

Classification of Output Stages

Class A,B & AB

Biassing AB

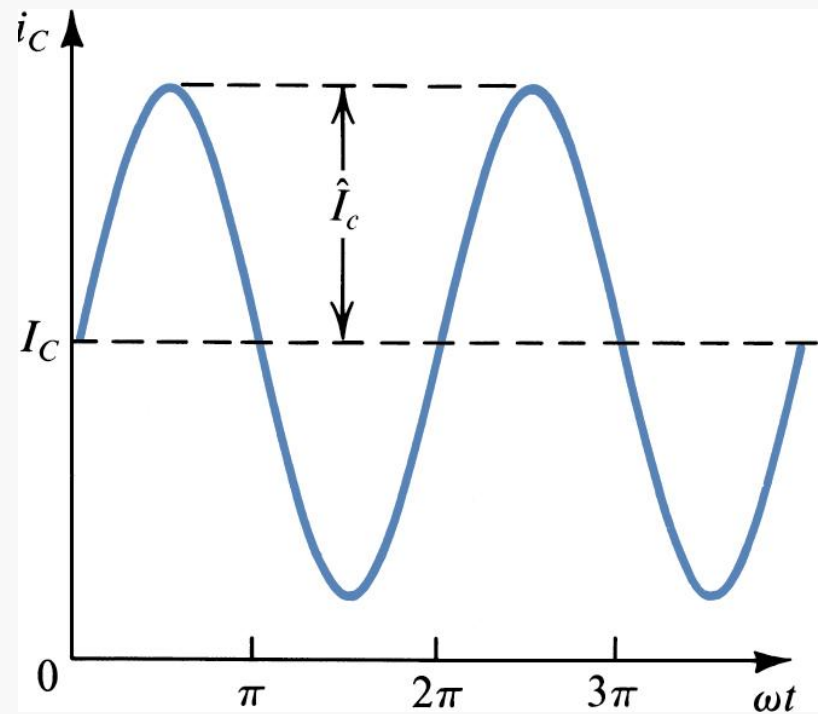
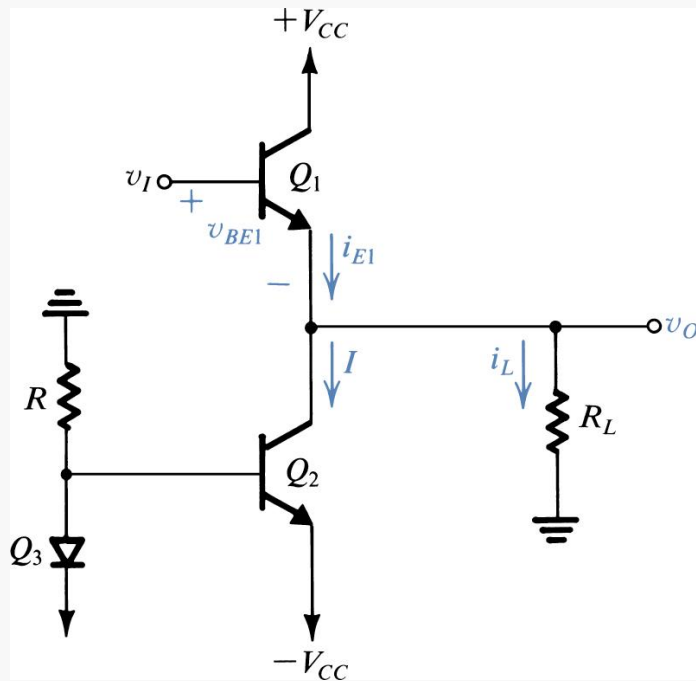
Power BJT

# Introduction

- Low output resistance to deliver power w/o loss, ie. efficiency
- Linearity, ie. total harmonic distortion criteria
- Junction temperature and high power BJT
- Waveform shape?

# Class A Output Stage

- Collector current waveform



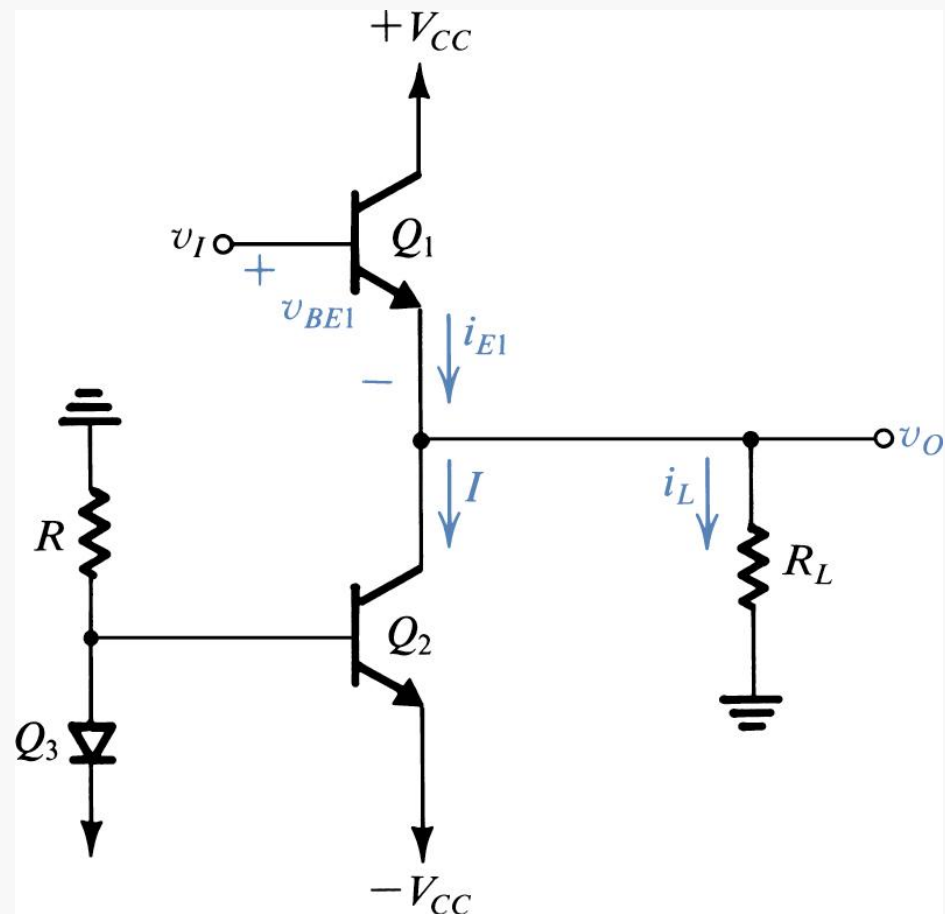
# Transfer Characteristic of Class A

- Emitter follower  $Q_1$  biased with constant current  $I$  supplied by  $Q_2$

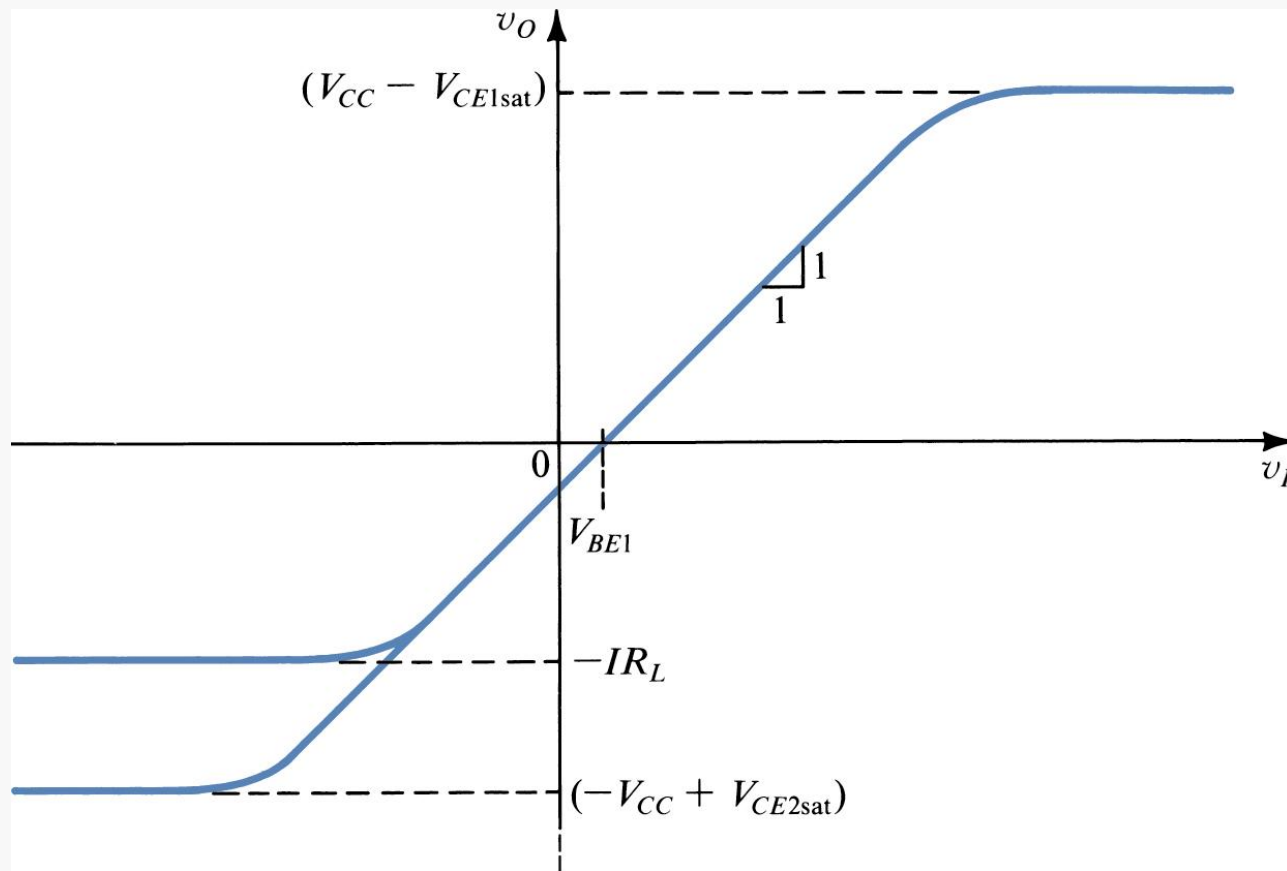
$$v_O = v_I - v_{BE1}$$

$$v_{O\max} = V_{CC} - V_{CE1\text{sat}}$$

$$v_{O\min} = -IR_L$$

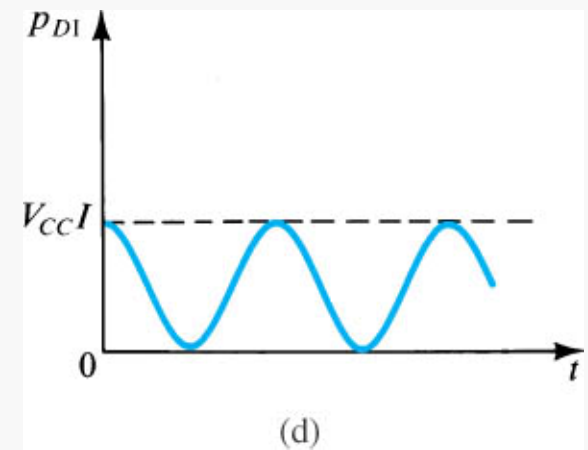
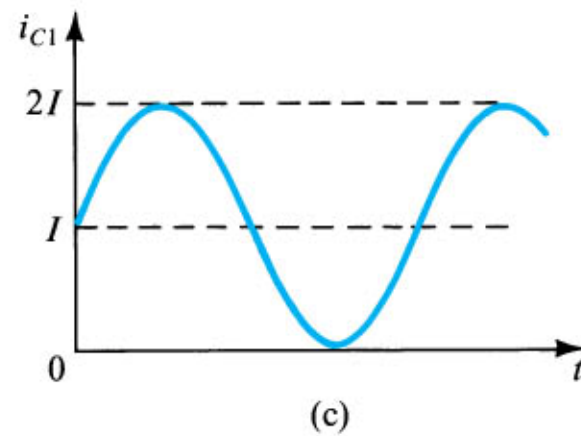
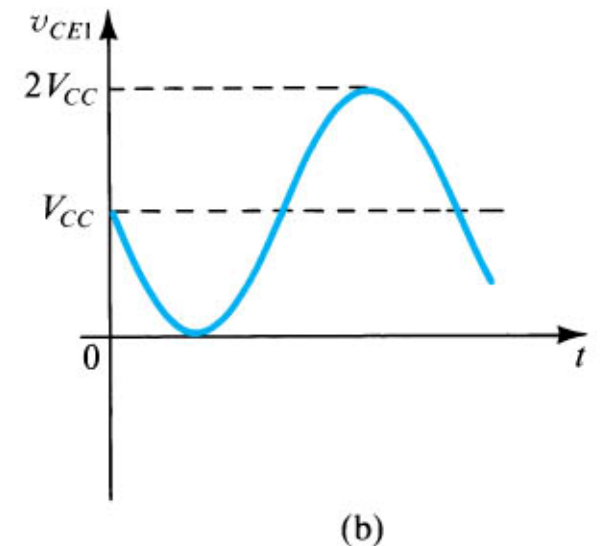
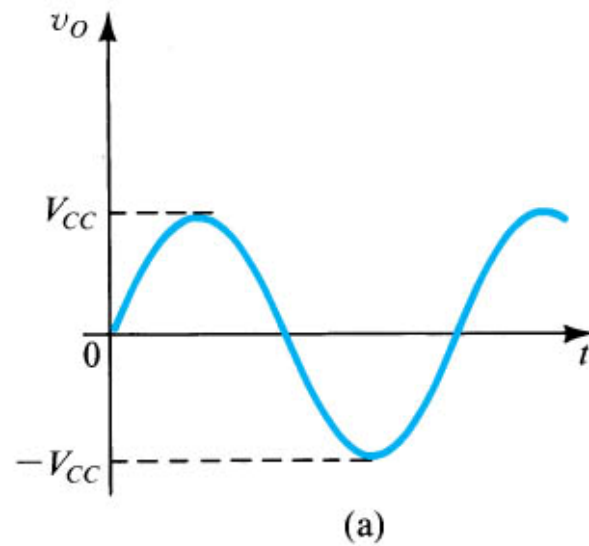


# Transfer characteristic of the emitter follower



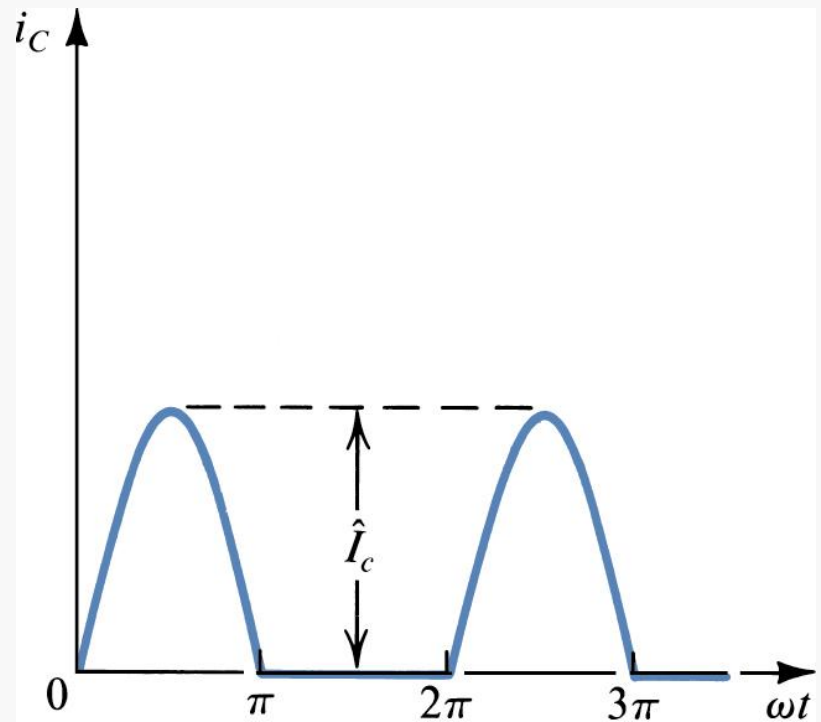
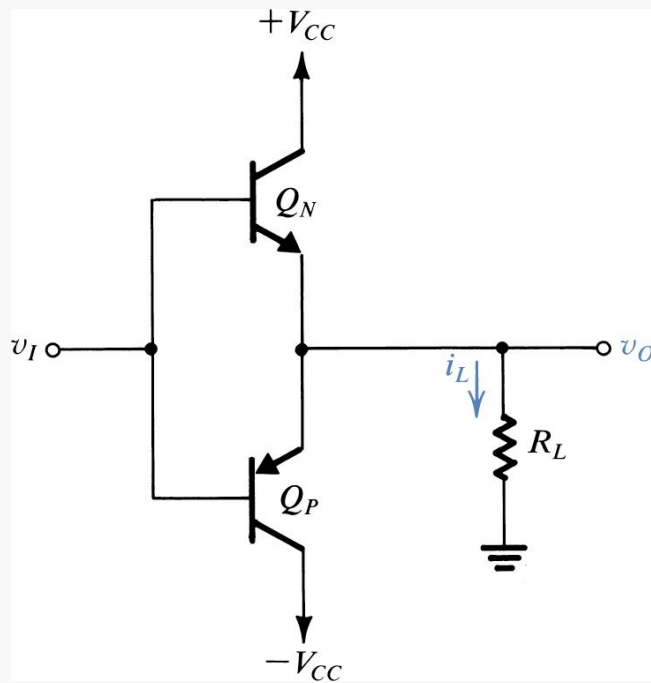
# Waveforms from Class A

$$I = V_{CC}/R_L$$
$$R_L = V_{CC}/I$$



# Class B

- Conducts only half of the cycle

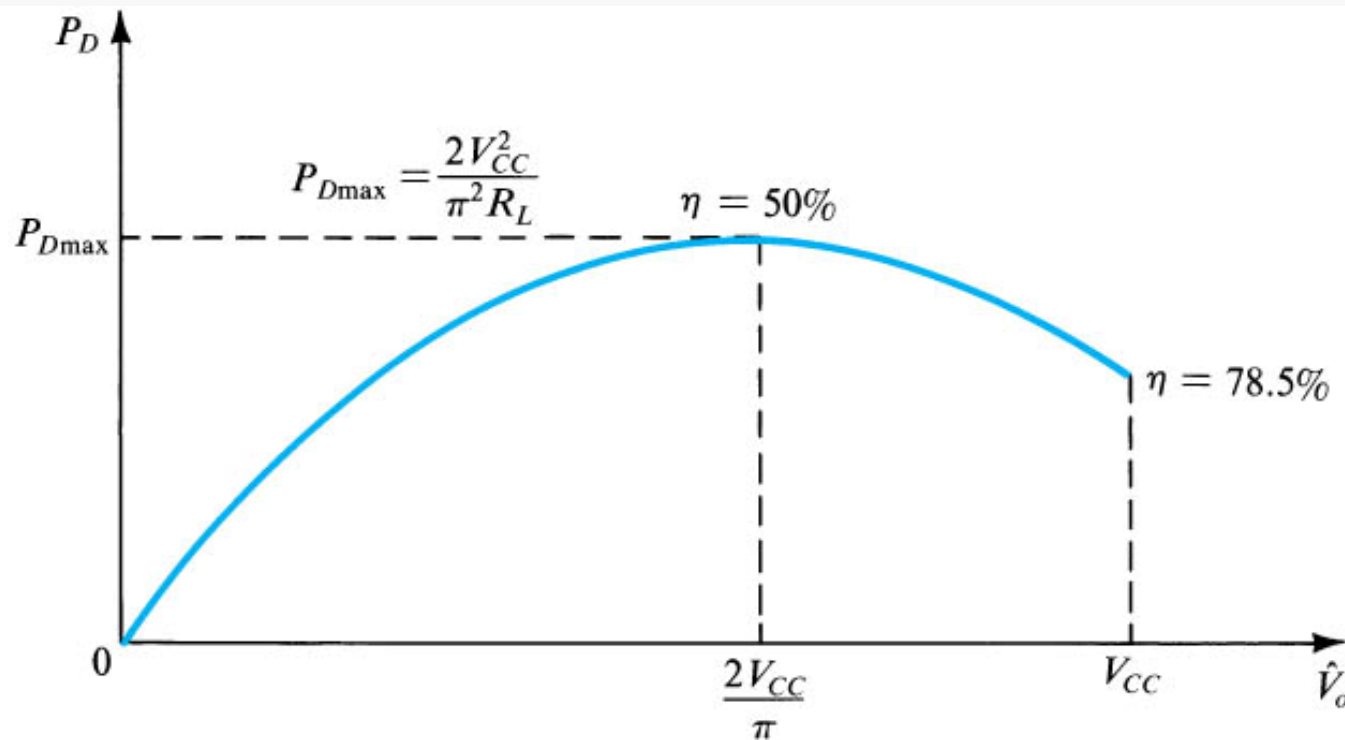


# Power Dissipation

- Maximum instantaneous power in  $Q_1$  is  $V_{CC}I$ .
- 1. Emitter follower dissipated most power when  $v_O = 0$ .
- 2. If  $R_L = 0$ , short circuit, protection?
- 3. Power conversion efficiency:  $\eta = \frac{P_L}{P_S}$

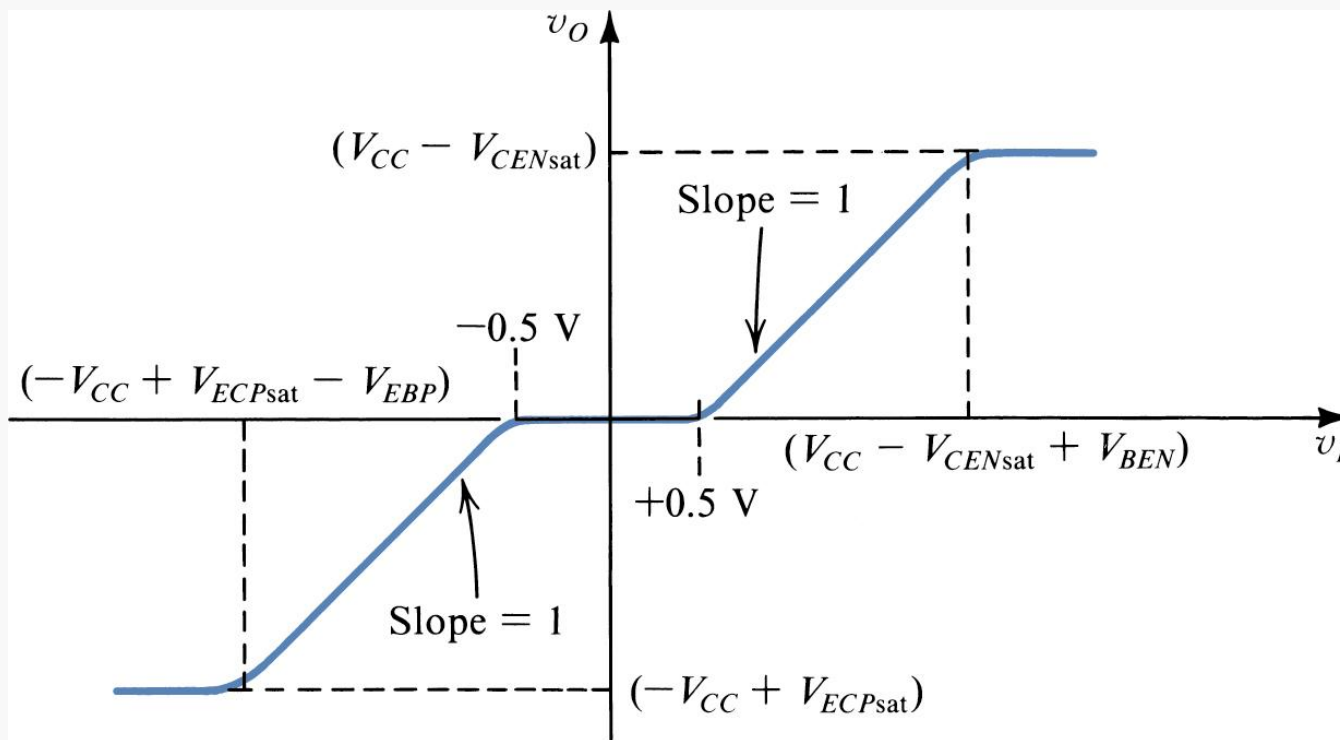
# Power Efficiency Class B

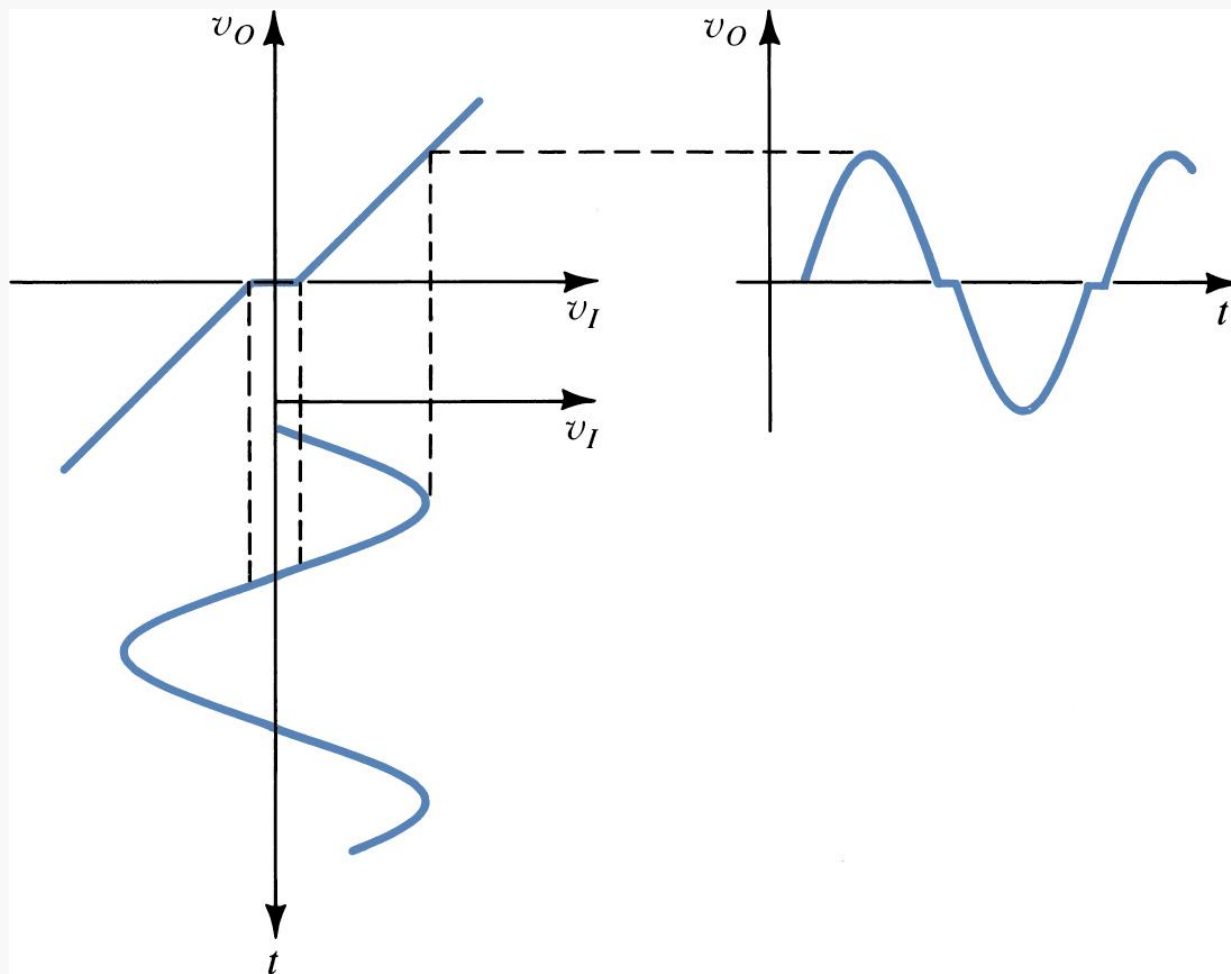
Power dissipation of the class B output stage versus amplitude of the output sinusoid



# Linearity

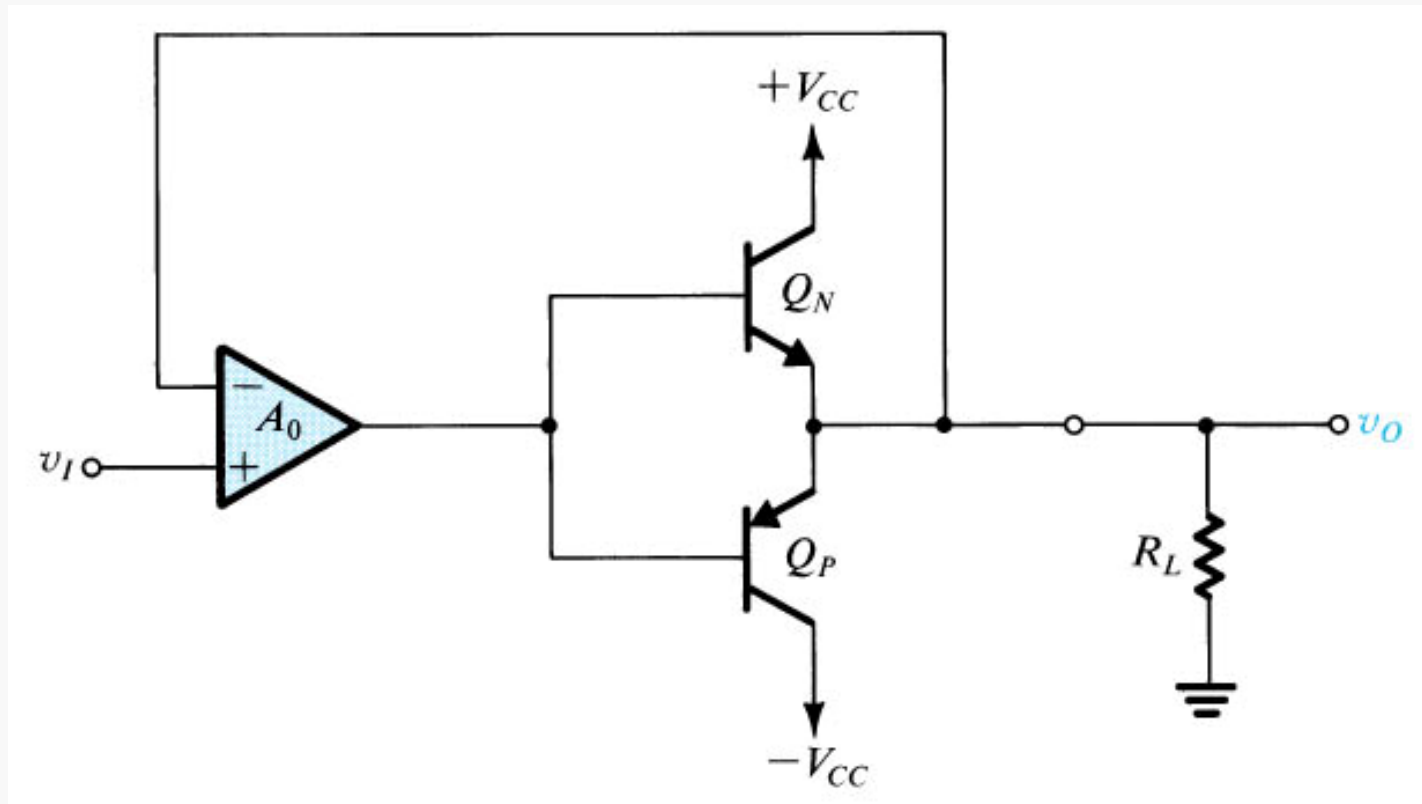
- Transfer characteristic for the class B output stage



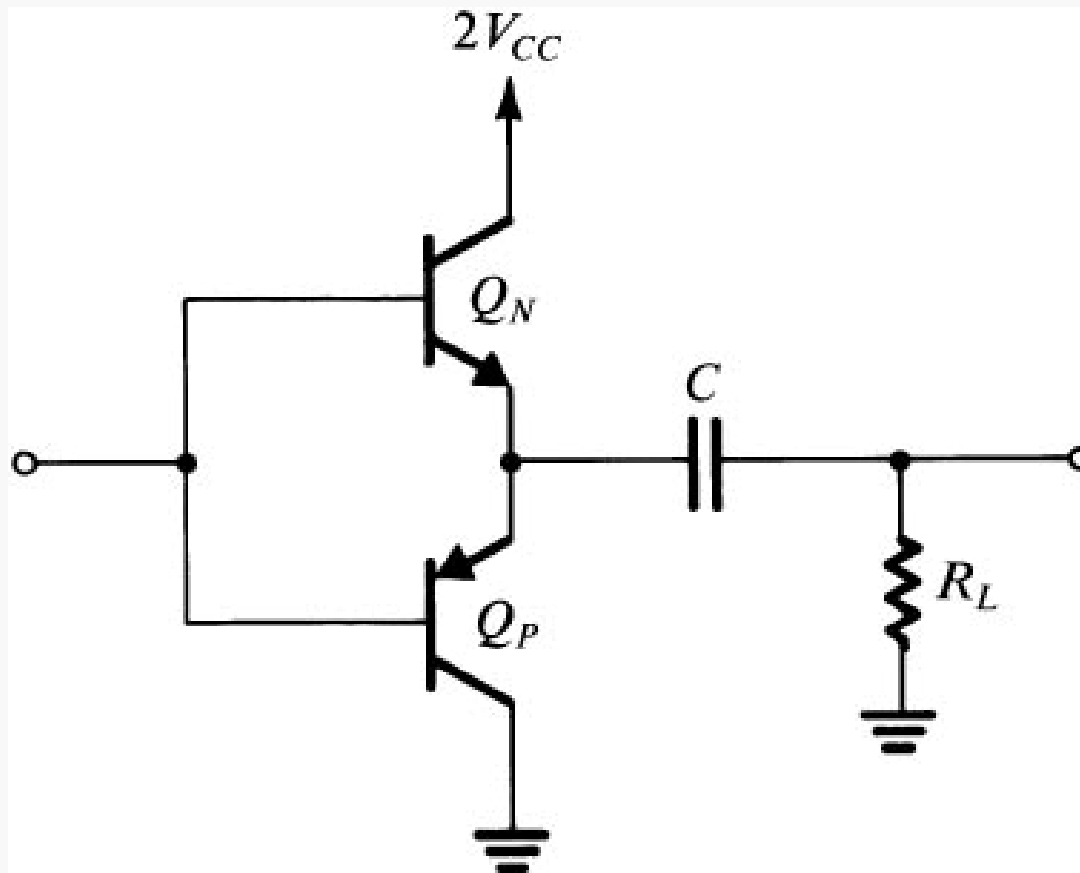


# Opamp Implementation

Op amp connected in a negative-feedback loop to reduce crossover distortion

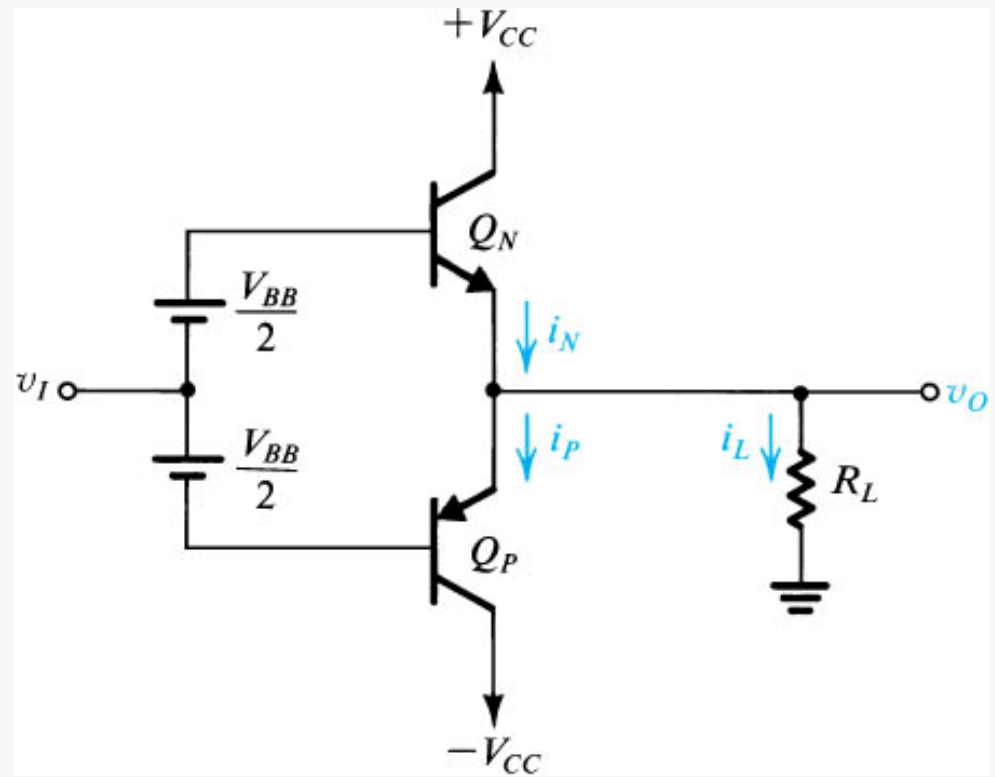
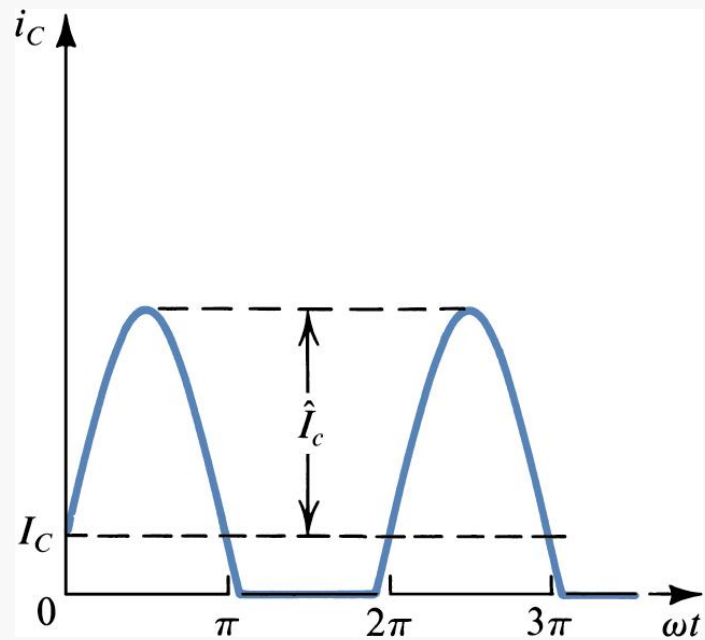


# Class B Single Power Supply



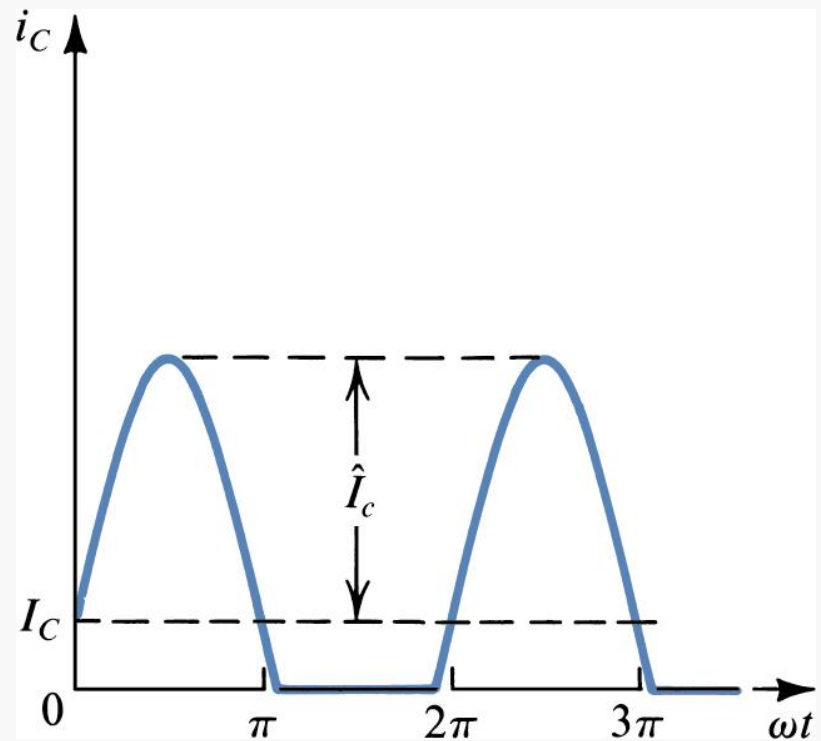
# Class AB

- Conduction more than half cycle

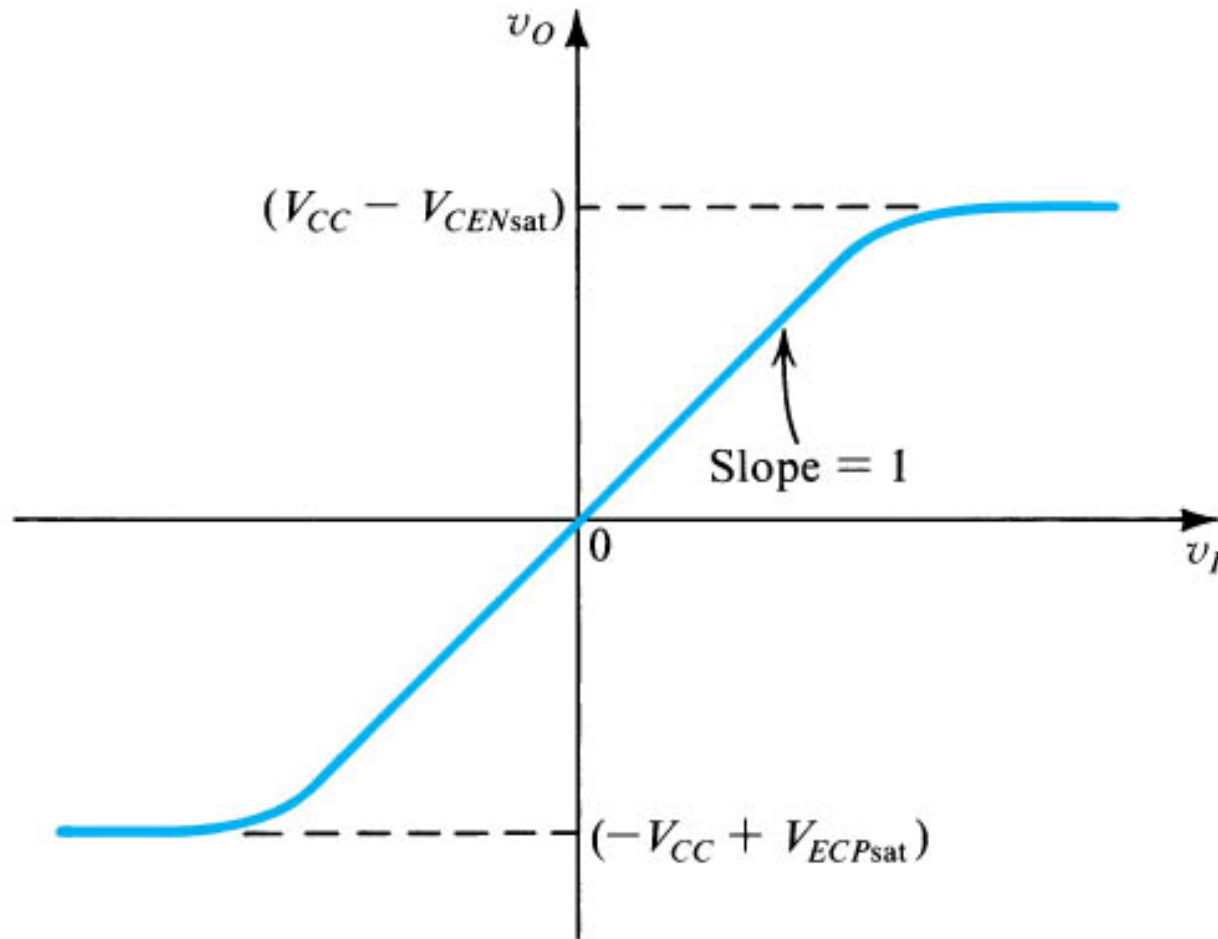


# Class AB

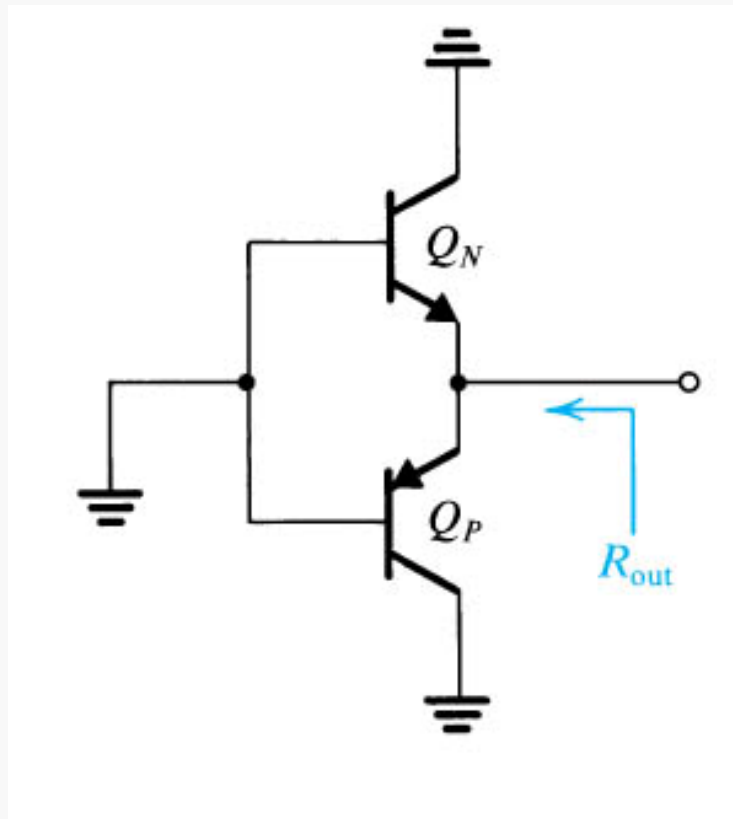
- Conduction more than half cycle



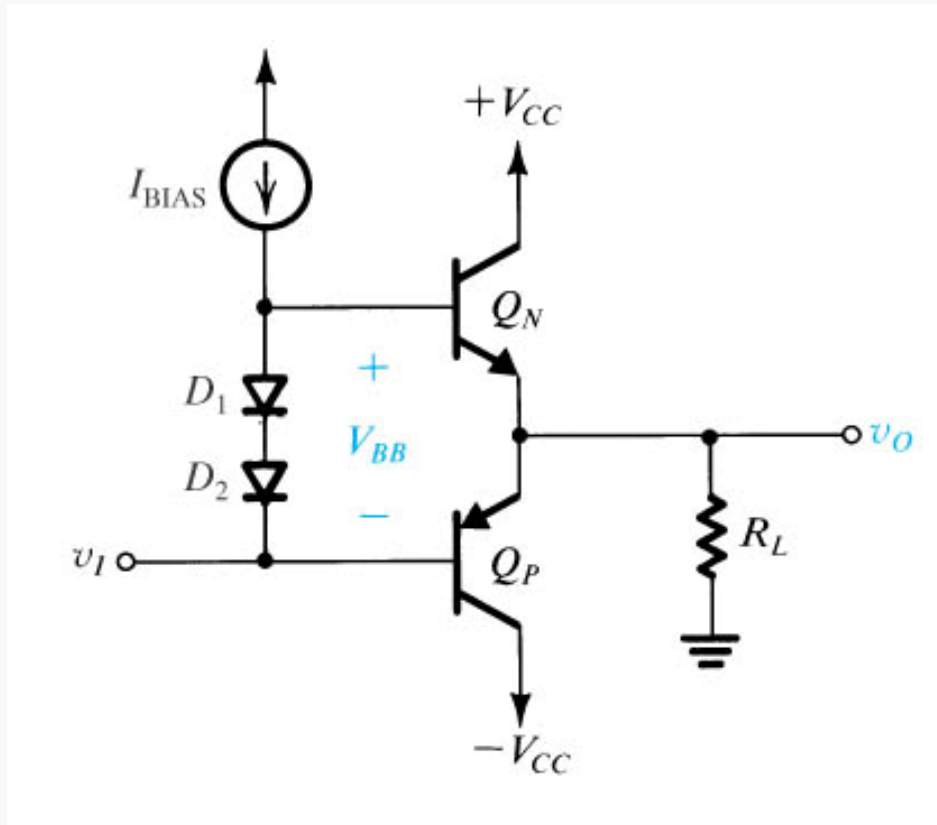
# Transfer Function Class AB



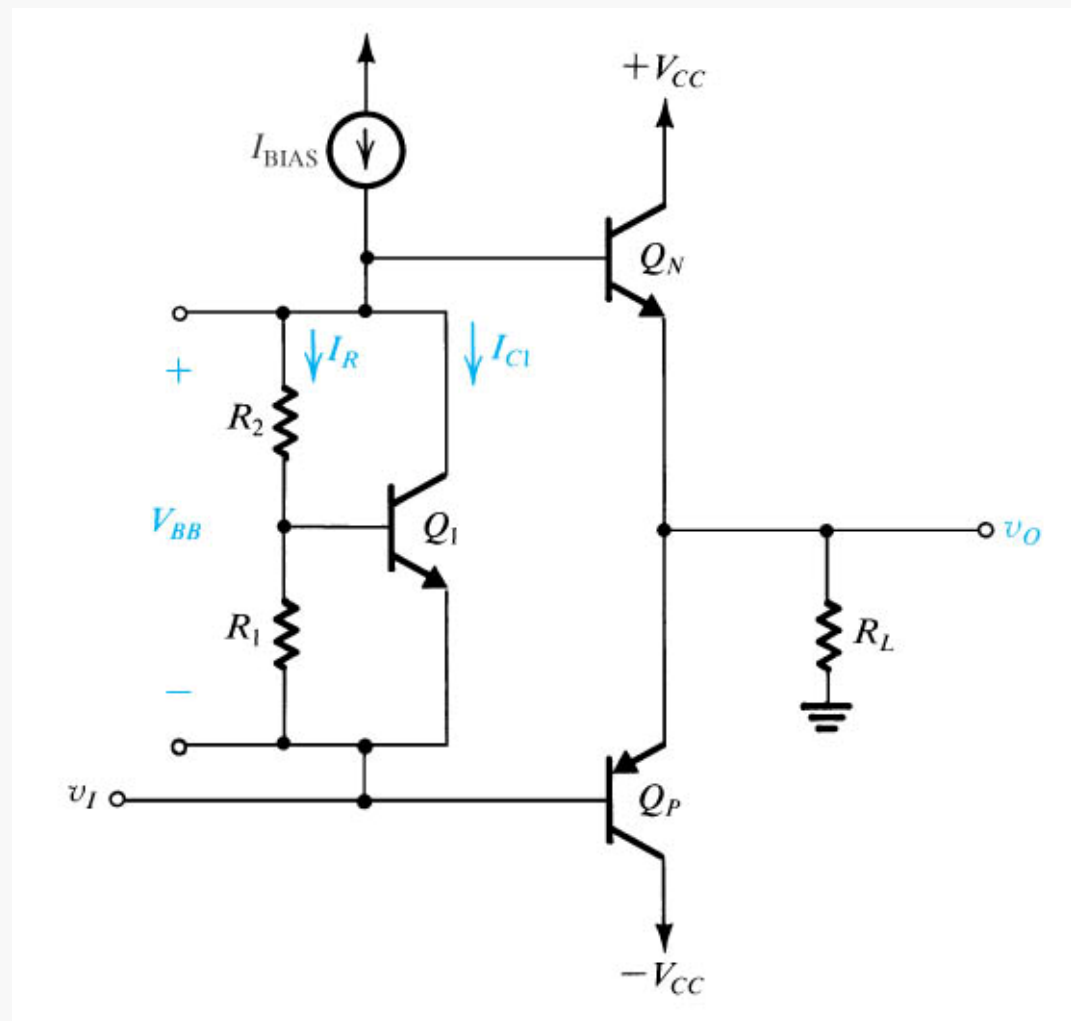
# Determining Output Impedance Class AB



# Class AB using Diodes

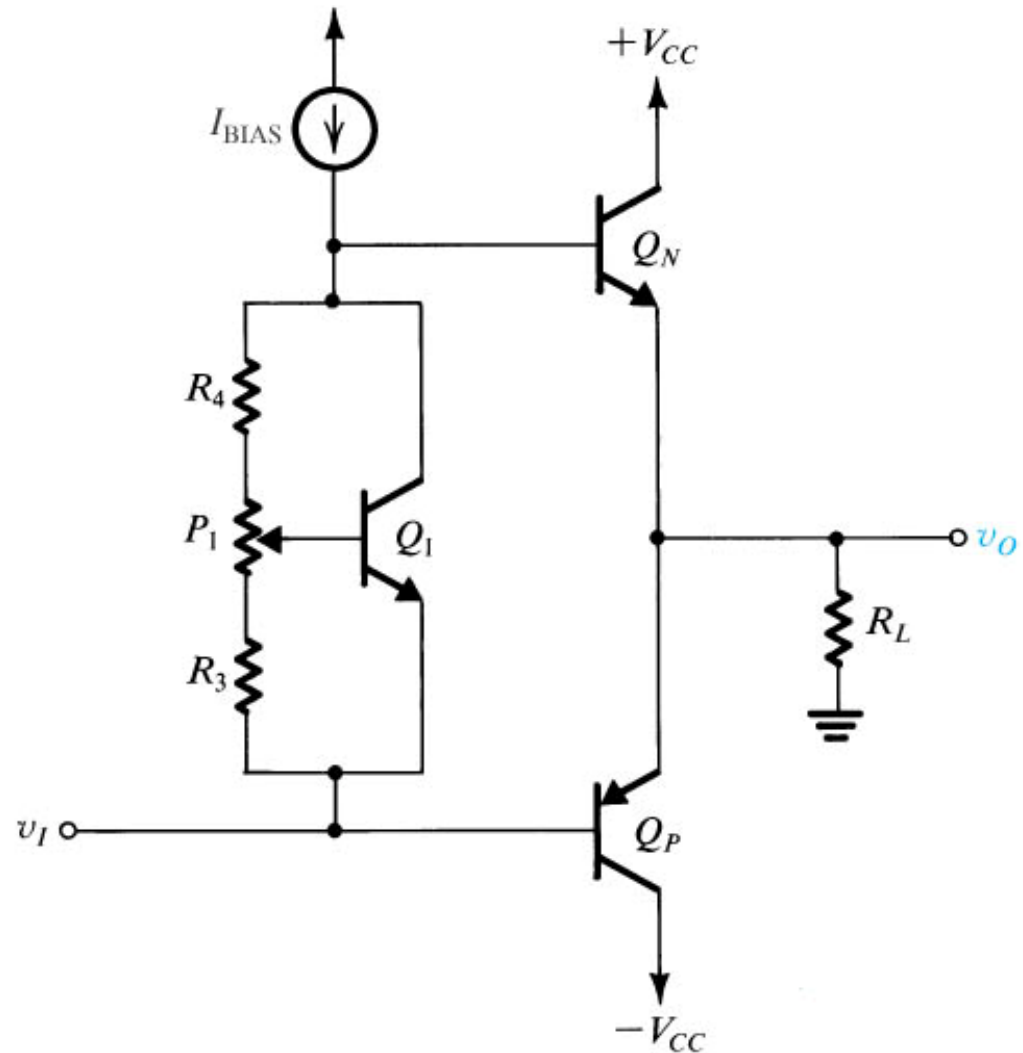


# Class AB using $V_{BE}$ multiplier



# Class AB with $V_{be}$ multipot.

The potentiometer is adjusted to yield the desired value of quiescent current in  $Q_N$  and  $Q_P$ .



# Class C

- Used in Radio frequency applications (mobile phones, radio and TV)

