

Output Stages and Power Amplifiers

Chapter 14

Classification of Output Stages

Class A,B & AB

Biasing AB

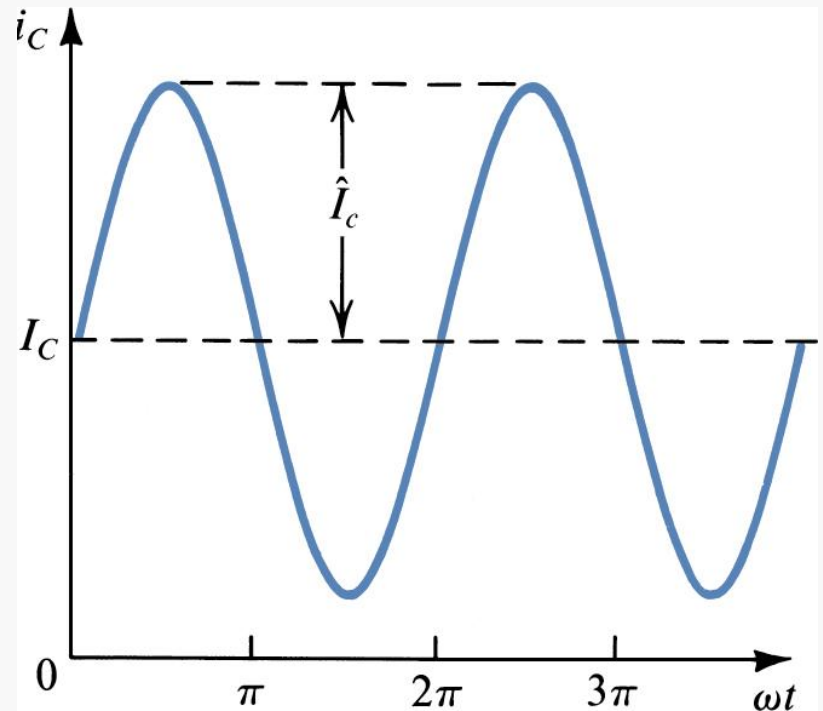
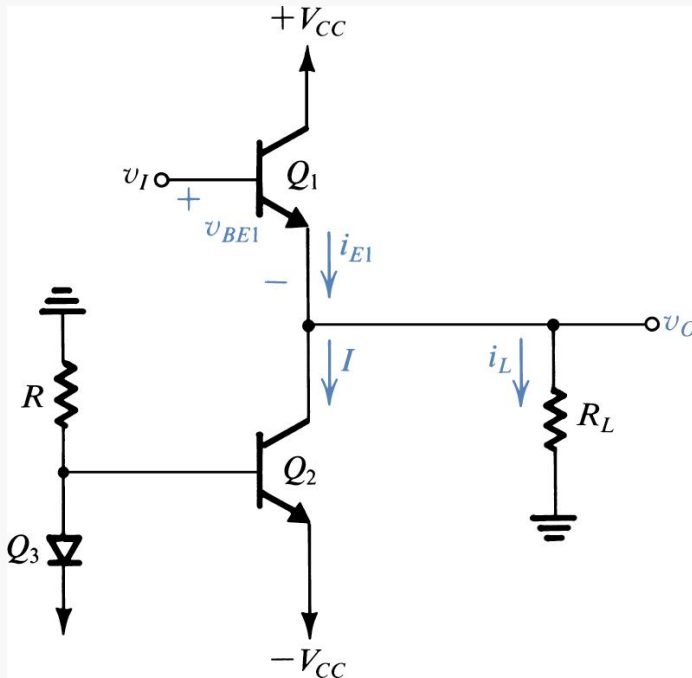
Power BJT

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



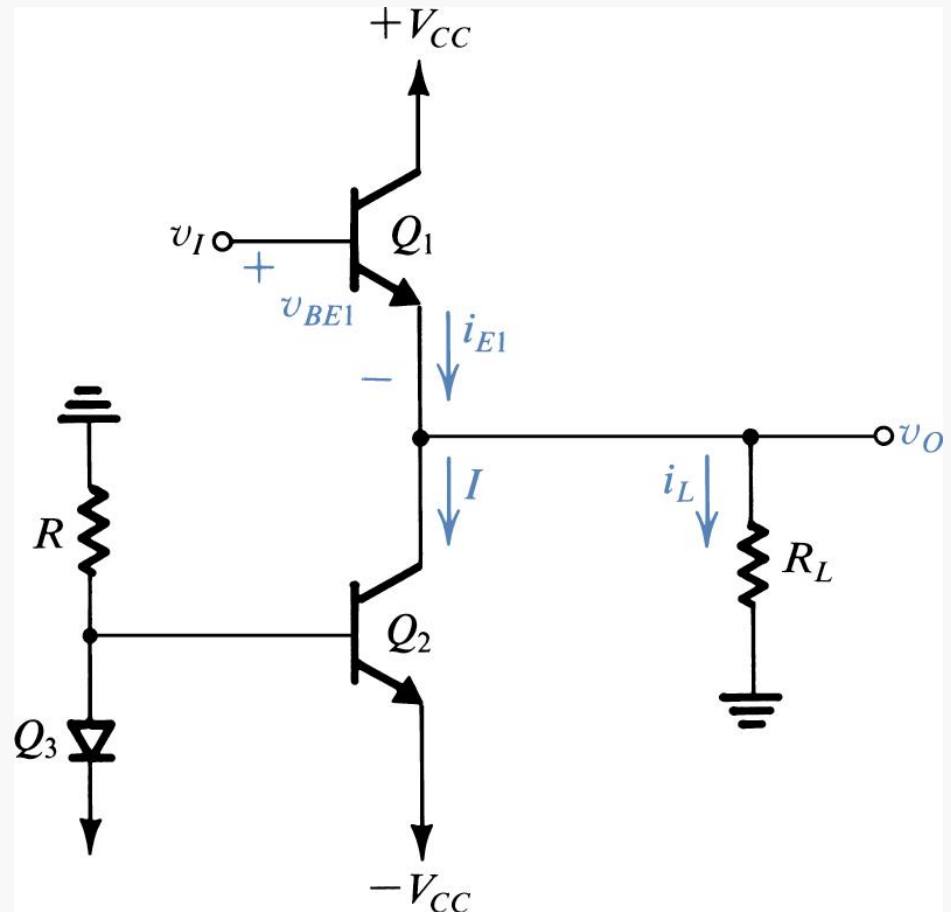
Transfer Characteristic of Class A

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

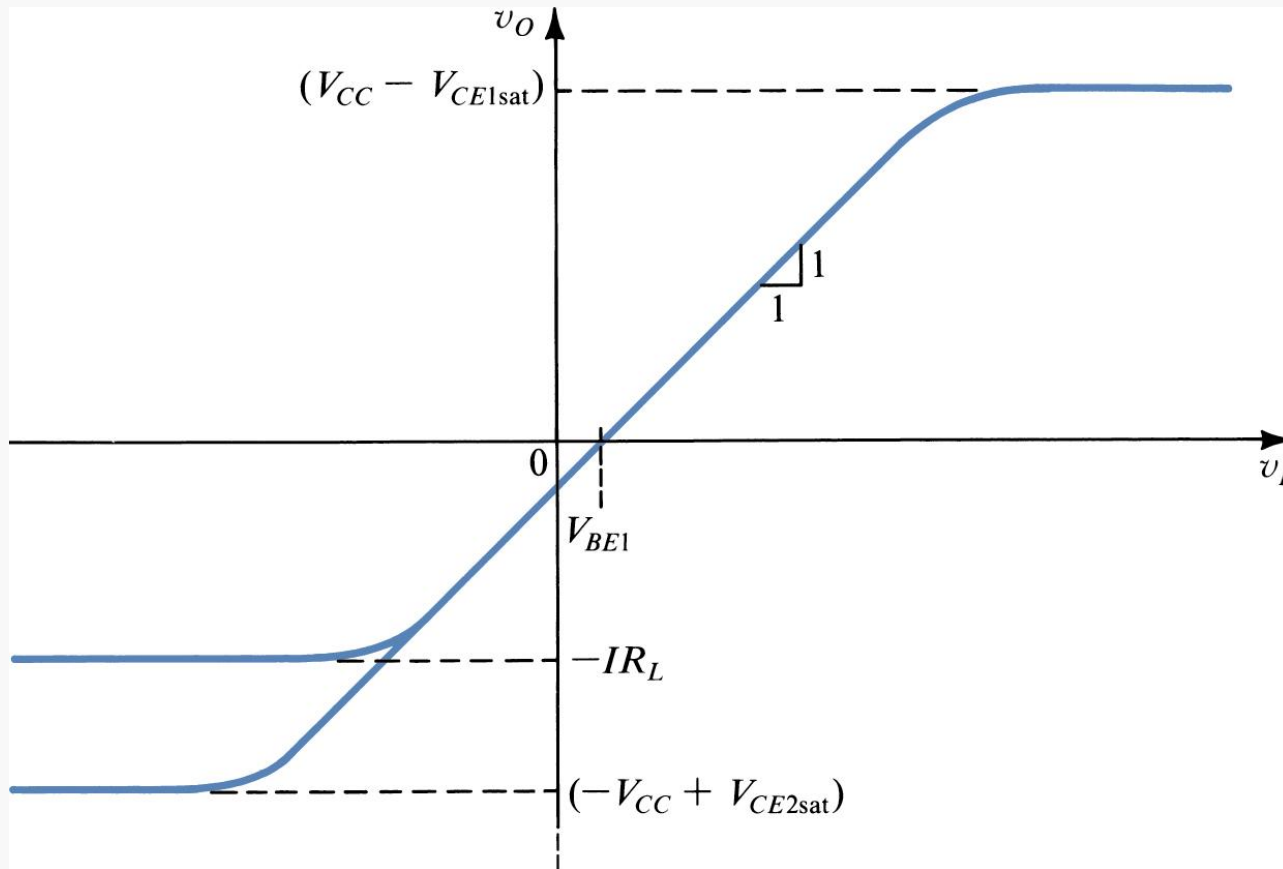
$$v_O = v_I - v_{BE1}$$

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

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

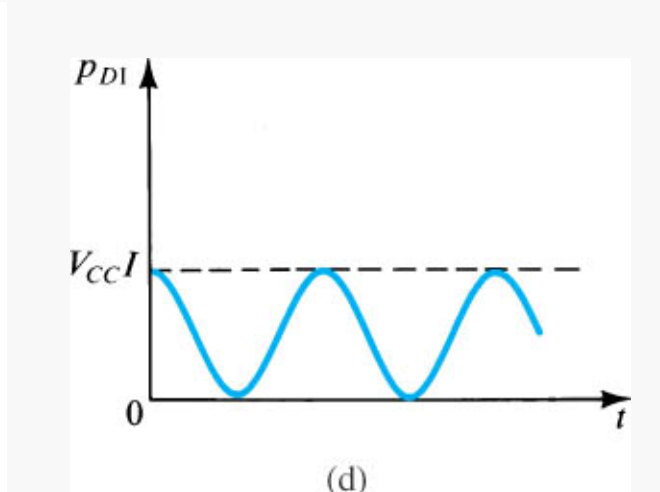
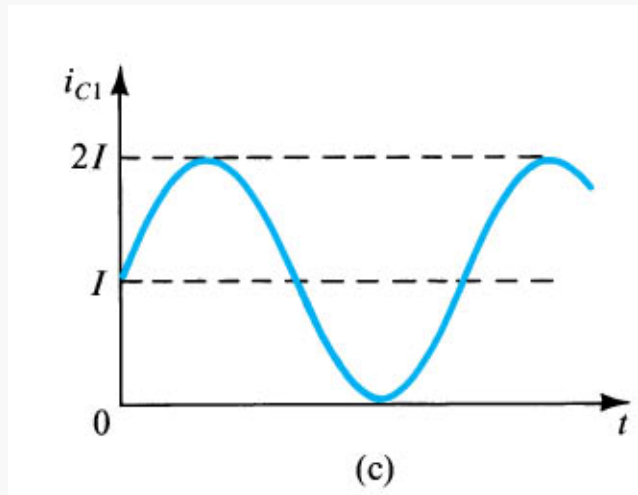
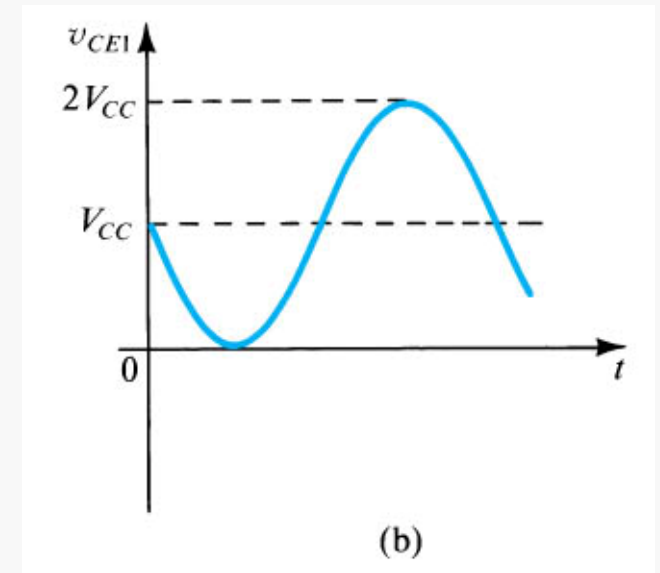
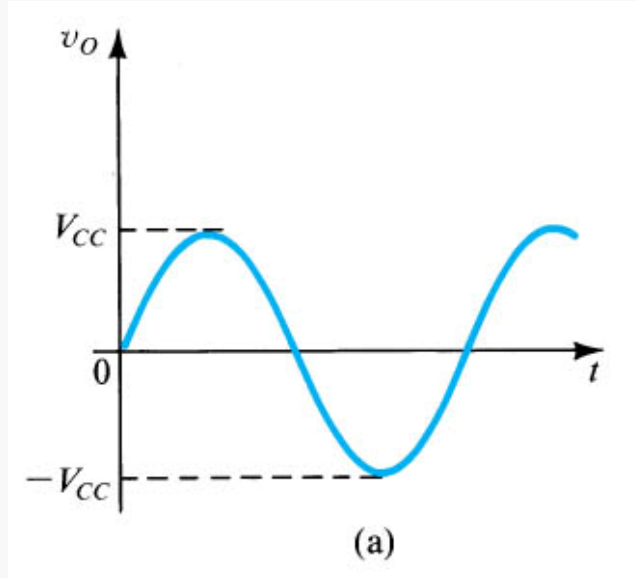


Transfer characteristic of the emitter follower



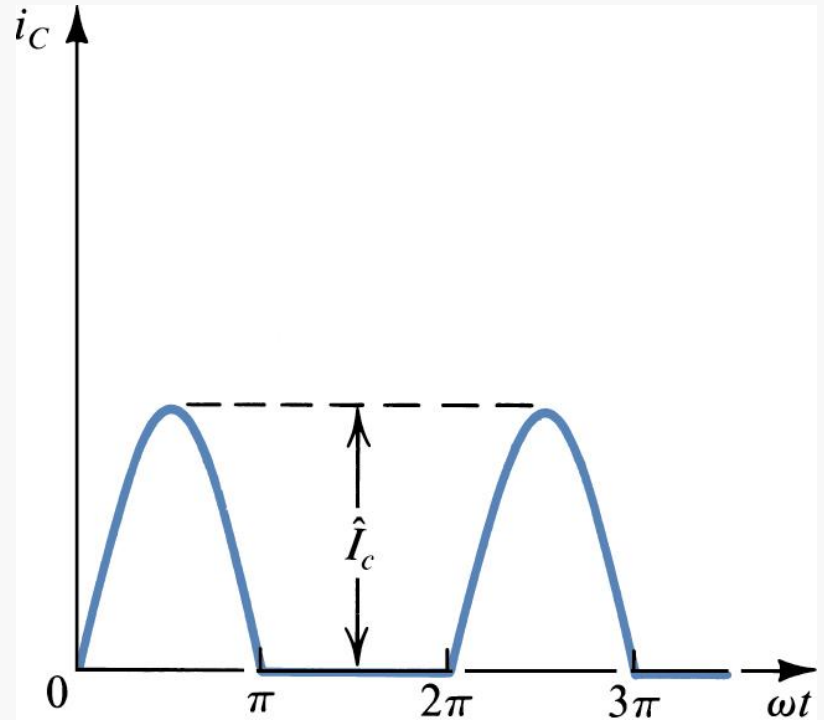
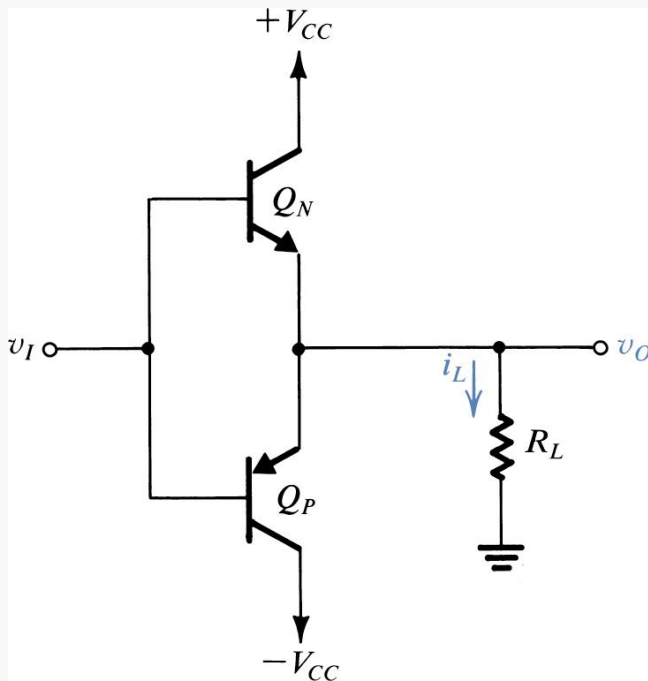
Waveforms from Class A

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



Class B

- Conducts only half of the cycle

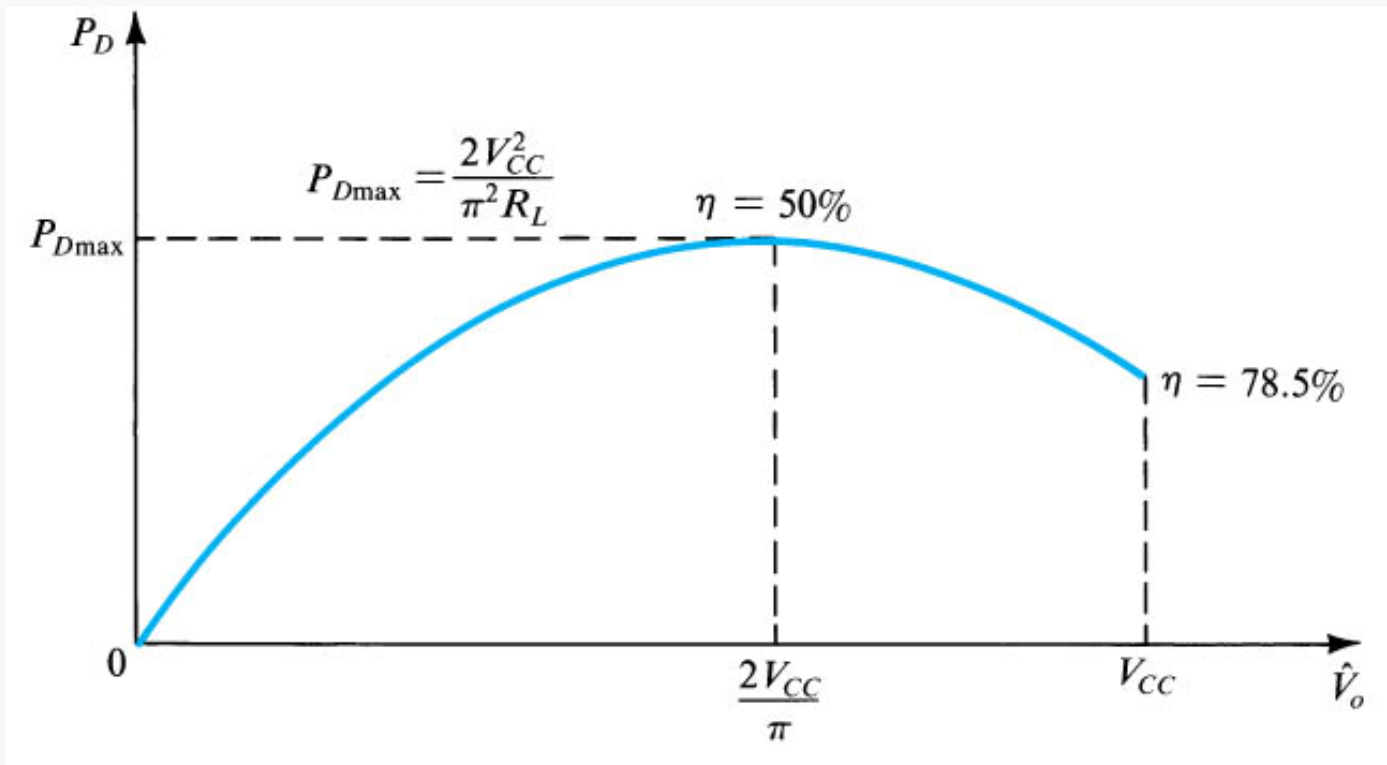


Power Dissipation

- 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: $\eta = \frac{P_L}{P_S}$

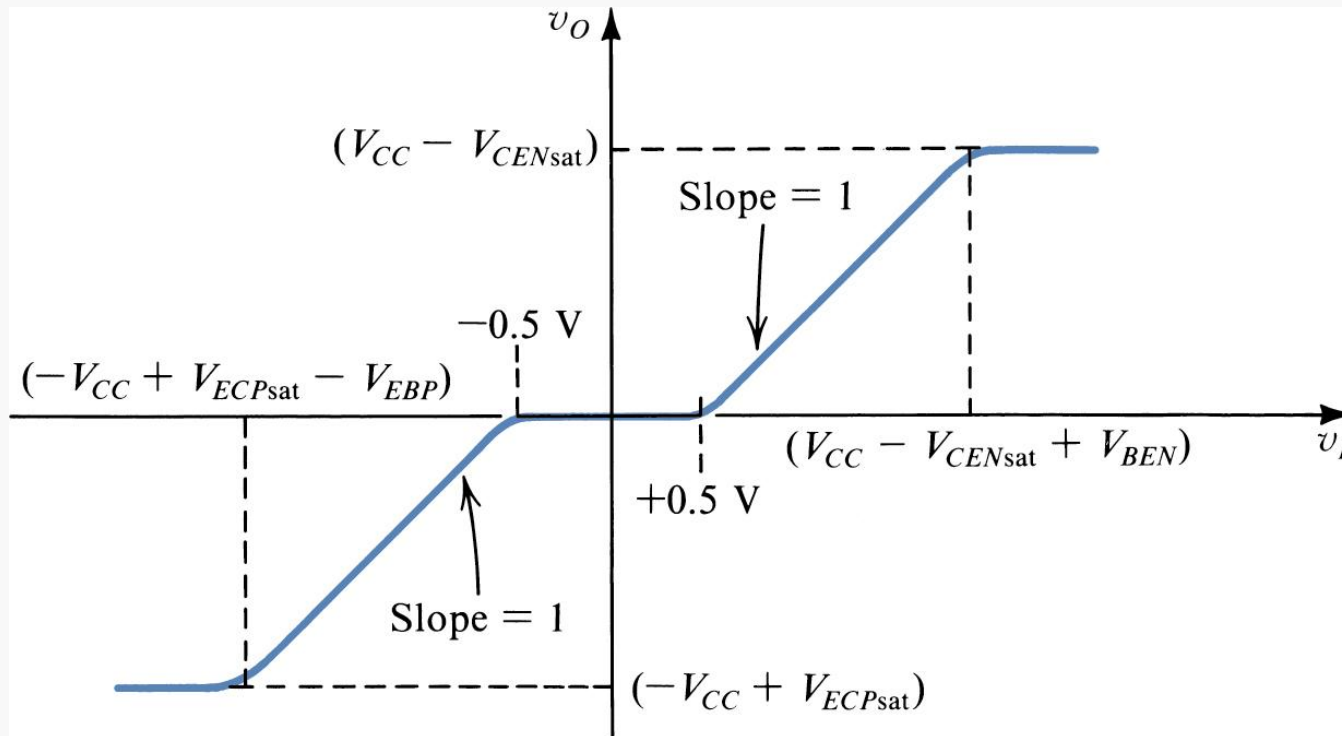
Power Efficiency Class B

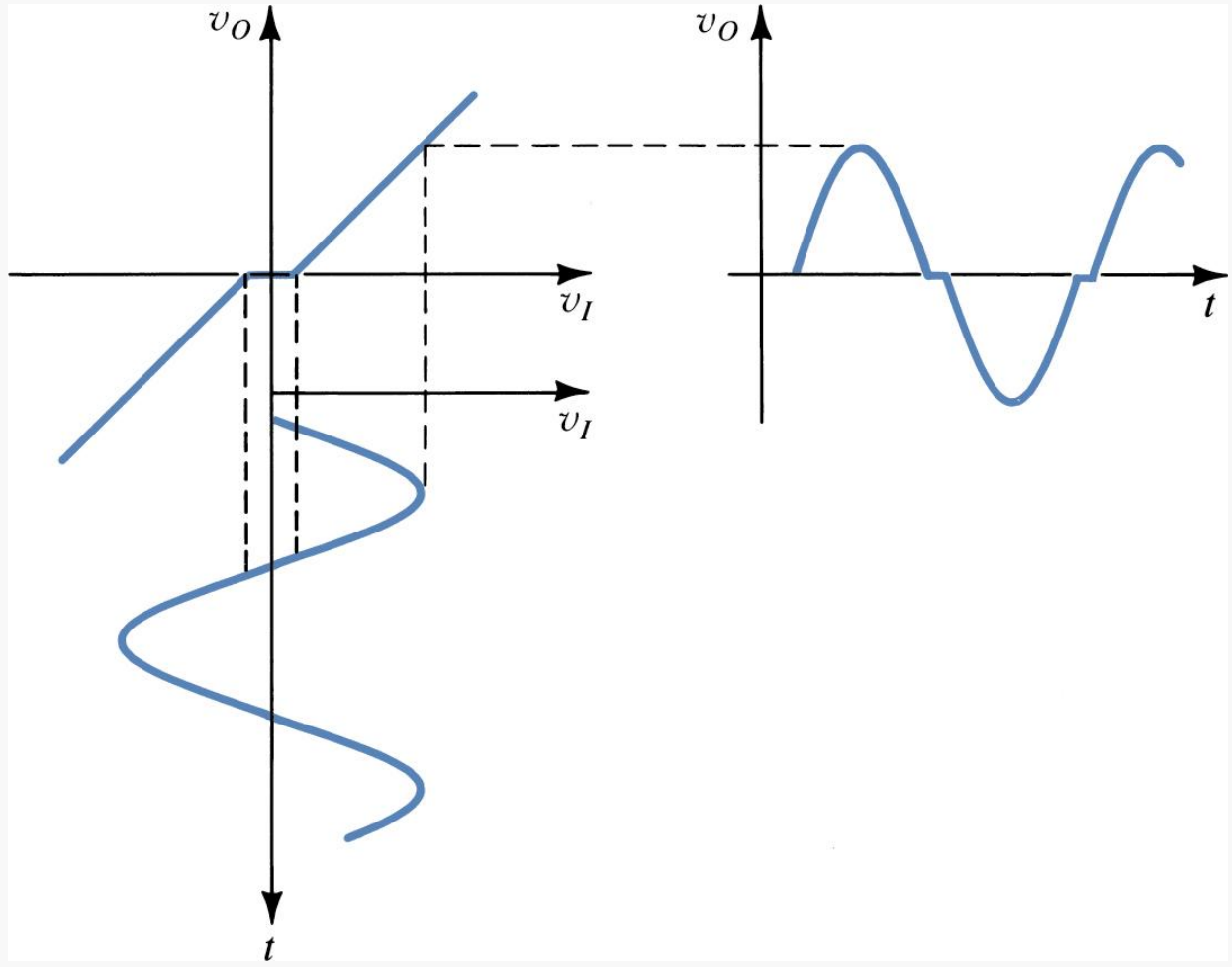
Power dissipation of the class B output stage versus amplitude of the output sinusoid



Linearity

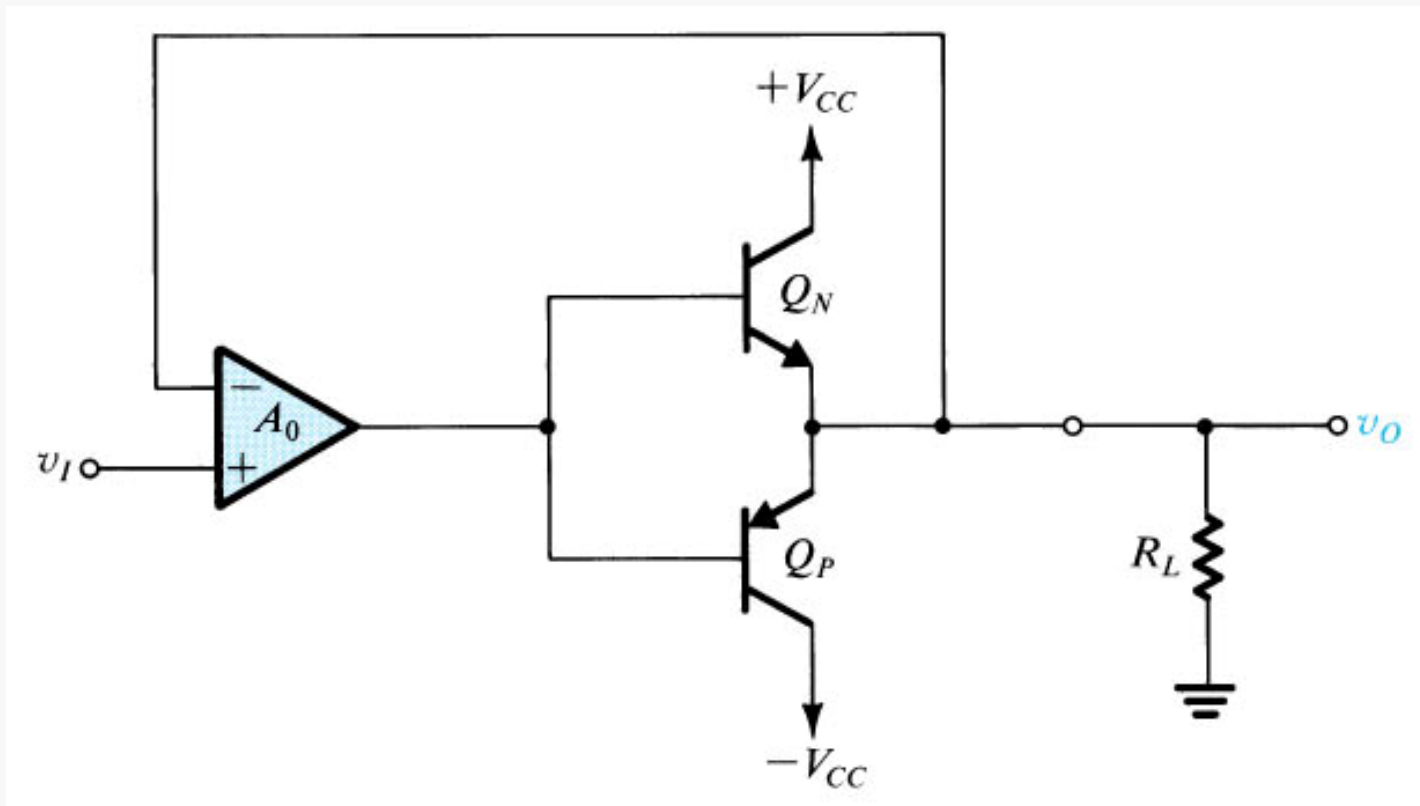
- Transfer characteristic for the class B output stage



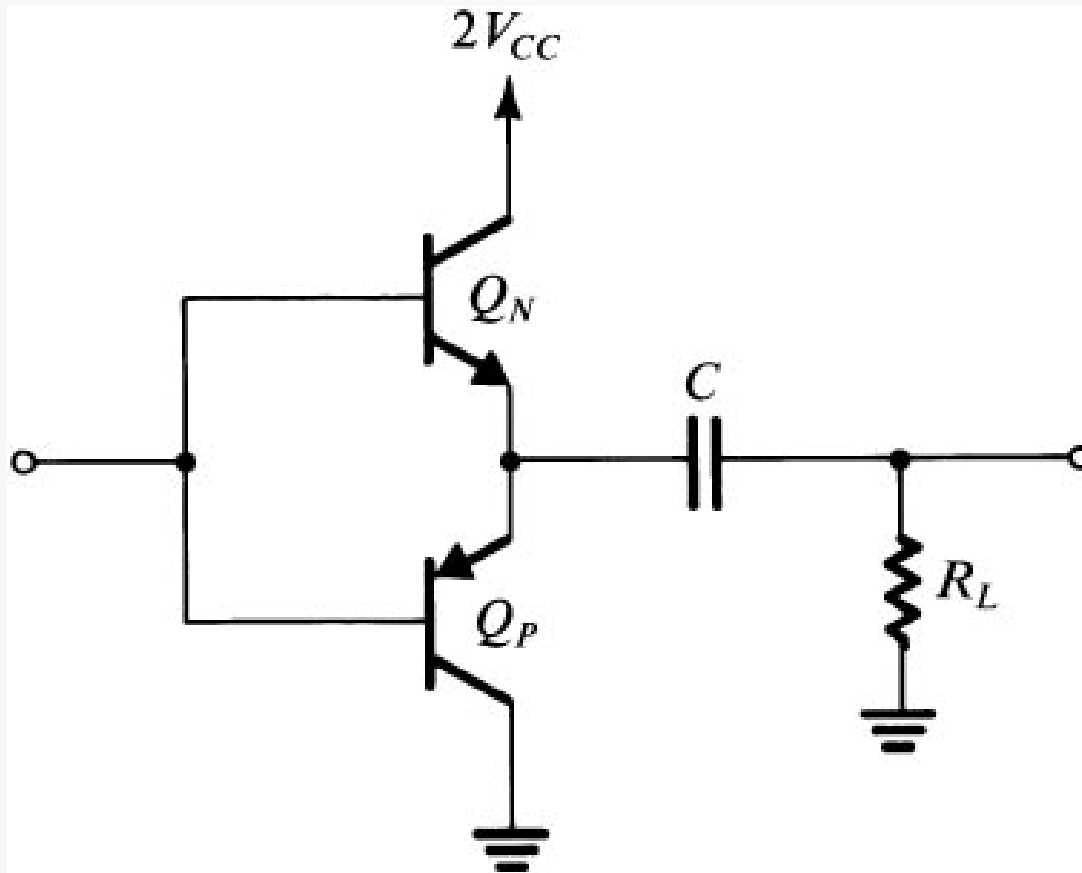


Opamp Implementation

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

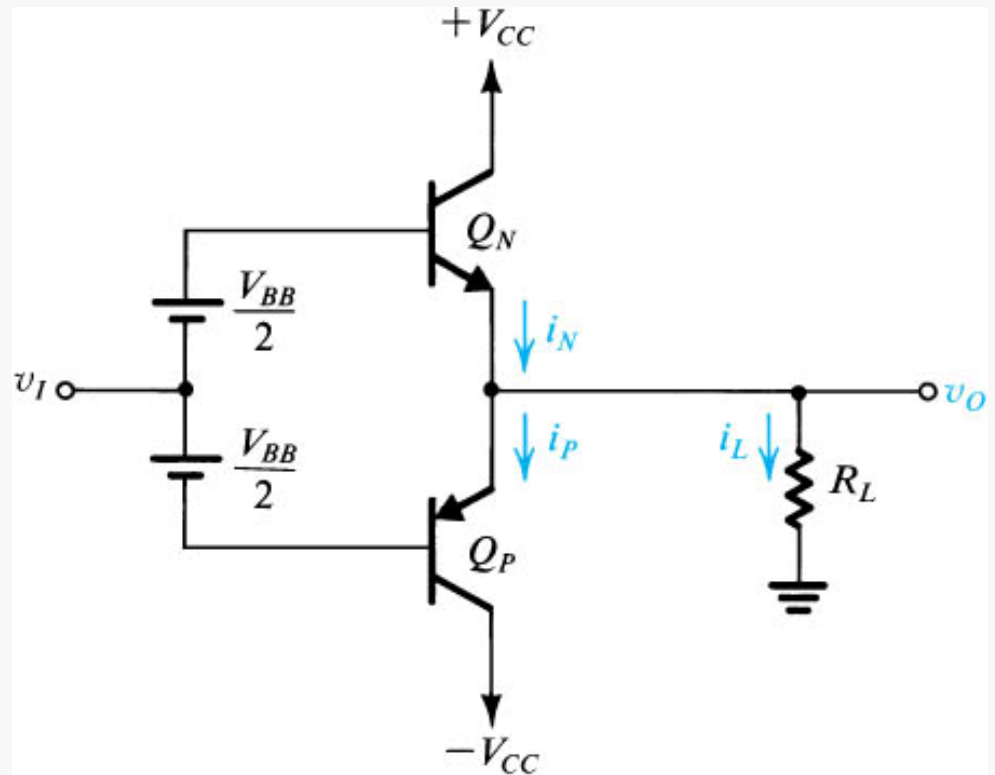
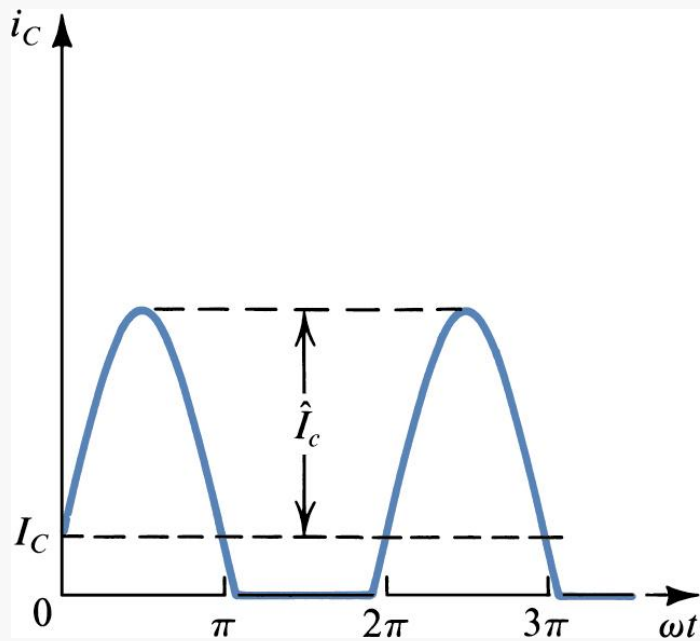


Class B Single Power Supply



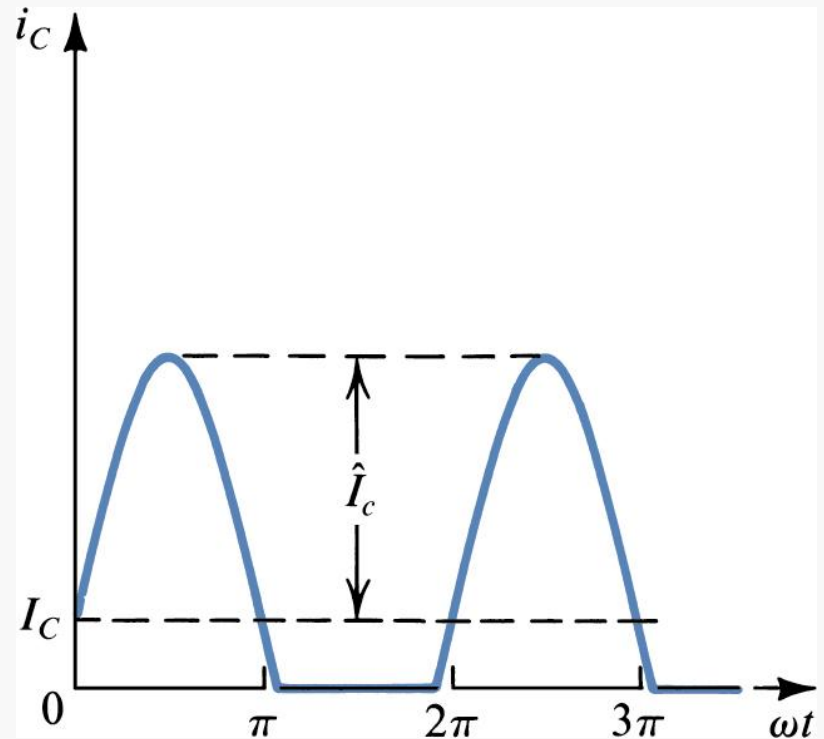
Class AB

- Conduction more than half cycle

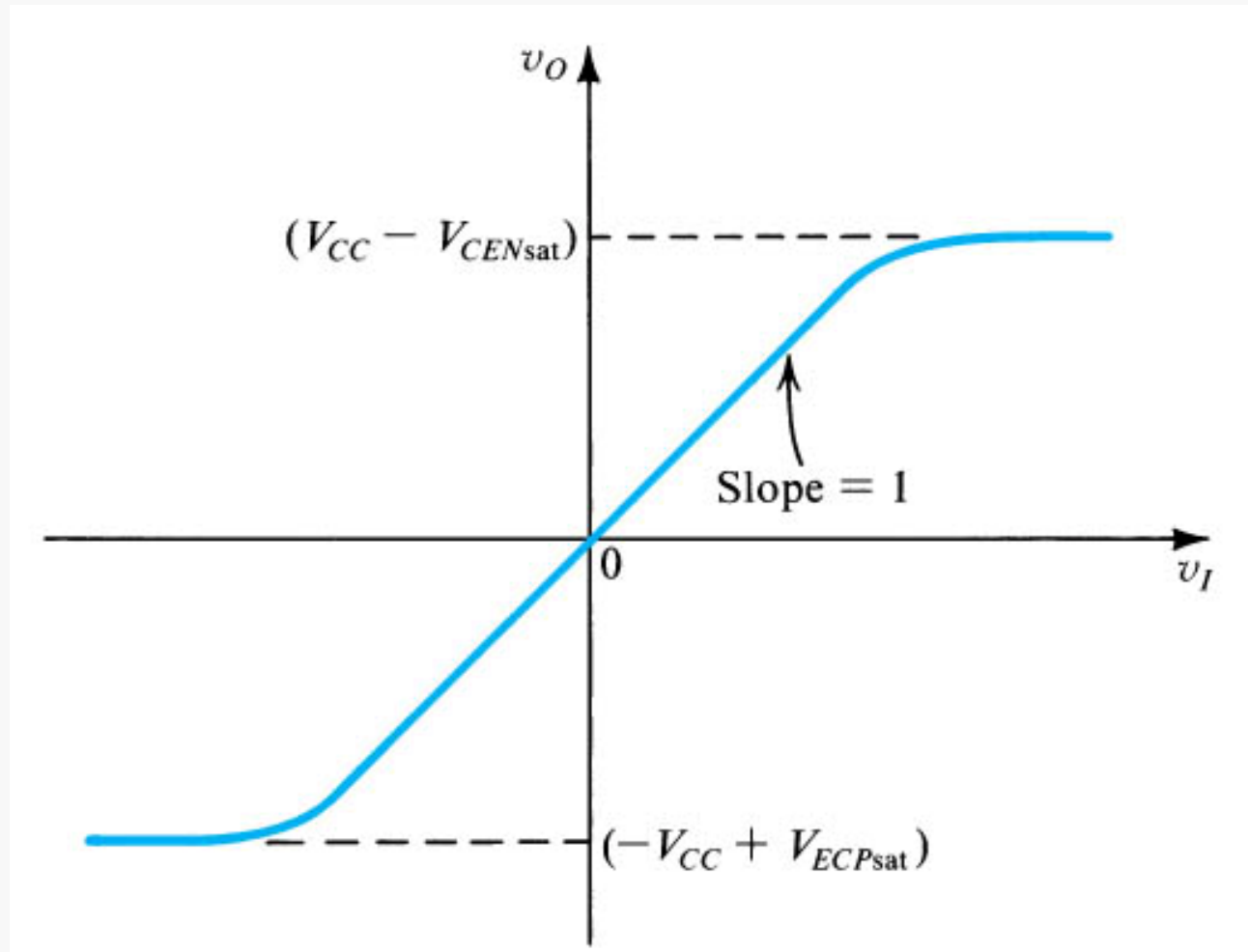


Class AB

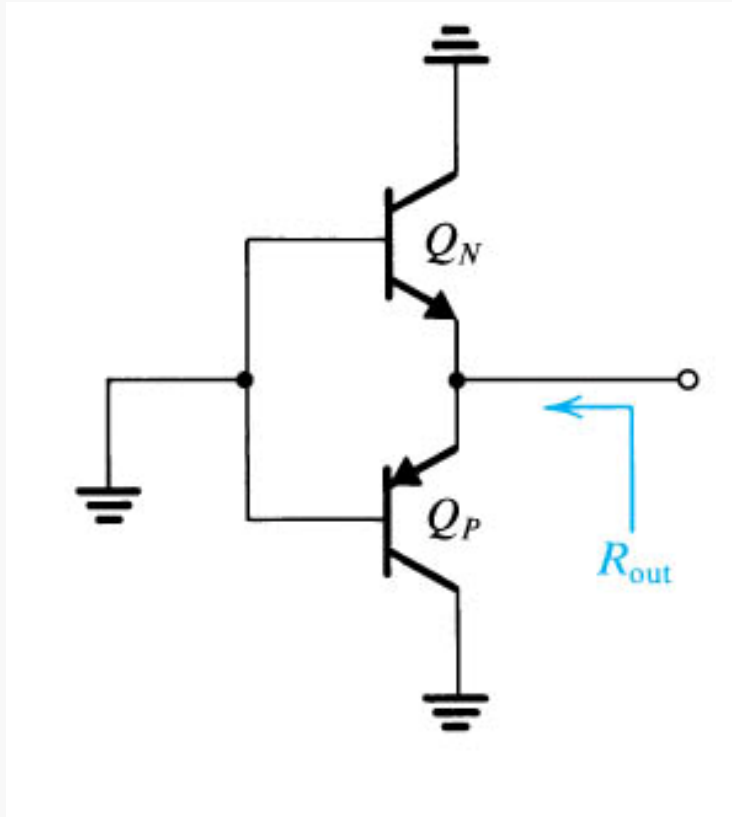
- Conduction more than half cycle



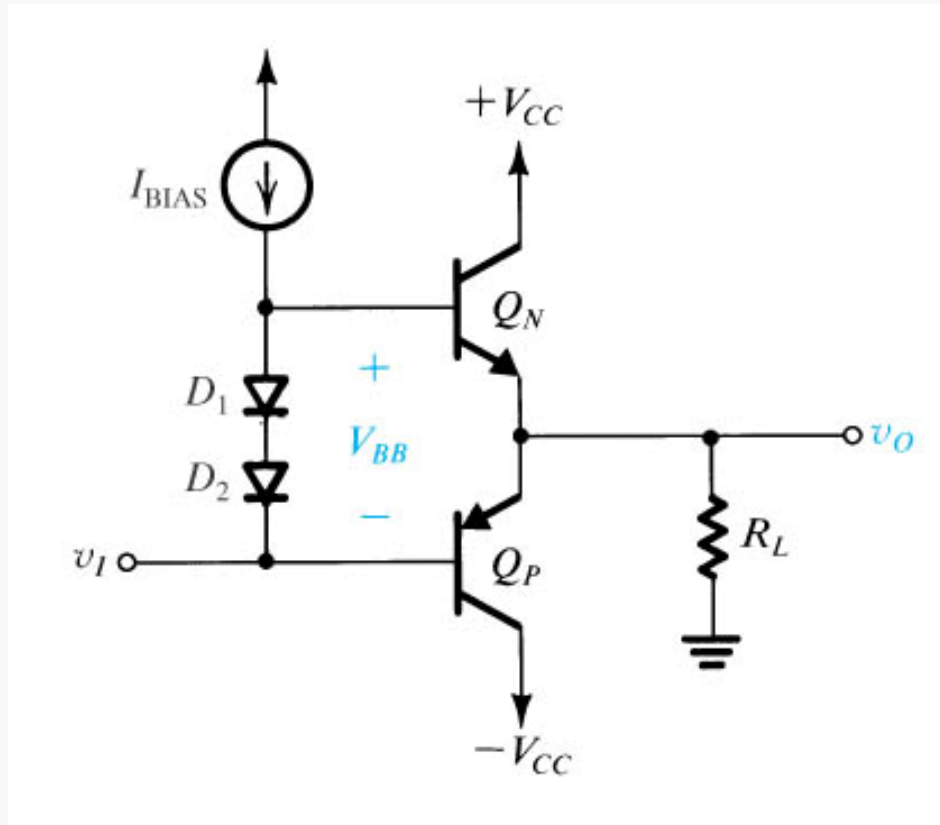
Transfer Function Class AB



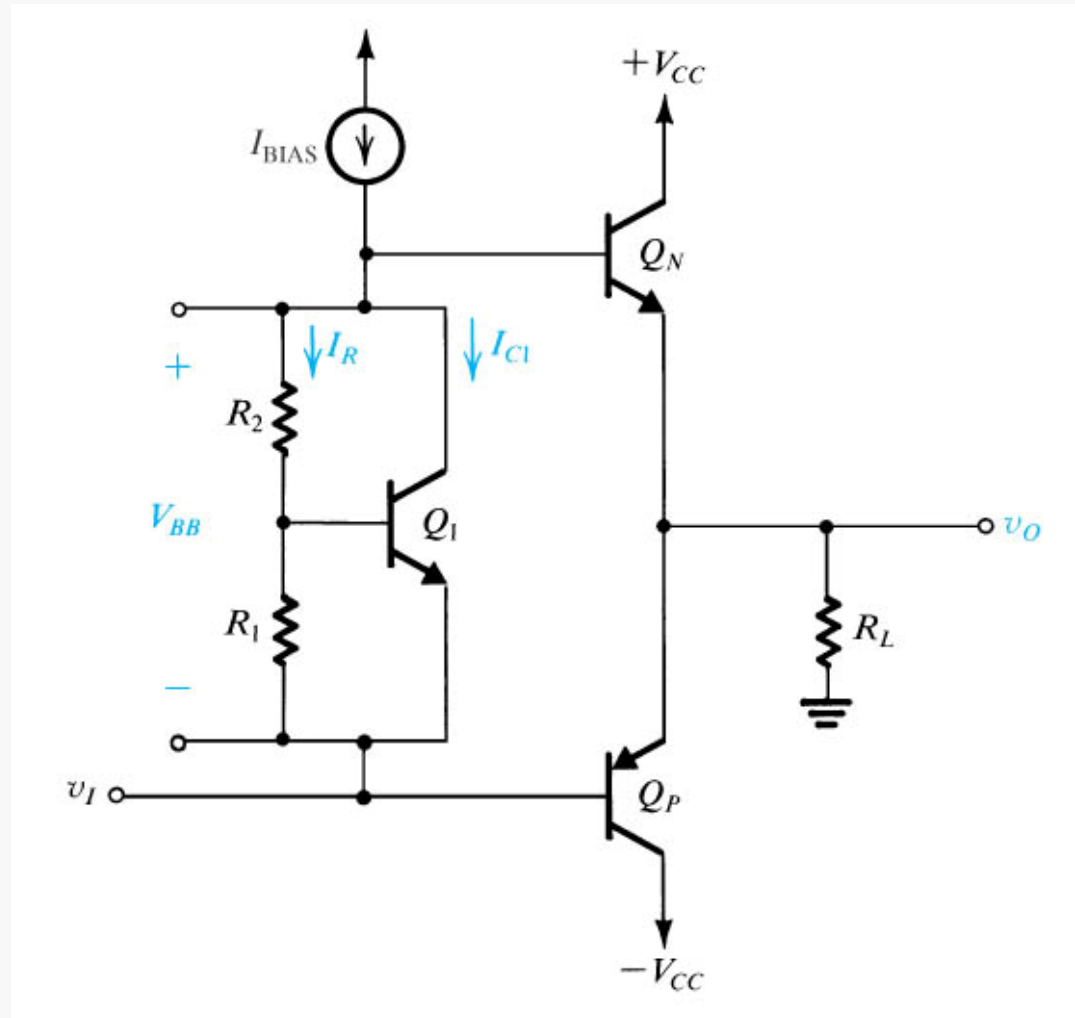
Determining Output Impedance Class AB



Class AB using Diodes

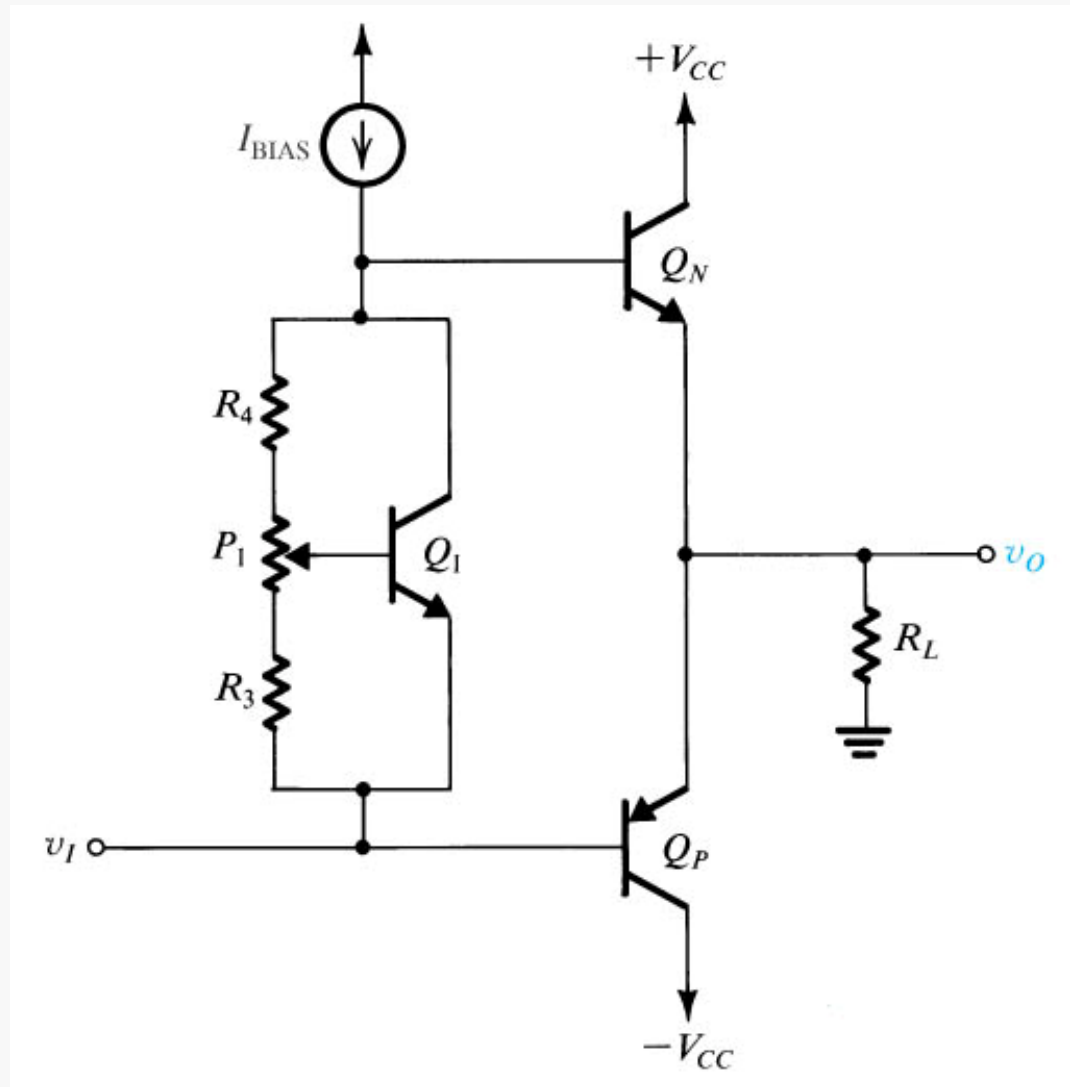


Class AB using V_{BE} multiplier



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)

