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 $Q_2$

\[ v_O = v_I - v_{BE} \]
\[ v_{O_{\text{max}}} = V_{CC} - V_{CE_{1,sat}} \]
\[ v_{O_{\text{min}}} = -IR_L \]
Transfer characteristic of the emitter follower
Waveforms from Class A

\[ I = \frac{V_{CC}}{R_L} \]
\[ R_L = \frac{V_{CC}}{I} \]
Class B

- Conducts only half of the cycle
Power Dissipation

• Maximum instantaneous power in Q₁ 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

\[ P_{D_{\text{max}}} = \frac{2V_{CC}^2}{\pi R_L} \]

\( \eta = 50\% \)

\( \eta = 78.5\% \)
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 B Single Power Supply Diagram]
Class AB

- Conduction more than half cycle
Class AB

- Conduction more than half cycle
Transfer Function Class AB

\[ V_O = (V_{CC} - V_{CE\text{sat}}) \]

Slope = 1

\[ V_I = -V_{CC} + V_{ECP\text{sat}} \]
Determining Output Impedance
Class AB
Class AB using Diodes
Class AB using V_BE multiplier
Class AB with V_be multip+pot.

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

![Circuit Diagram](image)
Class C

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