8.4 POWER AMPLIFIER TYPES

Class A       Linear
Class B, AB   Linear* (Complementary)
Class C       Nonlinear (RF, Tuned)
Class D and E Switching (Linear Audio)

BACKGROUND

(a) AC Load Line and (b) Equivalent Circuit of A BJT Operating in Large Signal Mode
(a) Input I-V Characteristics and (b) Current Transfer Characteristics of a BJT Operating in Large Si

\[ i_C = \beta i_B \left( 1 + \frac{V_{CE}}{V_A} \right) \]

for \( i_B \geq 0 \), NPN
Overall Transfer Characteristics of a BJT Operating in Large Signal Mode

Conclusion:
1. Transistor amplifiers are inherently nonlinear distorting.
2. Pick Q-point in the middle
Class-A operation in which Q-point is held in the middle of the linear portion of input-output character.

**Disadvantage:** The Class-A amplifier consumes a high and constant DC power, $I_{CQ} \cdot V_{CC}$ irrespective of the maximum undistorted AC power output and its maximum power conversion efficiency is limited. Therefore, Class-A amplifiers, particularly when they are used to amplify signals of varying amplitudes, are less efficient and more power-hungry.
Class-B and Class-C Modes of Operation

Class-B Conduction Angle: \( \theta_B = 180^\circ \) and Class-C Conduction Angle: \( \theta_C < 180^\circ \)
Class-AB Operation and Linearity

- No distortion for $v > 0$
- Negatives are clipped off
- Positive half distorted at the bottom
- For AB
- For B
- $v_{IN}$
- $Q_{AB}$
- $Q_B$
- **Complementary Class-B Operation**

Complementary Class-B Operation and Cross-Over Distortion
Principle of Class-E Operation
Theoretical efficiency → 100 %
Pulse - Width - DeModulation

\[ i \]

\[ C \text{ (averaged by low-pass filtering)} \]