Power Amplifiers

Class A Amplifier

A **class-A** emitter follower biased with a constant-current source is shown in the following **Figure**. Study the **Figure** carefully. Transistor parameters are: β = **180,** V_{BE} = **0.7 V,** and V_{CE}**(sat) = 0.2V**. Neglecting base currents, **find**:

(i) The value of I_Q.

(ii) The maximum and minimum values of i_{E1} and i_L.

(iii) The value of R that will produce the maximum possible output signal swing.

(iv) The conversion efficiency.

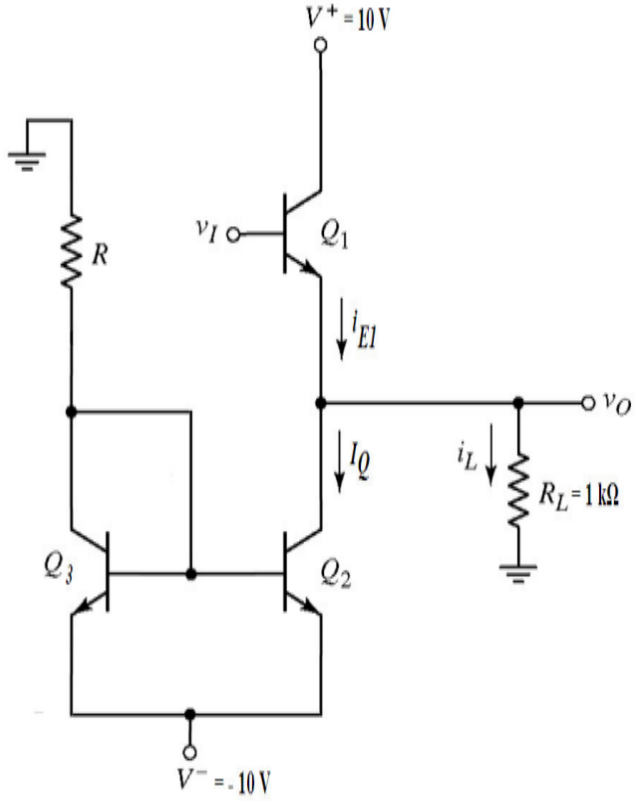


Fig: Output Stage of Class A Amplifier.

(i) $v_O(\text{max}) = V^+ - V_{CE}(\text{sat}) = 10 - 0.2 = 9.8\ \text{V}$

$I_Q = i_L(\text{max}) = v_O(\text{max}) / R_L = 9.8 / 1\text{k} = 9.8\ \text{mA}$

(ii) $i_{E1}(\text{max}) = 2\ I_Q = 19.6\ \text{mA}$

$i_{E1}(\text{min}) = 0$

$i_L(\text{max}) = I_Q = 9.8\ \text{mA}$

$i_L(\text{min}) = -I_Q = -9.8\ \text{mA}$

(iii) $R = (0 - V_{BE} - (-10)) / I_Q = 9.3 / 9.8\text{m} = 949\ \Omega$

(iv)

$$\overline{P}_L = \frac{1}{2}\left(i_L(\max)\right)^2 R_L = \frac{1}{2}(9.8\text{m})^2(1\text{k})$$

$$\Rightarrow \overline{P}_L = 48.02\text{mW}$$

$$\overline{P}_S = I_Q(V^+ - V^-) + I_Q(0 - V^-)$$

$$\Rightarrow \overline{P}_S = 9.8\text{m}(20) + 9.8\text{m}(10) = 294\text{mW}$$

$$\eta = \frac{\overline{P}_L}{\overline{P}_S} = \frac{48.02\text{m}}{294\text{m}} = 16.3\%$$

Class B Amplifier

An idealized class B output stage is to deliver 35 W of average power to a 25Ω load for a symmetrical input sine wave. The maximum output voltage is required to be 80% of the power supply voltage.

- Find the power supply voltage.
- With that power supply voltage, calculate the value of the power conversion efficiency η.

$P_L^* = 35\ \text{W}, R_L = 25\Omega$

$P_L^* = (1/2)(V^2_P/R_L) \rightarrow 35=(1/2)(V^2_P/25)$

$V_P = 41.83\ \text{V} = 0.8\ V_{CC}$

$V_{CC} = V_P / 0.8 = 52.3\ \text{V}$

$P_S^* = (2\ V_{CC})(V_P/\pi R_L) = (2\text{x}52.3)(41.83/\pi(25))$

$P_S^* = 55.7\ \text{W}$

$\eta = P_L^*/ P_S^* = 35/55.7 = 0.628$ or 62.8%

Class AB Amplifier

❖ **Voltage Transfer Characteristics for The Class-AB Output Stage**:

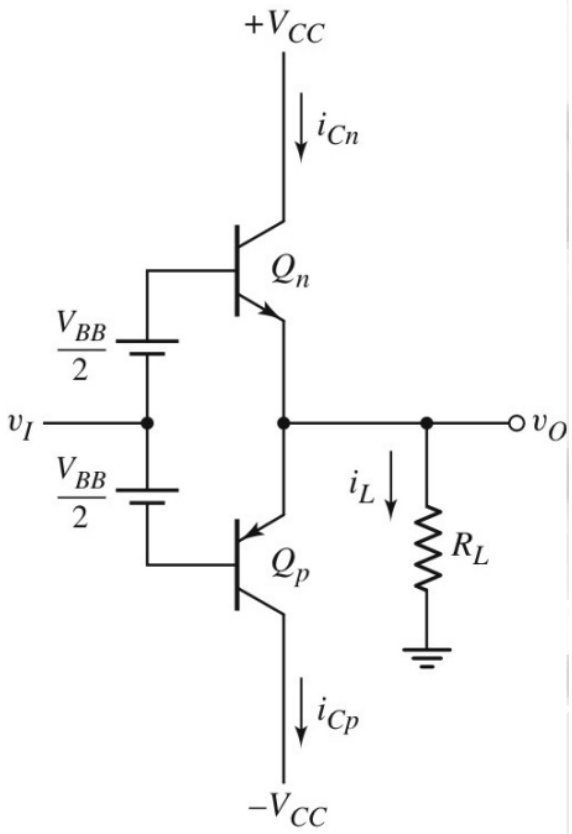
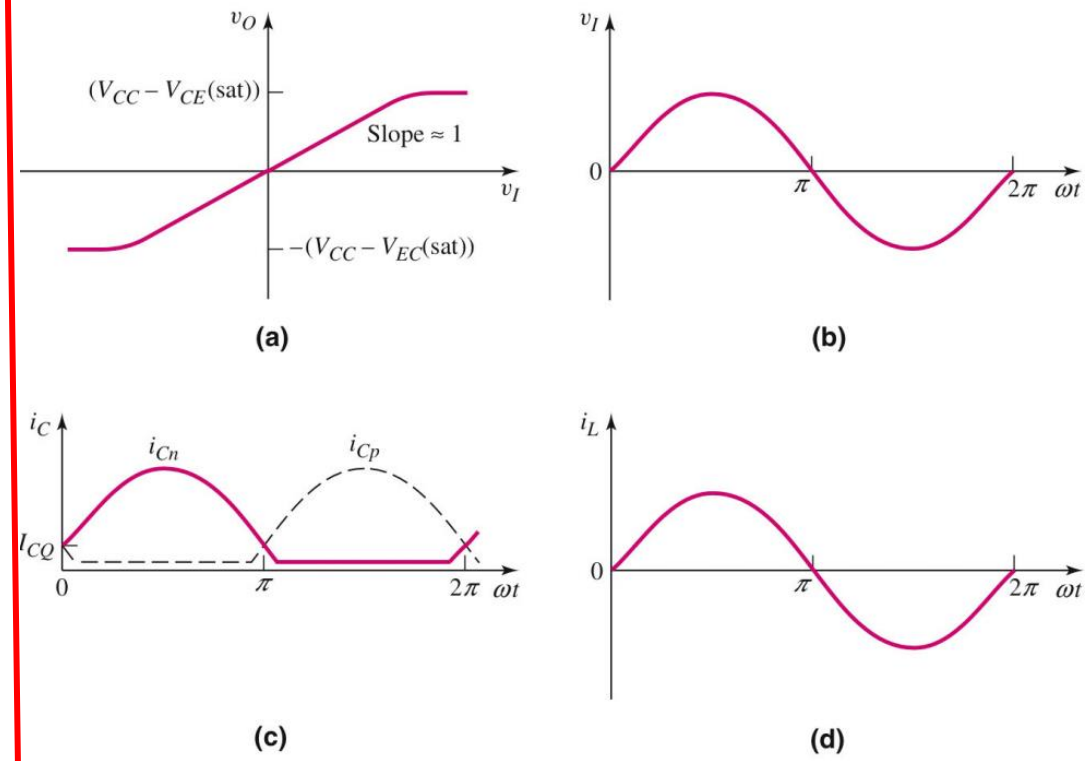


Fig: Class AB Bipolar Output Stage.



(a) Voltage transfer curve
(b) Sinusoidal input signal
(c) Collector currents
(d) Output current


Thank
you