

K. J. SOMAIYA COLLEGE OF ENGINEERING
DEPARTMENT OF ELECTRONICS ENGINEERING
ELECTRONIC CIRCUITS
Power Amplifier Circuits

Numerical 1:

In a class B power amplifier, load $R_L = 10\Omega$, supply voltage $V_{CC} = 18V$, $V_{EE} = -18V$, AC input voltage is $16V$ peak, frequency is $1000Hz$. Calculate the efficiency of the circuit. Select suitable power transistor having ratings: I_C close to $5A$ & V_{CEO} close to $30V$.

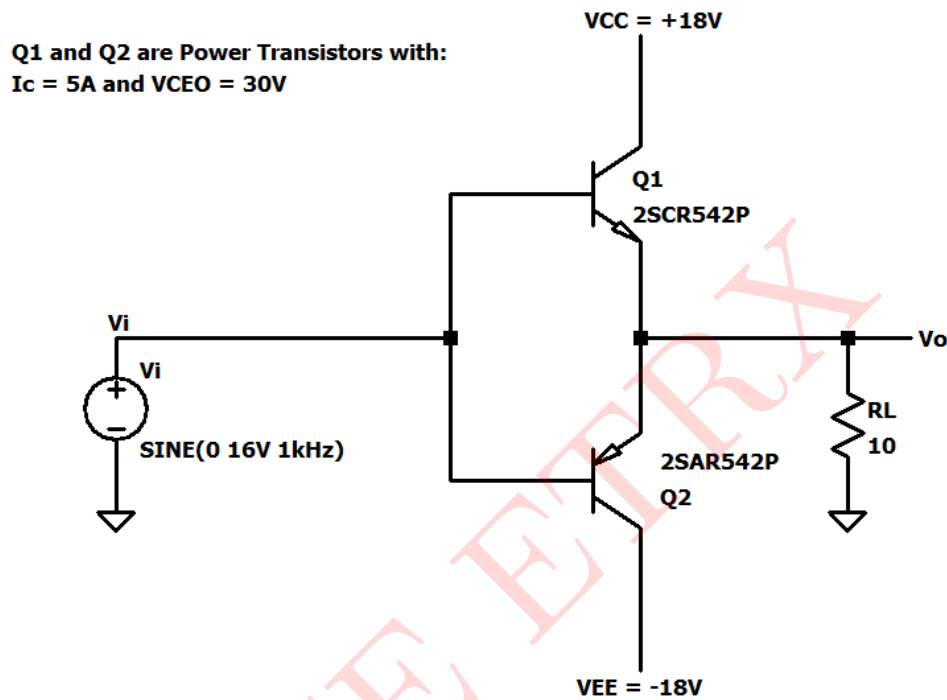


Figure 1: Circuit 1

Solution:

$$\begin{aligned} V_i &= V_m \sin \omega t \\ &= V_m \sin 2\pi ft \\ &= 16 \sin 2\pi \times 1000t \end{aligned}$$

$$V_m = 16V$$

$$P_{ac} = \frac{V_m^2}{2R_L} = \frac{16^2}{2 \times 10} = 12.8W$$

$$I_m = \frac{V_m}{R_L} = \frac{16V}{10\Omega} = 1.6A$$

$$P_{dc} = \frac{2V_{CC}I_m}{\pi} = \frac{2 \times 18 \times 1.6}{\pi} = 18.334W$$

$$\text{Efficiency } (\eta) = \frac{P_{ac}}{P_{dc}} = \frac{12.8W}{18.334W} \times 100$$

$$\eta = 0.698 = \mathbf{69.8\%}$$

SIMULATED RESULTS

The above circuit is simulated in LTspice and results are presented below:

Q1 and Q2 are Power Transistors with $I_c = 5A$ and $V_{CE0} = 30V$

$$\begin{aligned} P_{in}(DC) &= V_{CC} \times I_{CQ} \\ &= 36 \times (I_m/\pi) \\ &= 36 \times (1.5187/\pi) \end{aligned}$$

$$P_{in}(DC) = 17.4 \text{ W}$$

$$\begin{aligned} P_{out}(AC) &= V_{om} \times I_{om} \\ &= V_{om} \times I_{om} \times 0.5 \\ &= 15.2 \times 1.5187 \times 0.5 \end{aligned}$$

$$P_{in}(DC) = 11.542W$$

$$\begin{aligned} \% \text{Efficiency} &= 100 \times [P_{out}(AC)/P_{out}(DC)] \\ &= 100 \times [11.542W/17.4W] \end{aligned}$$

$$\% \text{Efficiency} = 66.33\%$$

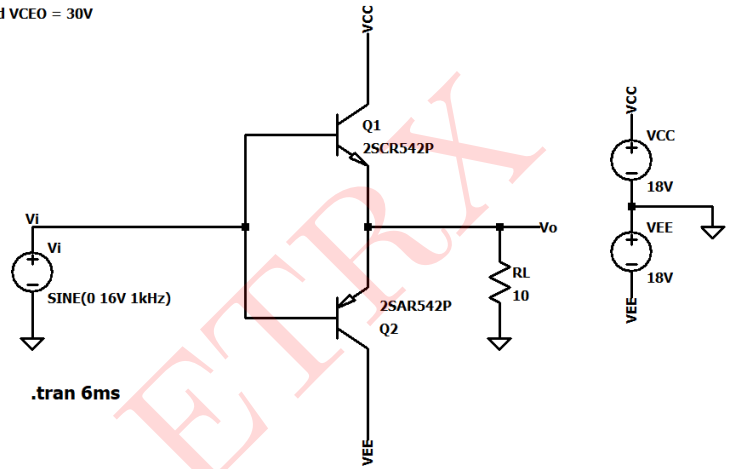


Figure 2: Circuit Schematic

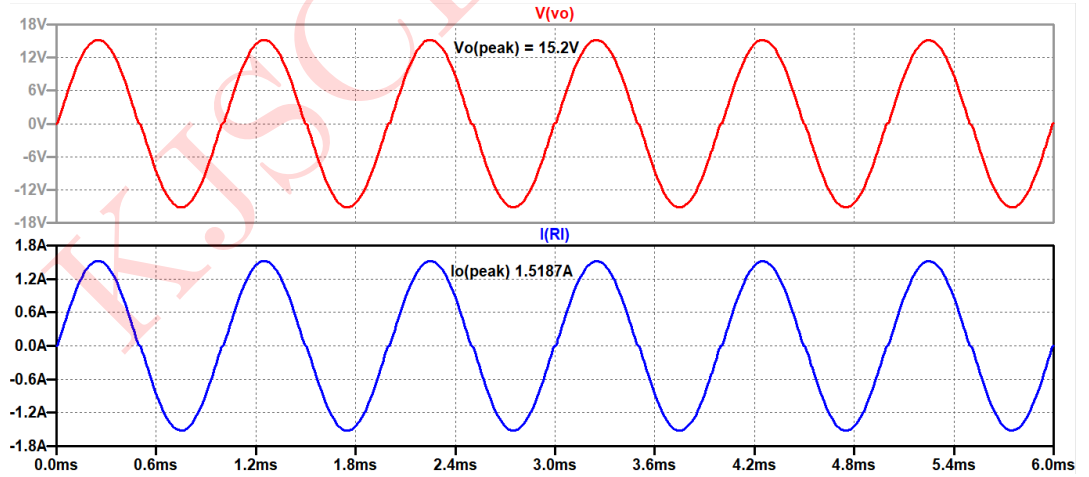


Figure 3: Output load Voltage

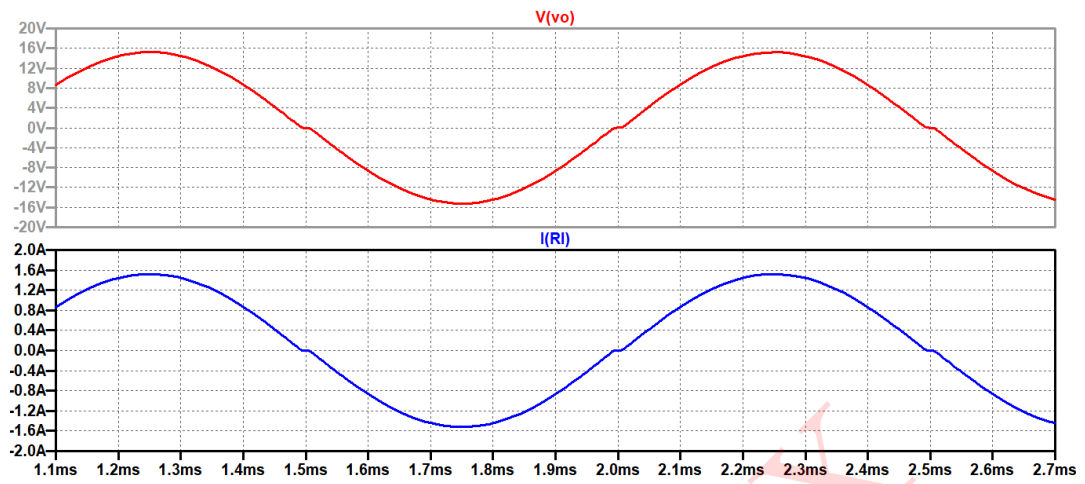


Figure 4: Cross over distortion

Comparison of Theoretical and Simulated results:

Parameters	Theoretical	Simulated
Input DC Power	18.334W	17.4W
Output AC Power	12.8W	11.542W
Efficiency	69.8%	66.33%

Table 1: Numerical 1
