Bachelor of Engineering Electronic Engineering (HONS)

Headphone Amplifier Design

By

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Electronic Engineering

List of Tables

List of Figures

Chapter 1

Simple transistor circuit

1.1 Transistor basic property

Figure 1.1 shows the basic NPN bipolar junction transistor circuit.

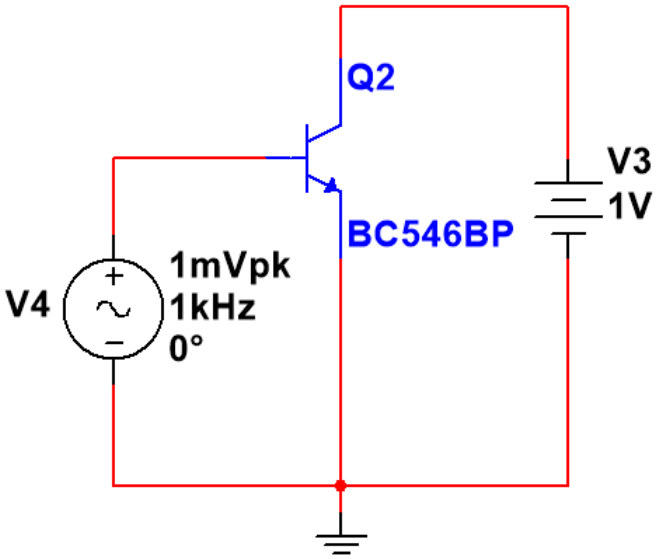


Figure 1.1: Single transistor circuit

We can get transistor operating state from simulation result as Table 1.1. It's obvious that I_C and I_E is proximately 200 times greater than I_B which is the main function of transistor.

Equation 1.1 defines β which is the most important parameter of transis-

I_B	9.09789μ
I_C	$2.02293m$
I_E	$-2.03003m$

Table 1.1: DC operating point analysis result

tor.

$$\beta = \frac{I_C}{I_B} \tag{1.1}$$

1.2 Limit current gain

Generally, we need a method to control the current gain as we want. Figure 1.2 is a simply solution by adding transistor R_C and R_E.

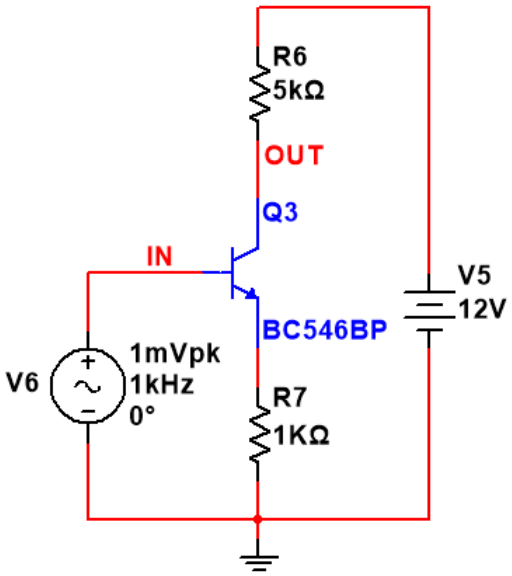
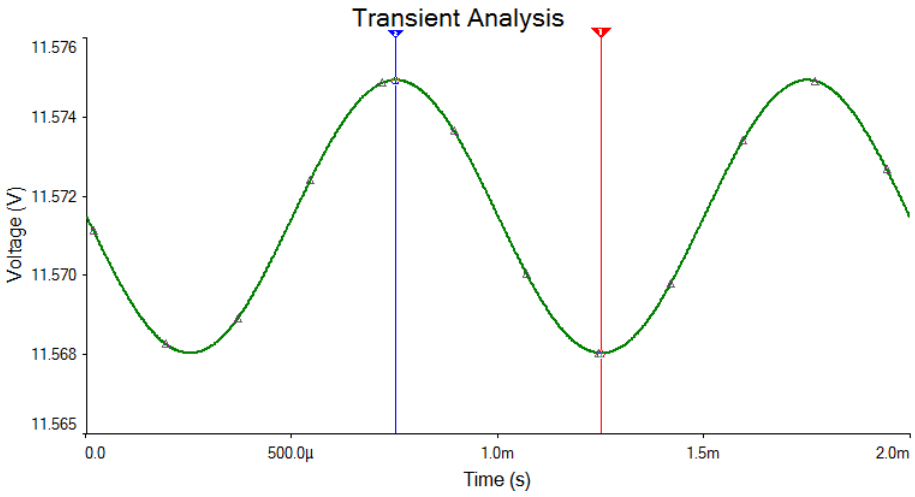


Figure 1.2: Basic transistor circuit with R_c and R_e

We can derive voltage gain A_V with Equation 1.2. And in circuit in Figure 1.2, A_V is approximate 5 theoretically.

$$A_V \triangleq \frac{V_{out}}{V_{in}} \approx -\frac{R_C}{R_E} \tag{1.2}$$

From simulation result in Figure 1.3, the practical $A_V = \frac{7.6486m}{2m} = 3.8243$.



	V(in)	V(out)
x1	1.2508m	1.2508m
y1	658.7000m	11.5676
x2	749.1749µ	749.1749µ
y2	656.7000m	11.5752
dx	-501.6502µ	-501.6502µ
dy	-1.9999m	7.6486m
dy/dx	3.9867	-15.2469
1/dx	-1.9934k	-1.9934k

Figure 1.3: Output of the circuit in Figure 1.2

after