

LAB #06

Objectives

To study the current voltage characteristics of NPN Bipolar Junction Transistor (BJT).

Theory

The Bipolar Junction Transistor (BJT) can be modeled as a current controlled current source. The circuit symbol and the pin out for the actual device can be seen in Figure 4-1.

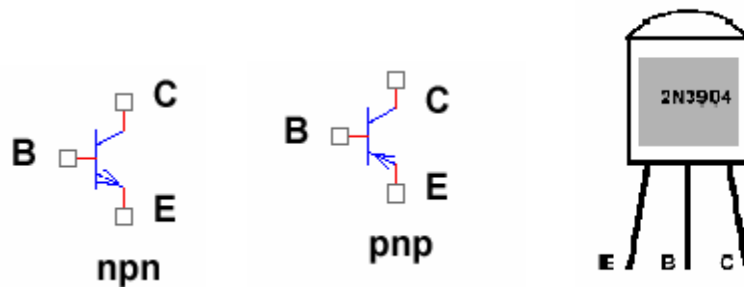


Figure 6.1: The bipolar junction transistor.

The Common Base (CB) (Figure 4-2) circuit characteristics constitute a family of static characteristics plots of collector current versus collector-base voltage for several values of emitter current.

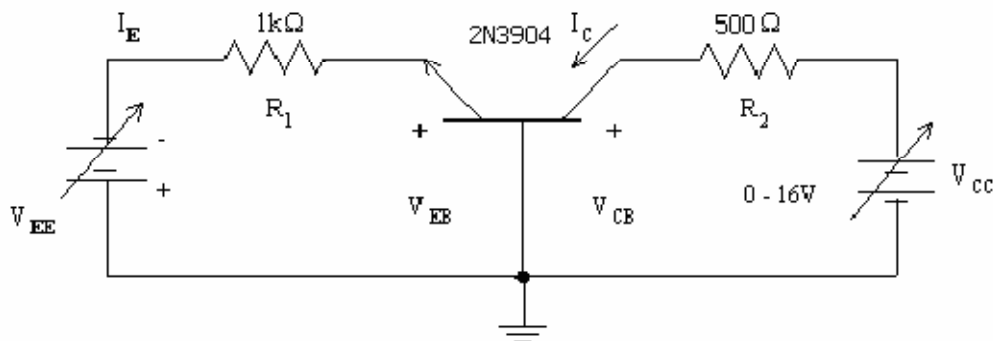


Figure 6.2: CB configuration circuit using an npn transistor

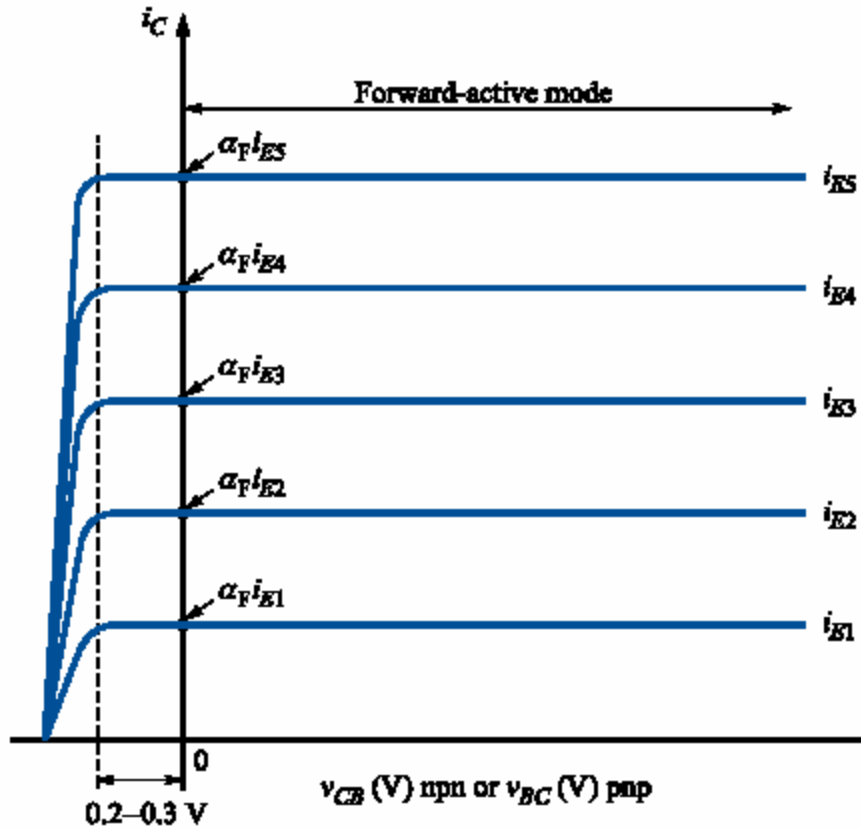


Figure 6.3: Transistor I-V Characteristics for Common Base Circuit

The curves in Fig. 4-3 can be used to calculate the large signal current gain α_{dc} and the small signal current gain, α_{ac} . These values are in general calculated for a given bias point I_{CQ} , V_{CBQ} using the following equations:

$$\alpha_{dc} = I_{CQ} / I_{EQ}$$

$$\alpha_{ac} = |I_{CQ} - I_{CQ'}| / |I_{EQ} - I_{EQ'}|$$

Preparatory Exercise

Requirement

Instruments

1. DC power supply
2. Function Generator
3. Digital Multimeter (DMM)

Components

1. 2N3904
2. Resistors: 1k Ω , 500 Ω

Procedure

Part A: Transistor Common-Base Collector Characteristics

1. Connect the circuit shown in Figure 6.1.
2. Vary V_{cc} from 0 to +10V in steps of 1 Volts and measure (record) the collector current and the voltage across collector and base .
3. Repeat the procedure for different values of I_E (vary I_E from 0-10mA in steps of 2mA).
4. Now, fix emitter current I_E at 2mA. Remove Variable Supply+ source and Replace your V_{cc} source with a NI Elvis Supply - (a negative power supply). By using a negative source, we are going to slightly forward bias B-C junction. (We want to obtain the whole I-V characteristics as shown in Fig. 4-3.)
5. Change Negative power supply from 0 to -1 V in steps of 100 mV. By using negative supply, we are slowly forward biasing the C-B junction. You should still be in forward active region until the forward bias exceeds 200-300 mV as indicated in Figure 6.3. Later current should fall to zero.
6. Repeat the procedure 5 for different values of I_E (vary I_E from 2-10mA in steps of 2mA).

Observations

1. Plot the V-I characteristics with I_C on Y-axis and V_{CB} on X-axis.
2. Calculate α_{DC} and α_{AC} from the curves.