VoltageDividerBias -- Overview

Akshay Gopal

PES Institute of Technology

ECE

Lab Overview

After performing this lab exercise, learner will be able to:

• Design Votage Divider biasing circuit
• Verify the DC conditions
• Build the circuit and observe the output

Equipment

To carry out this experiment, you will need:
• TBS 1000B-EDUOscilloscope from Tektronix.
• Voltage probe (provided with oscilloscope) / BNC cables
• Breadboard and connecting wires
• Circuit components - Resistor, Transistor SL 100, Regulated DC supply 0-30V DC, Multimeter (for testing)

Theory

• Value of β or hFE of transistors change with temperature and also changes from transistors to transistors. (For SL 100, β varies from 50 to 300).

• This changes the Q point and will result in poor stability. In voltage divider circuit, dependence of Q point on β is reduced and with proper design Q point can be made independent of β.

• Two methods are used to analyze this circuit. viz exact method which can be applied to any voltage divider bias circuit and second one is approximate method where calculation are simplified if β RE

>10R2.

Design

Q point equations:
Exact Analysis

IB = (Vth – VBE) /(Rth+ (1+ β)RE)
where Vth = R2 *Vcc / (R1+R2) and Rth = R1 //R2 = R1*R2 /(R1+R2)

IC = β IB

VCE = Vcc- Ic(RC+RE)

Given Vcc = 10V, Q point VCEQ = 5V and ICQ = 2mA
Measure β = 200
Assume VBE = 0.7V for silicon diodes

VE = 10% of Vcc = 1V

Assume IE ~ IC

RE = VE /IE = 1V/ 2mA = 500 Ohm

Rc = (Vcc- VCE -VE) / IC =(10-5-1) / 2mA = 2k ohm.

V2 =V B = VE + VBE = 1+0.7 = 1.7V

βRE ≥ 10R2

R2 = (βRE)/10
V1 = Vcc – V2
V1/ V2 = R1 / R2
R1 = (V1/ V2) * R2

R2 = 1.7V / 90μA = 18.9K
R1 = 8.3V / 100μA = 83K

Circuit Diagram

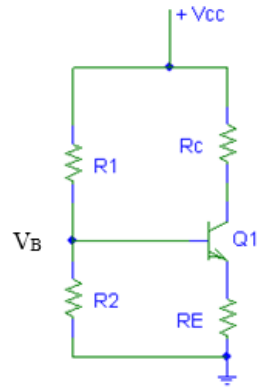

Fig : Voltage divider bias circuit

VoltageDividerBias -- Procedures

Step 1

Study the circuit, and design the resistors.

Step 2

Place the components on spring board or bread board and connect them as given in circuit diagram figure. Use the springs/patch cords/ wires for connection as required.

Step 3

Set Vcc to 10V DC.

Measure DC voltage across
a. Collector and emitter of transistor (VCE)
b. Across the resistor Rc (VRC)
c. Across the resistor R2 (VB or VR2)
d. Across the resistor RE (VE)

Step 4

Calculate the value of IB ,IE and Ic using equations

I2= VB/ R2, and Ib= 9* IB

IC = VRC/ RC and IE = VE/ RE

Note :- IC and IB can be measured directly by connecting mA and uA in series with Rc, and RB

Step 5

Compare the measured IB , IE and VCE and IC with the design value.

Step 6

Repeat this experiment by changing the transistor.(change in β value).

Step 7

Draw load line and locate Q point for transistor 1

Parameters	Transistor 1 β =	Transistor 2 β =	Design Values calculated for transistor 1
I_B			
I_E			
I_{Cq}			
V_{CEq}			

Step 8

Result

The voltage divider bias circuit with emitter resistor is designed and verified with the given values.