



BAŞKENT UNIVERSITY
ELECTRIC & ELECTRONICS ENGINEERING

EEM 214 ~ ELECTRONICS–I
LABORATORY
REPORT

Experiment Name : BJT Biasing
Experiment Number : 8

Student Name : [REDACTED]
Student Number [REDACTED]
Experiment Date/Day: 5 / 5 / 2006
Laboratory Number:

Honor Pledge:

I did this preliminary work or lab report by myself and I have neither cheat from anybody nor let anybody cheat from me at the any part of this work.

Student Signature:

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1. The results of measurements :

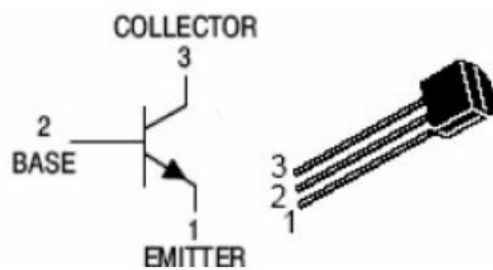
$$1k\Omega = 972\Omega$$

$$100\Omega = 98\Omega$$

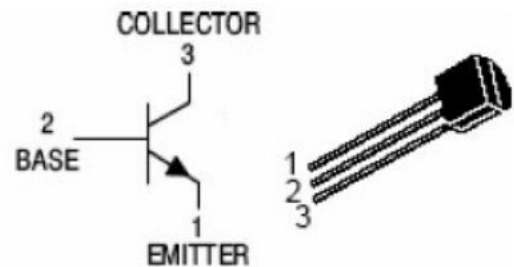
$$2.2k\Omega = 2.162k\Omega$$

$$470k\Omega = 471.2k\Omega$$

2.



BC238B



2N3903-2N3904

We built circuit in fig 1 with $R_b = 470k\Omega$ and we used it to calculate the beta of each of the three transistors. And we measured node voltages : V_{cc} , V_c , V_B and $\beta = I_c/I_B$. They are shown in the table below.

	V_{CC}	$V_{C_{measured}}$	$V_{B_{measured}}$	$\beta_{calculated}$
2N3903	15V	13,242V	0,680V	54,77
2N3904	15V	10,444V	0,712V	154,45
BC238B	15V	4,132V	0,697V	365,7

β values are calculated below

For transistor 2N3903 ;

$$I_c = (V_{cc} - V_c)/R_c \rightarrow I_c = (15 - 13,242)/972\Omega = 1,88A$$

$$I_b = (V_{cc} - V_B)/R_b \rightarrow I_b = (15 - 0,680)/417,2k\Omega = 34,32mA$$

$$\beta = I_c/I_b = (1,88/34,32)*1000 = 54,77$$

For transistor 2N3904 ;

$$\begin{aligned}I_c &= (15-10,444)/972 \, \Omega = 4,68\text{mA} \\I_b &= (15- 0,712)/471,2\text{k} \, \Omega = 30,3\text{A} \\ \beta &= I_c/I_b = 4,68\text{mA}/30,3\text{A} = 154,45\end{aligned}$$

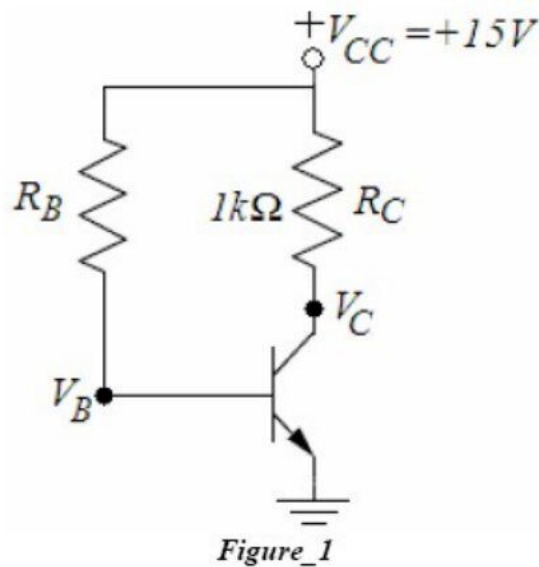
For transistor BC238B;

$$\begin{aligned}I_c &= (15-4,132)/972 \, \Omega = 11,1\text{mA} \\I_b &= (15-0,697)/471,2\text{k} \, \Omega = 30,35\text{A} \\ \beta &= I_c/I_b = 11,1\text{mA}/30,35\text{A} = 365,7\end{aligned}$$

2. We used the medium value of β which is 154,45 and we calculate the values of the specified resistor for each of the four circuits. Where $I_c=6\text{mA}$.

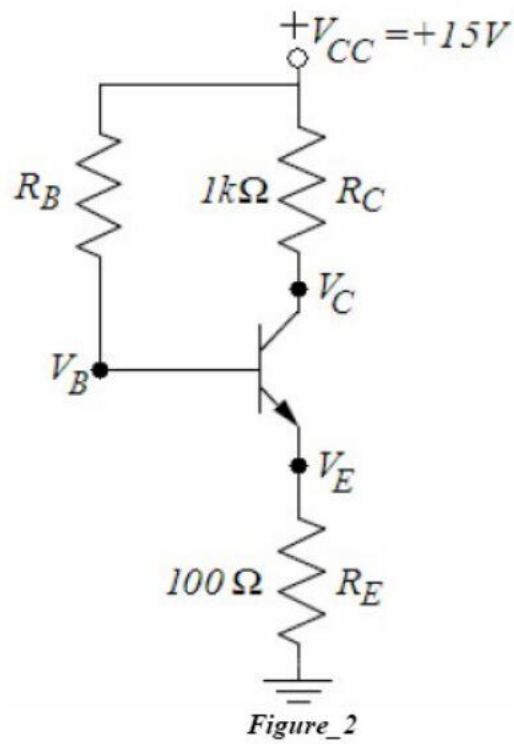
$$I_b = I_c / \beta = 6\text{mA} / 154,45 = 3,88 \cdot 10^{-5}$$

a.



$$R_b = (V_{CC}-V_{BE})/I_b = (15-0,65)/3,88 \cdot 10^{-5} = 369,8\text{k}$$

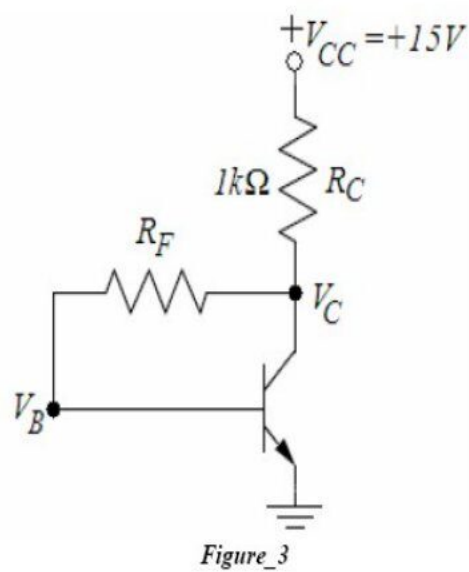
b.



$$R_B = (V_{CC} - V_{BE} - I_C R_E) / I_B = (15 - 0,65 - (6 \cdot 10^{-3} \cdot 100)) / 3,88 \cdot 10^{-5}$$

$$R_B = 354,8k$$

c.



$$R_F = (V_{CE} - V_{BE})/I_b$$

$$V_C = 15 - (6/154,45 * 0,972) = 14,96V$$

$$R_F = (14,96 - 0,65)/3,88 * 10^{-5} = 368,8k$$

d.

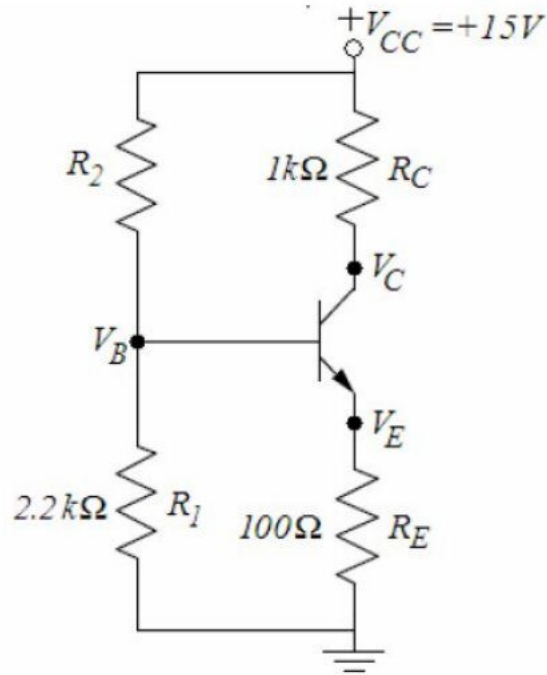


Figure_4

$$I_{R1} = 0,65 + 6/154,45 * 100/2,2k = 4,53/2,2k = 206\mu A$$

$$R2 = (V_{CC} - V_{BE} - I_C R_E) / (I_{R1} + I_b)$$

$$R2 = (15 - 0,65 - 6/154,45 * 0,1) / (0,206 + 6/154,45) = 14,35/5,28 = 27,2k$$

3.

		<i>V_C measured</i>	<i>I_{CQ} calculated</i>
Circuit in Fig.1	Low β	13,372 V	2,628 mA
	Medium β	8,993 V	6 mA
	High β	1,400 V	13,6 mA
Circuit in Fig.2	Low β	12,411 V	2,589 mA
	Medium β	9,245 V	5,755 mA
	High β	2,576 V	12,424 mA
Circuit in Fig.3	Low β	11,302 V	3,698 mA
	Medium β	9,003 V	5,997 mA
	High β	5,808 V	9,192 mA
Circuit in Fig.4	Low β	9,315 V	5,685 mA
	Medium β	9,297 V	5,703 mA
	High β	9,016 V	5,991 mA

Calculations are shown below;

For figure 1 :

Low $\beta \rightarrow I_{CQ} = (15 - 12,372) / 1k = 2,628mA$

Medium $\beta \rightarrow I_{CQ} = (15 - 8,993) / 1k = 6mA$

High $\beta \rightarrow I_{CQ} = (15 - 1,4) / 1k = 13,6mA$

For figure2:

Low $\beta \rightarrow I_{CQ} = (15 - 12,411) / 1k = 2,589mA$

Medium $\beta \rightarrow I_{CQ} = (15 - 9,245) / 1k = 5,755mA$

High $\beta \rightarrow I_{CQ} = (15 - 2,576) / 1k = 12,424mA$

For figure3:

Low $\beta \rightarrow I_{CQ} = (15 - 11,302) / 1k = 3,698mA$

Medium $\beta \rightarrow I_{CQ} = (15 - 9,003) / 1k = 5,997mA$

High $\beta \rightarrow I_{CQ} = (15 - 5,808) / 1k = 9,192mA$

For figure4:

Low $\beta \rightarrow I_{CQ} = (15 - 9,315) / 1k = 5,685mA$

Medium $\beta \rightarrow I_{CQ} = (15 - 9,297) / 1k = 5,703mA$

High $\beta \rightarrow I_{CQ} = (15 - 9,016) / 1k = 5,991mA$

5-)

a-)

$$\%range = 100 * \frac{(I_{CQhigh} - I_{CQlow})}{I_{CQmedium}}$$

For Fig.1:

$$\% range = 100 \times (13,6 - 2,628) / 6 = 182$$

For Fig.2:

$$\% range = 100 \times (12,424 - 2,589) / 5,755 = 171$$

For Fig.3:

$$\% range = 100 \times (9,192 - 3,698) / 5,997 = 92$$

For Fig.4:

$$\% range = 100 \times (5,991 - 5,685) / 5,703 = 5$$

b-)

Circuit in Fig.4 → Circuit in Fig.3 → Circuit in Fig.2 → Circuit in Fig.1
Most Stable → → → → → → → → → → → → → → → → → → Least Stable

% range calculations shows us that the circuit in Fig.4 is most stable. Changes in β doesn't effect the I_{CQ} circuit in Fig.4. So it is the most stable circuit.

c-)

There are some small differences between theoretical and experimental values.

Reasons are be defined as measurement errors and probably we couldn't set the pot correctly to the resistor value of we want.