JUNCTION TRANSISTOR : COMMON EMITTER CHARACTERISTICS

RAVITEJ UPPU

1. Aim

1. Connect NPN common emitter transistor circuit to determine experimentally and plot the family of collector($V_C E$ (potential between the collector and emitter ends of transistor) vs I_c (collector current)) characteristic curves for the Common Emitter configuration.
2. To measure the effects on I_C on varying I_B(base current).
3. To determine beta (β)(current gain in common emitter).

2. Theory

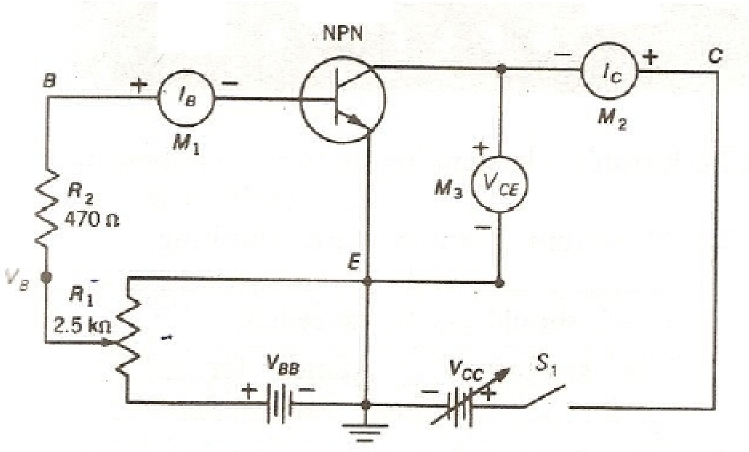
First, let try to describe a Junction Transistor. It is a three-terminal device constructed of doped semiconductor material.Junction transistor's operation involves both electrons and holes.Although a small part of the transistor current is due to the flow of majority carriers, most of the transistor current is due to the flow of minority carriers and so Junction Transistors are classified as 'minority-carrier' devices.

An NPN transistor can be considered as two diodes with a shared anode region. In typical operation, the emitterbase junction is forward biased and the basecollector junction is reverse biased. The electrons in the base are called minority carriers because the base is doped p-type which would make holes the majority carrier in the base.The base region of the transistor must be made thin, so that carriers can diffuse across it in much less time than the semiconductor's minority carrier lifetime, to minimize the percentage of carriers that recombine before reaching the collectorbase junction.

The grounded emitter or common emitter configuration is pretty frequently used.In the case of the common emitter, the input signal is applied between base and emitter the output taken from the collector to emitter i.e the emitter is common to both input and output circuits. The current gain in common emitter is defined as the change in collector current effected by a change in base current with collector voltage maintained at a constant value i.e $\beta = \frac{\Delta I_C}{\Delta I_B}$.

3. Procedure

We connect the circuit as follows :



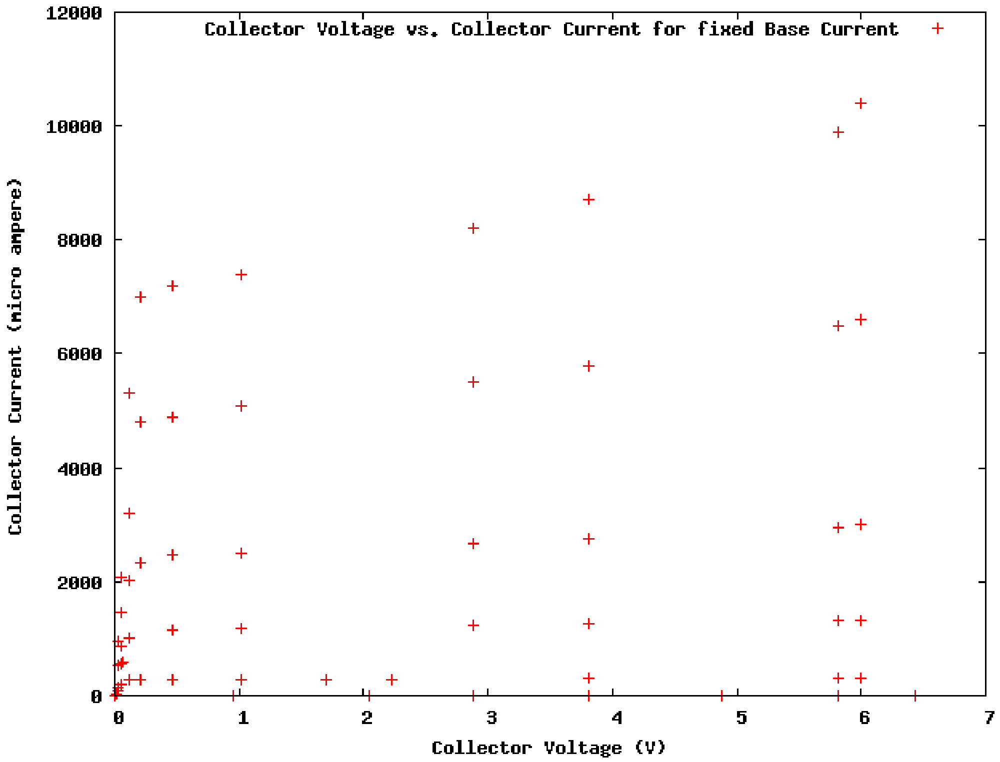
In the experiment, V_BB is $1.5V$ and V_CC is a variable DC supply which we vary from 0 to $6V$ Now, we vary V_CC and measure I_C for a fixed value of I_B. Tabulate V_CE and I_C. Now vary I_B and repeat the same steps. Take such readings for about 5 values of I_B. From this, we can plot the V_CE versus I_C curves and we can also calculate the β, the current gain, by finding the difference between the base current and Collector current for a fixed V_CE.These can also be tabulated/

4. Observations and Results

V_C Collector Voltage (V)	I_c Collector Current (μA)	V_C (V)	I_C (μA)
$I_B = 0\mu A$		$I_B = 30\mu A$	
0	0	0	0
0.95	1	0.03	538
2.05	2	0.05	872
2.88	3	0.11	2037
3.81	4	0.21	2343
4.88	5	0.46	2464
5.81	6	1.02	2513
6.43	7	2.88	2669
		3.81	2751
		5.81	2942
		6.00	2999
$I_B = 10\mu A$		$I_B = 40\mu A$	
0	0	0	0
0.02	98		
0.03	133		
0.05	196	0.05	1455
0.11	267	0.11	3200
0.21	280	0.21	4800
0.46	282	0.46	4900
1.02	285	1.02	5100
2.23	290	2.88	5500
3.81	296	3.81	5800
5.81	302	5.81	6500
6.00	304	6.00	6600

$I_B = 20\mu A$		$I_B = 50\mu A$	
0	0	0	0
0.01	30	0.03	958
0.05	551	0.05	2086
0.11	1024	0.11	5300
0.21	1160	0.21	7000
0.46	1176	0.46	7200
1.02	1188	1.02	7400
2.88	1244	2.88	8200
3.81	1267	3.81	8700
5.81	1321	5.81	9900
6.00	1333	6.00	10400

The graph of the above data with V_C versus I_c looks like

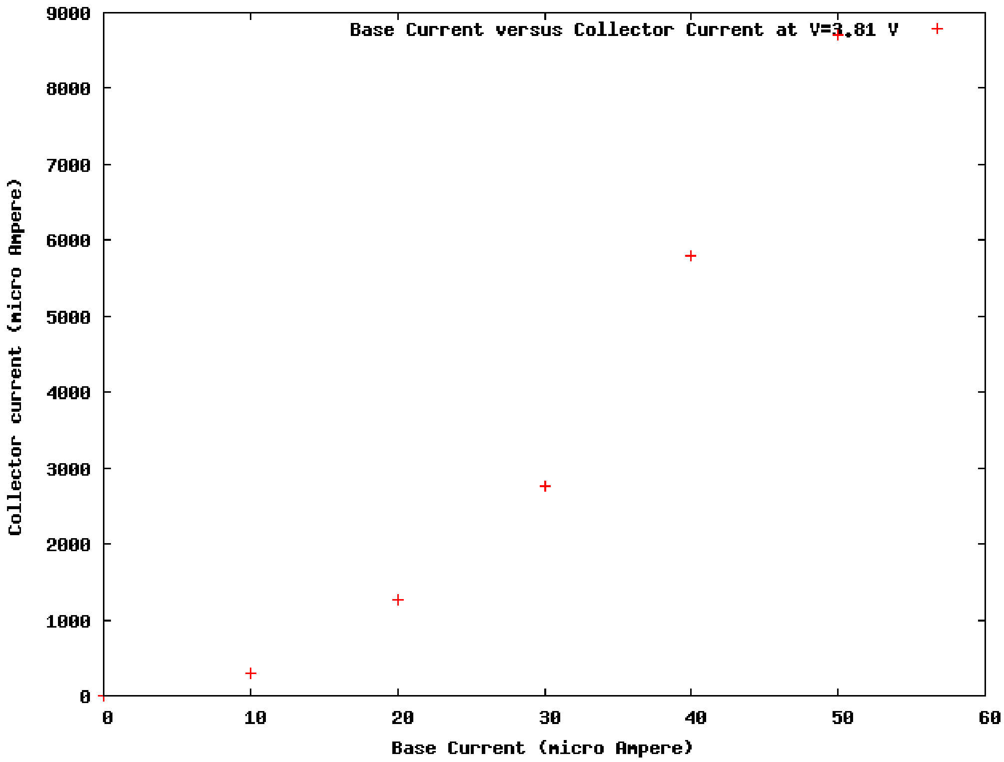


The curves rises very steeply to a higher value of I_C for higher I_B.

Now, let us try to find β, the current gain at $V_C = 3.81V$.

S.No	ΔI_B(reference $I_B = 10\mu A$)	ΔI_C μA	β
1	10	971	97.1
2	20	2455	122.75
3	30	5504	183.47
4	40	8404	210.10

The plot looks like this for the base current versus collector current at $V = 3.81V$



So the range of β for this voltage is as given in the previous table and is depicted in the graph below