ECE 2200L
Introduction to Microelectronics Circuits Laboratory

Experiment 11
Switching Characteristic of BJT

Report

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Objective

To study the large signal switching characteristics of the bipolar junction transistor in time domain as it is driven into ON and OFF states.

Result

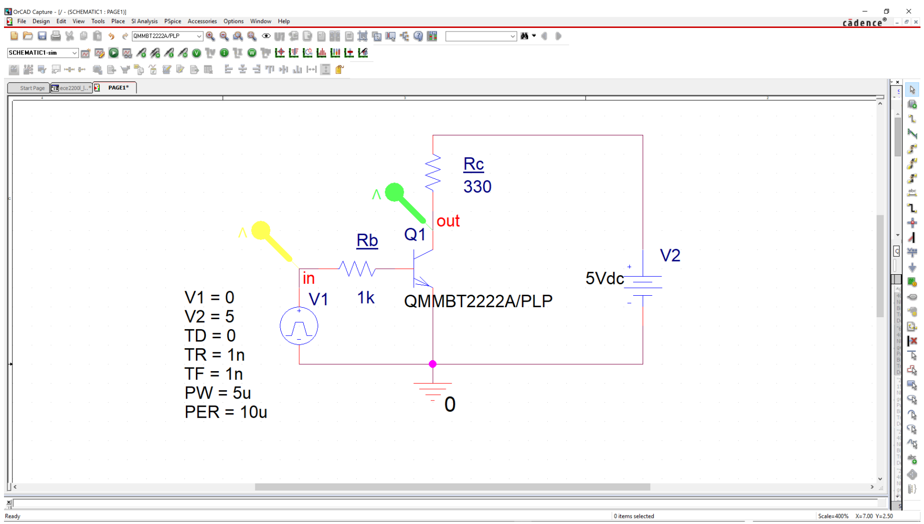

Figure 1: PSpice Circuit with $R_b = 1\,\mathrm{k\Omega}$

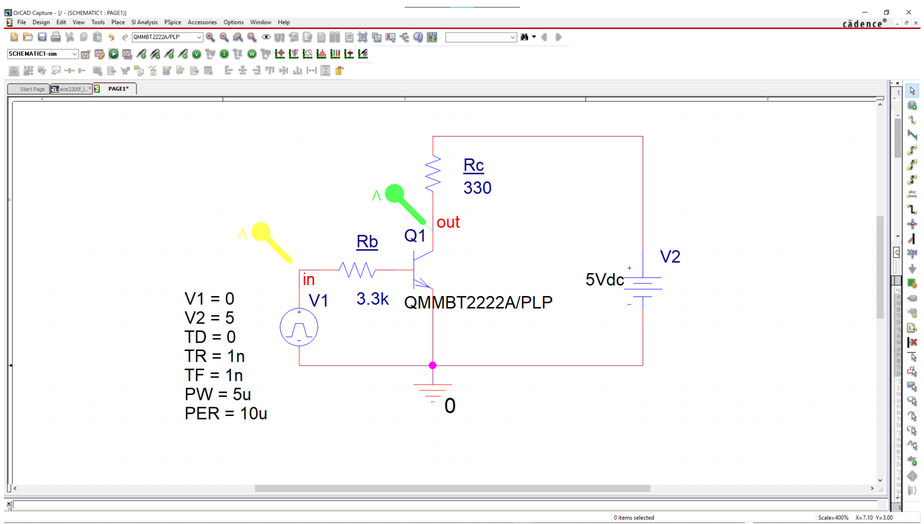

Figure 2: PSpice Circuit with $R_b = 3.3\,\mathrm{k\Omega}$

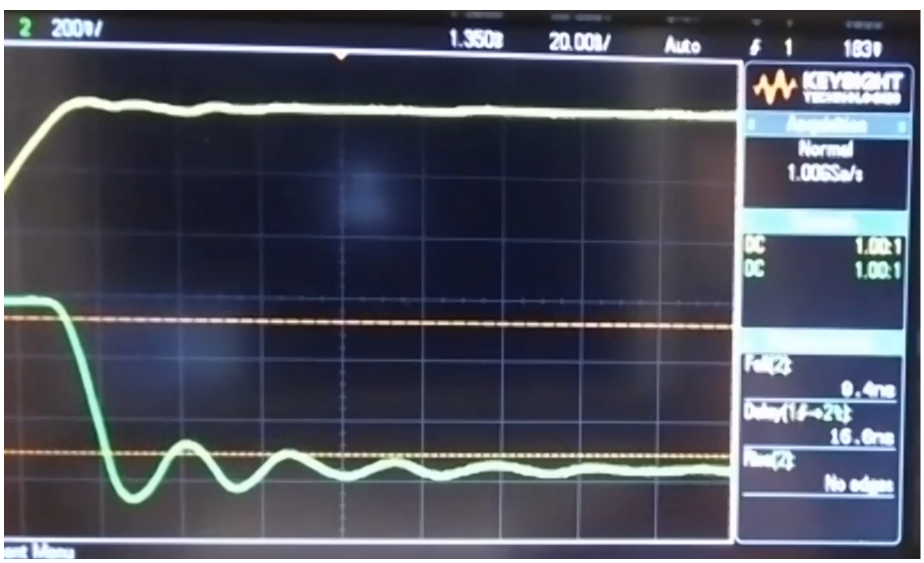

Figure 3: Oscilloscope display of collector current rise with $R_b = 1\,\mathrm{k\Omega}$

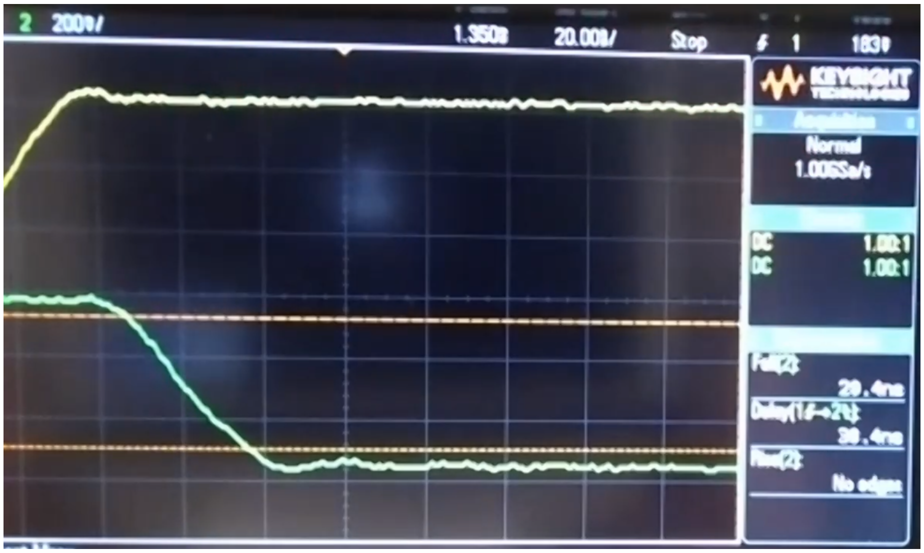

Figure 4: Oscilloscope display of collector current rise with $R_b = 3.3\,\mathrm{k}\Omega$

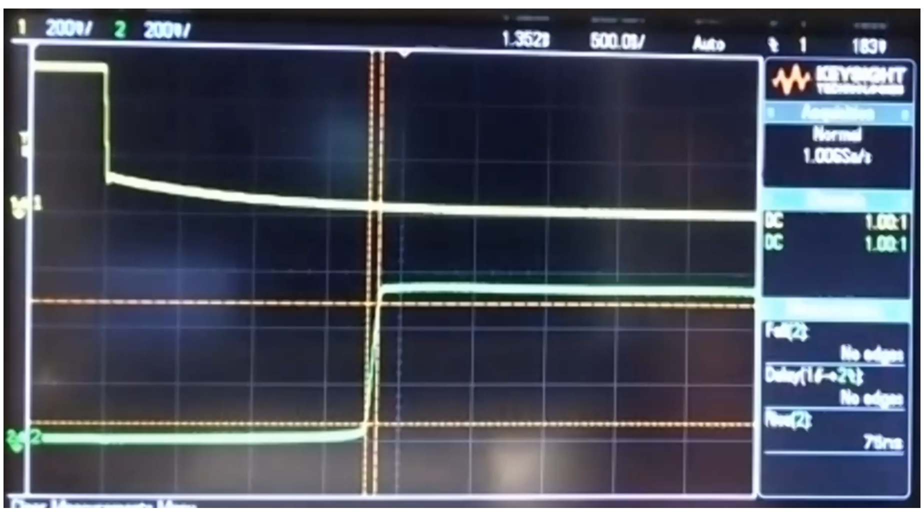

Figure 5: Oscilloscope display of collector current fall with $R_b = 1\,\mathrm{k}\Omega$

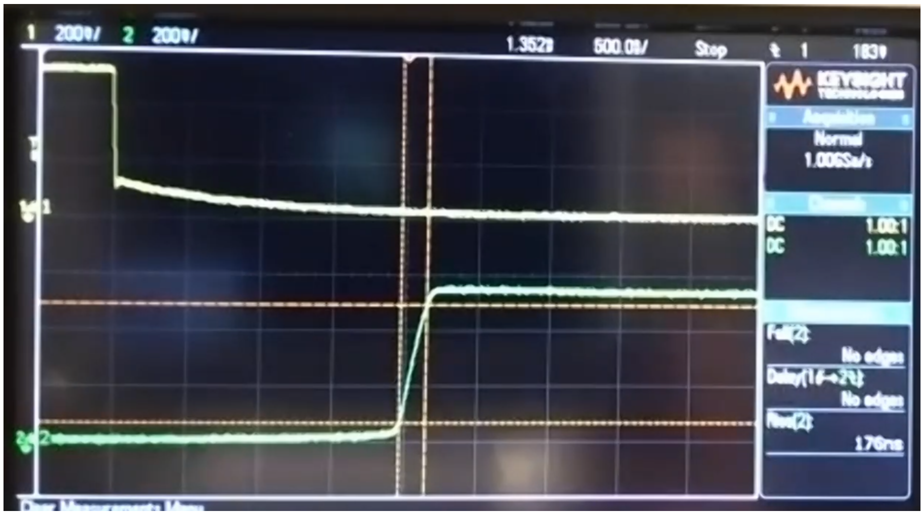

Figure 6: Oscilloscope display of collector current fall with $R_b = 3.3\,\mathrm{k\Omega}$

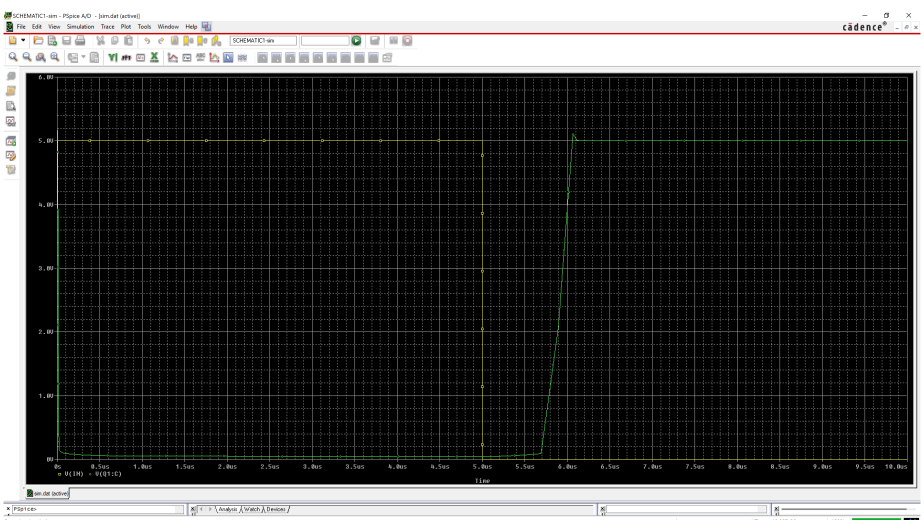

Figure 7: PSpice simulation V_{in} and V_{out} plot with $R_b = 1\,\mathrm{k\Omega}$

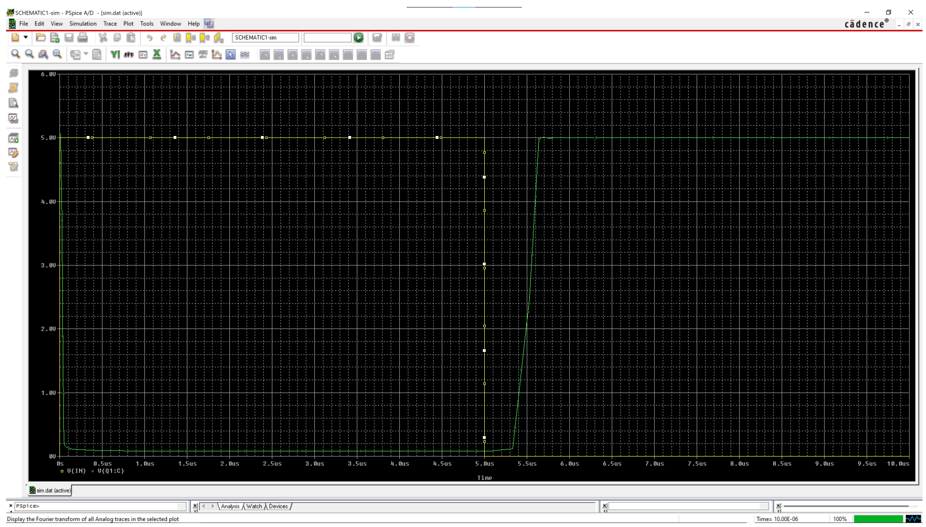

Figure 8: PSpice simulation V_{in} and V_{out} plot with $R_b = 3.3\,\mathrm{k}\Omega$

From the oscilloscope output we obtained the following data:
With $R_b = 1\,\mathrm{k}\Omega$, $T_d = 17\,\mathrm{ns}$, $T_r = 11\,\mathrm{ns}$, $T_s = 1900\,\mathrm{ns}$, $T_f = 70\,\mathrm{ns}$;
With $R_b = 3.3\,\mathrm{k}\Omega$, $T_d = 38\,\mathrm{ns}$, $T_r = 30\,\mathrm{ns}$, $T_s = 2000\,\mathrm{ns}$, $T_f = 176\,\mathrm{ns}$
From the simulation output we obtained the following data:
With $R_b = 1\,\mathrm{k}\Omega$, $T_d = 6.6\,\mathrm{ns}$, $T_r = 8.4\,\mathrm{ns}$, $T_s = 735\,\mathrm{ns}$, $T_f = 297\,\mathrm{ns}$;
With $R_b = 3.3\,\mathrm{k}\Omega$, $T_d = 18.5\,\mathrm{ns}$, $T_r = 29\,\mathrm{ns}$, $T_s = 365\,\mathrm{ns}$, $T_f = 252\,\mathrm{ns}$

Conclusion

As demonstrated above, the simulation have a significantly shorter turn-on time and turn-off time than actual circuit, which is likely a result of a considerably sharp rising and falling edge and the use of an ideal BJT in simulation.