HACETTEPE UNIVERSITY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
ELE-314 ELECTRONICS LABORATORY III

EXPERIMENT 2
SWEEP GENERATOR

1. PURPOSE:

To investigate the sweep generator implemented with BJT

2. THEORY :

The function of the sweep generator is to produce a voltage waveform changing linearly with time. They are widely used in Cathode Ray Oscilloscopes, radars and television circuits. An ideal sweep generator has a sawtooth shape output as shown in figure 1. However, we will observe not exactly the same waveform but close one in the experiment.

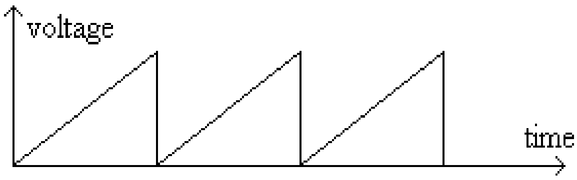
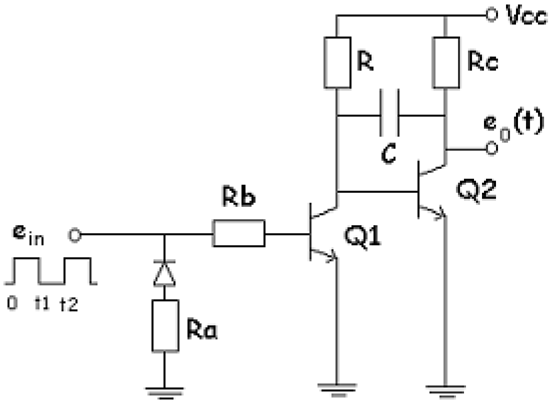


Figure 1. A typical sawtooth waveform.

In CRT's, the linearly changing voltage waveform makes the spot of the oscilloscope sweep from the beginning to the end of the fluorescent screen with a constant speed. The period of time taken to cause the spot to deflect across the face of the fluorescent screen is known as the sweep time. When the spot reaches the right hand side of the tube, it must immediately return to the left hand side and start tracing again. Initially the time base voltage is zero; at this time the spot is close to the left hand edge of the CRT face.

A Miller sweep circuit is shown in figure 2. The transistor Q1 performs the function of a switch which opens and closes at predetermined intervals (See figure 3). When this switch is ON, Q1 is in SAT and Q2 is in cut-off and the voltage over the capacitor C is charged to V_{CC} through R_C . Here the time constant $\tau_R = R_C C$. When the switch is opened Q1 is in CUT-OFF and Q2 is ACTIVE and the time constant of the circuit is $\tau_S = R_{TH}C$. R_{TH} is the Thevenin equivalent resistance between the terminals a and b.

$$R_{TH} = (1+\beta)R_c$$
$$\tau_s = (1+\beta)R_c C$$



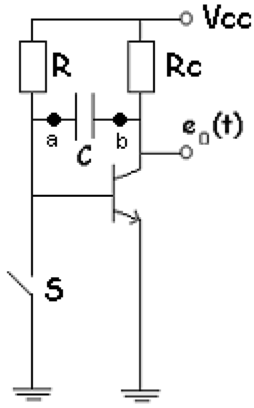


Figure 2. **Figure 3.**

The voltage $e_0(t)$ produced by the circuit in figure 2 is shown in figure 4.

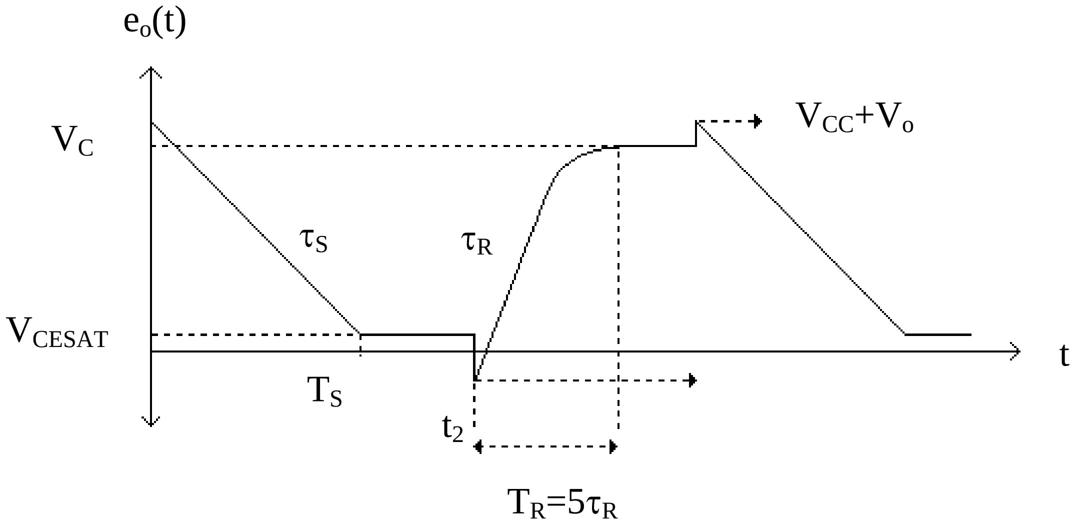


Figure 4.

T_S is called as the sweep time, T_R is called as the recovery time and $T_R = 5\tau_R$. T_R can be reduced by decreasing the value of R_C, but this degrades the linearity of the sweep. To improve the recovery time the circuit in figure 5 can be used. Here Q3 is used as an emitter follower. The resistance seen by the capacitor C is decreased by a multiple of $(1 + \beta)$. While S is closed , Q1 is in SAT and Q2 is in CUT-OFF and C is charged by the time constant

$$\tau_R = \frac{R_c C}{1+\beta}$$

When S is open Q1 is in CUT-OFF and the diode is ON and there is no change in τ_S and T_S.

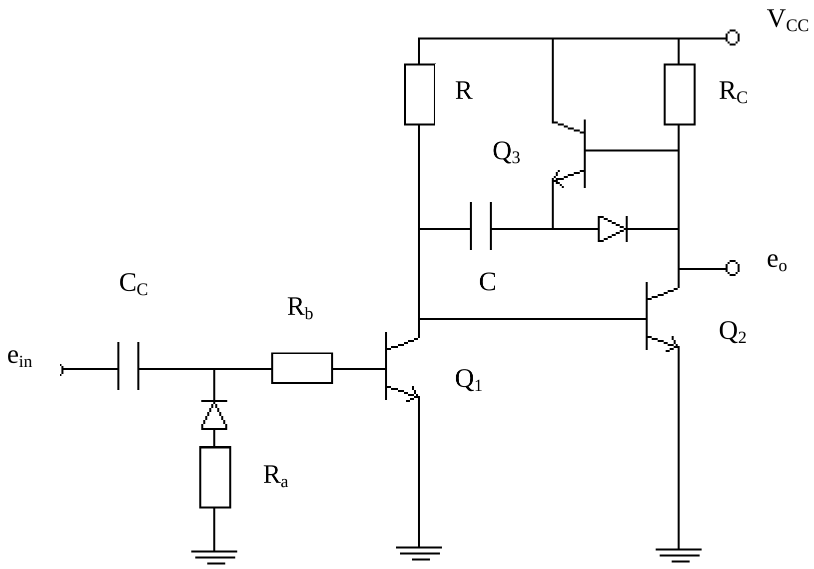


Figure 5.

3. PRELIMINARY WORK:

3.1. It is given that $R=R_C$ =10KΩ, R_b =22KΩ, R_a=1KΩ, C_C=0.1μF, C=0.01μF and V_{CC} = 12V. Plot $e_o(t)$ in Figure 3. when the switch S opens and closes at a rate of 500 Hz. (i.e. it is open for 1 msec. and closed for 1 msec. Assume input signal is a square wave input, f= 500 Hz and Vpp=4V).

3.2. Determine the effect of ON-OFF rate of S over e (t). (Specify your answers for the rates 1 KHz, 2 KHz, and 10 KHz). Does the circuit recover to the desired state?

3.3. Explain why the linearity is degraded when R_C is decreased.

3.4. Plot $e_o(t)$ in figure 5, if the switch is operating at a rate of 500Hz. (Assume input signal is a square wave input, f= 500 Hz and Vpp=4V)

3.5. Do Pspice simulations of figure 3 and 4, by using given components in step 3.1 and 3.4

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