Waveform Generators

I. Aim

Study of square and traingular wave generator using a Schmitt trigger and integrator.

II. Theory

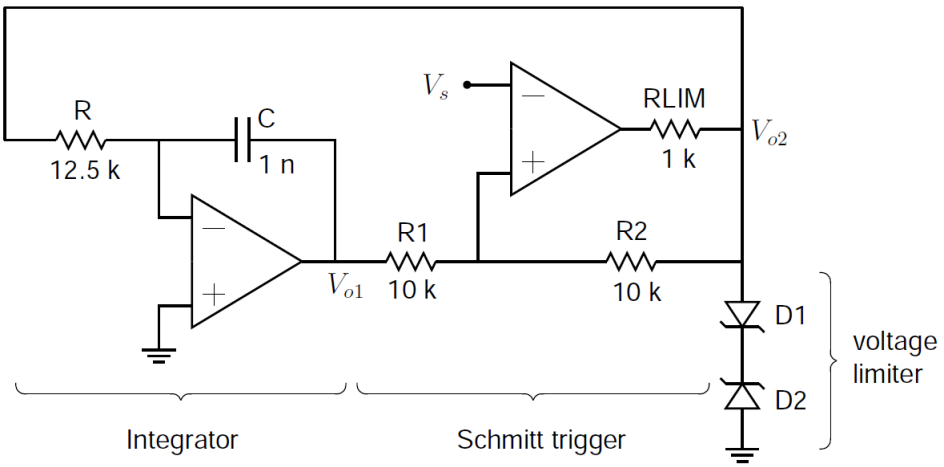

Figure 1

The Schmitt trigger output is either at positive or negative saturation $\pm V_{sat}$ due to the presence of positive feedback. For this circuit, the output saturation values will be based on the voltage limiting zener diodes which will limit the voltage to $\pm V_{LIM}$. Here, V_{LIM}=$\pm(V_D + V_Z)$ where V_D is the diode forward biased voltage and V_Z is the zener breakdown voltage. Integration of a constant value results in a ramp. Thus, the output of the integrator will be a positive or negative going ramp for a square wave input.

Using superposition theorem, the voltage at the non-inverting terminal, V_{NI2}, of the Schmitt trigger is given by

$$V_{NI2} = V_{o1}\frac{R_2}{R_1 + R_2} + V_{o2}\frac{R_1}{R_1 + R_2} \tag{1}$$

Since R_1=R_2

$$V_{NI2} = 0.5(V_{o1} + V_{o2}) \tag{2}$$

Assuming V_s=0V and that the output of the Schmitt trigger is at its positive limit $+V_{LIM}$ when the circuit is initially switched on. The contribution of the Schmitt trigger output to V_{NI2} will be $0.5V_{LIM}$. The output of the integrator is a negative going ramp for the positive dc input $+V_{LIM}$. The output of the Schmitt trigger will remain at $+V_{LIM}$ till the output of the integrator does not become more negative than $-V_{LIM}$. Once this happens, V_{NI2} will become negative. The Schmitt trigger output will then switch to its negative limit $-V_{LIM}$. The contribution of the Schmitt trigger to V_{NI2} now becomes –$0.5V_{LIM}$. Also, the output of the integrator will switch to a positive going ramp. This would continue till the output of the integrator become more positve than $0.5V_{LIM}$. At this point, the output will switch back to $+V_{LIM}$ and the cycle continues.

The output of the integrator will be a triangular wave while the output of the Schmitt trigger is a square wave, both limited in amplitude between $\pm V_{LIM}$ and having a duty cycle of 50%. V_s can be used to change the duty cycle of the output waveform.