Project 3: Schmitt Trigger

The purpose of this project was to design a Schmitt Trigger using an LM741 Op-Amp to produce a unique voltage hysteresis.

In order to determine the upper and lower limits of the zero crossing detection circuit was used (Figure 1), and the upper and lower limit of the Schmitt Trigger was set at $V_L = -10.9$ (Figure 2).

Figure 1: Circuit used for zero crossing detection test

Figure 2: $V_h$ and $V_L$ from zero crossing test
Next, the parameters for the circuit (Figure 3) were calculated using the assigned parameters (See Calculations page). The circuit was then built and tested. The measured $V_{th}$ and $V_{tl}$ were -1.511 V and 4.5337V respectively, which were fairly close to the calculated values. $V_{ref}$ had to be lowered to 1.8V in order to get this hysteresis, which was a drop of 0.7V. This hysteresis can be seen in figure 4.

Figure 4: voltage hysteresis of operating Schmitt Trigger

The circuit (Figures 5 and 6) was simulated in SPICE, however, SPICE were unable to simulate the circuit correctly, so using Microsoft Excel, the circuit was shown to produce the expected results. The curve in figure 6 was simulated.
Figure 5: Circuit used to simulate Hysteresis

Figure 6: Simulated Hysteresis loop

Conclusion:

After doing this experiment, a Schmitt Trigger was correctly designed based on the given parameters. A zero crossing test was used to determine Vh and VI, and these parameters were then used to design the circuit. When tested, this circuit worked as expected. The trickiest part of this experiment was the simulation. The software has some issues simulating the Hysteresis loop with the correct voltage parameters. The Schmitt trigger is a way to control the output voltage in a range by adjusting the input voltage. This project was a good example of a situation where the simulation does not at all reflect what happens to the actual circuit.
\[ V_{TH} = V_s \]
\[ V_{TL} = V \]