

Class Report 1: 4.8.3 Rotating Square Circuit

Samuel Hussey

1 Introduction

In this project, the 7-segment LED display was utilized to create a square pattern that rotates around the display using the 4 top and bottom segments. The pattern can circulate both clockwise and counter-clockwise or be paused in place by toggling the onboard switches. Source files can be found [here](#) and a video demonstration [here](#).

2 Implementation

The implementation of the circuit began with the design of a counter module capable of counting up and down in addition to being halted by an enable signal. This was critical to the design of the circuit as these mechanisms were used to change the direction of the rotating pattern and pause the circulation. The 3 MSBs of the counter output were fed into the display multiplexer which in turn controlled the 7-segment led enable signals (an). The led enable signals determine which led display was active at a given instant. The same counter output was also used in the top-level rotating square circuit as a select signal to assign the proper pattern to the active display's segments. Once the pattern has traversed the entire row of either the top or bottom of the display, the following counter value will signal the top/bottom pattern to change to the other and the display multiplexer will enable the led's in the opposite direction, resulting the circulating motion. SW[0] must be turned on to enable the circuit while SW[1] controls the direction of circulation. The CPU RESET button will reset the pattern to its original position. The design sketch illustrating the components of this circuit is shown in figure 1.

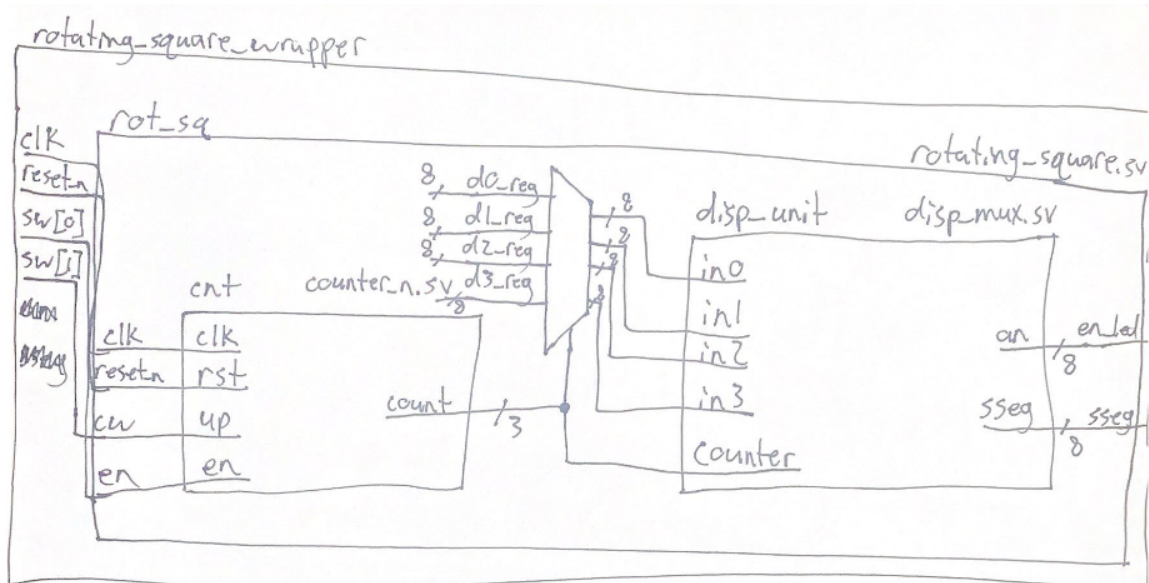


Figure 1: Design sketch of rotating square circuit.

3 Results

The simulated timing diagram is shown in figure 2. This figure demonstrates the led enable signal (en_led) moving the active-low select bit up and down while the sseg output pattern displayed at the bottom alternates between the top and bottom square pattern periodically. At approximately $5\mu s$, the cw signal is toggled to change the direction of circulation. It can be seen that the sseg output corresponding to the down motion of the led select bit is now aligned with the up motion. Near $9\mu s$, the enable is toggled to demonstrate the halting of the circuit's pattern.

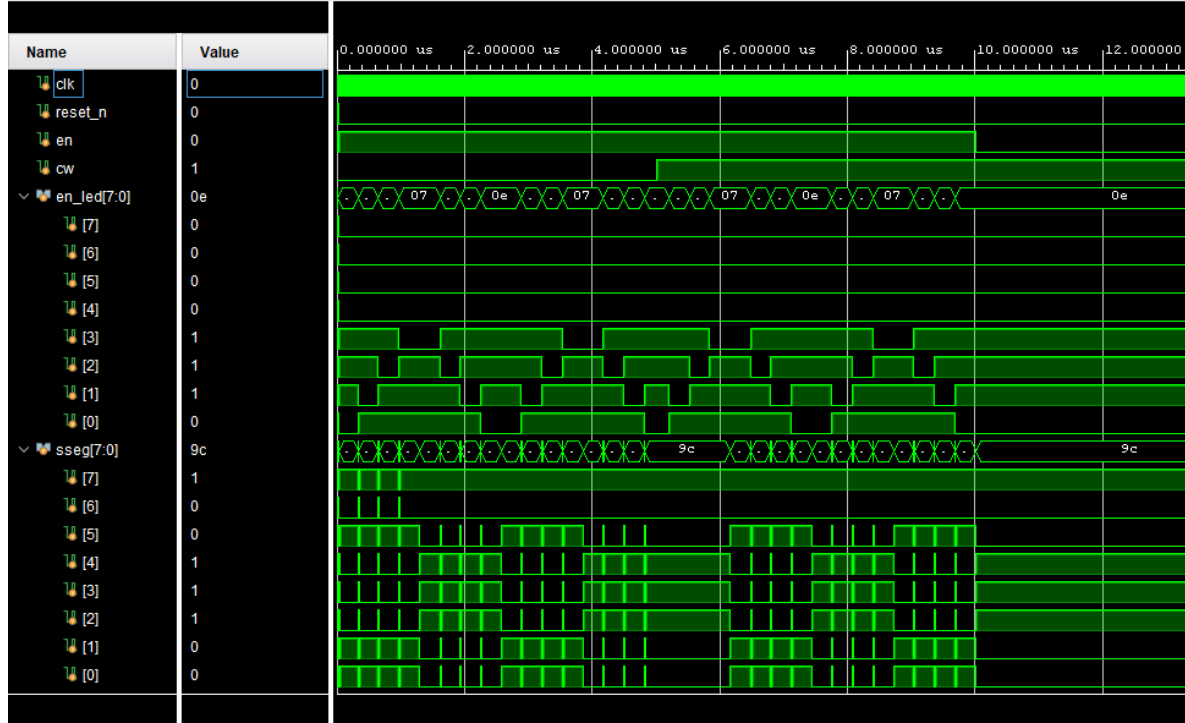


Figure 2: Timing diagram of testbench.

4 Discussion

The counter design enabled the circuit to be paused and change direction. Coordinating the top/bottom square pattern with the activated display was a matter of using a common count as select for the two respective case statements. Although a single counter was used, the timing diagram from simulation displayed brief instances of “XX” states in the sseg output while the en_led signal did not. Further analysis is needed to understand this issue. Otherwise, the circuit works as designed.