

4-bit Synchronous Up/Down Counter

Shubham Garg
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Abstract—4-bit up/down counter is a circuit that can perform both up and down counting. In this project I want to implement 4-bit Synchronous up/down. The circuit will consist of JK Flip flops as the main memory element. The emphasis of the project is to design a mixed signal circuit where the clock signal is a mixed signal.

Keywords—Counter, Synchronous, Flip Flop

1. CIRCUIT DETAILS

4-bit Up/Down Synchronous counter consists of JK Flip flops, AND Gates, OR Gates, inverters and common clock as the main elements. These components work in sync to start the counting. An input option to select the mode is also provided using and gates and inverter to select the mode of operation i.e. either counting up or counting down.

2. IMPLEMENTED CIRCUIT

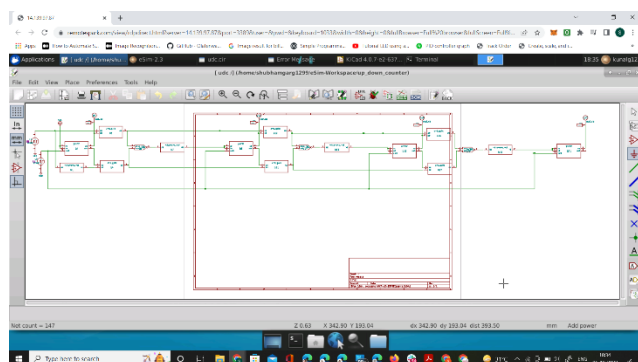


Figure 1: Up/Down Counter Circuit Diagram using esim

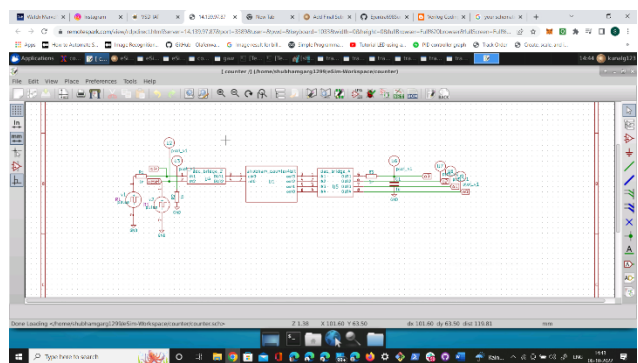


Figure 2: Up/Down Counter Circuit Diagram using esim (Final Schematic)

The figure shows the circuit diagram of the up/down counter designed using esim. The design is synchronized by providing a common clock to all the JK Flip Flops present in the circuit.

When the mode(up/down) is set to 0 the counter behaves as a down counter and will start counting from Q3,Q2,Q1,Q0 and will decrement its value to 0 while counting. When the mode(up/down) is set as 1 the counter will work as an up counter and will start counting from Q3,Q2,Q1,Q0 and will increment its value by 1.

3. REFERENCE CIRCUIT

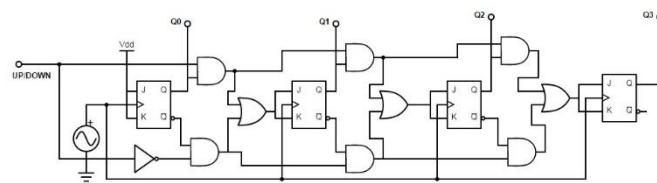


Figure 3: Reference circuit [1]

The circuit shown in Figure 3 is composed of block diagram of the 4-bit synchronous up/down counter. The output of the JK Flip flops are combined using OR Gates, whereas the AND Gates.

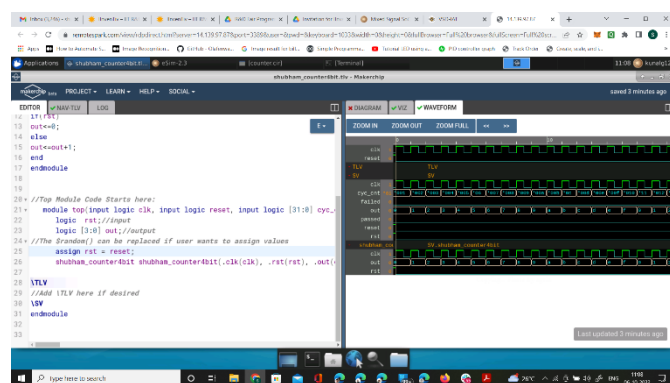


Figure 4: MakerChip Simulation

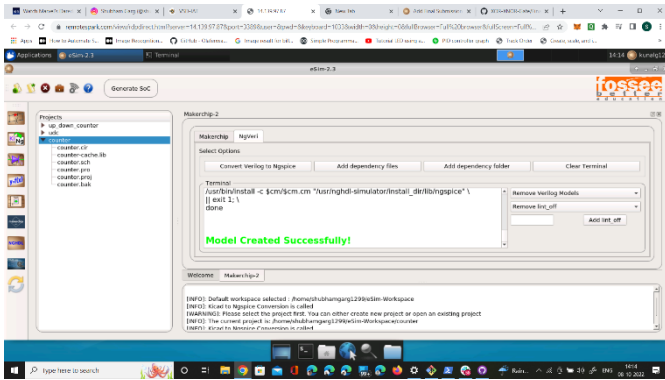


Figure 5: NgVeri Model Creation

4. IMPLEMENTED WAVEFORM

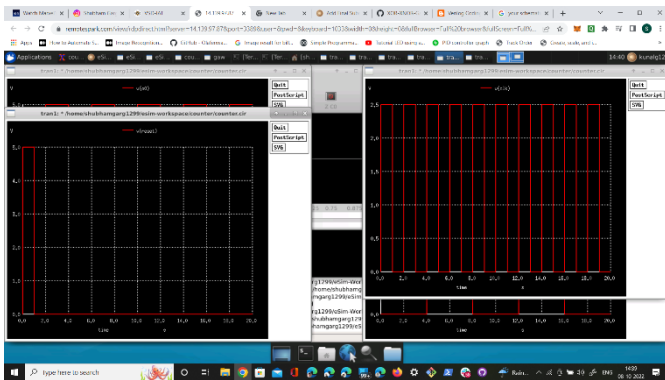


Figure 6: Implemented Waveform

REFERENCES

- [1] <https://www.electronicshub.org/synchronous-counter/>
- [2] https://spoken-tutorial.org/tutorial-search/?search_foss=eSim&search_language=English