

# MOD-10 SYNCHRONOUS COUNTER

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**Abstract**— The MOD-10 synchronous counter has numerous applications such as digital clock, frequency divider, D2A, and so on. MOD-10 counters are also referred to as Decade counters or BCD counters. In this project, I used a JK flipflop as a counter and an astable multivibrator to generate the clock signal.

**Keywords**— MOD-10 Counter, JK flipflop, Astable Multivibrator, CMOS implementation

## I. REFERENCE CIRCUIT DETAILS

The MOD-10 synchronous counter has a count range of 0 to 9. Because the counter is synchronous, the clock signal is sent to all of the flip flops at the same time. The MOD-10 synchronous counter is built with both analogue and digital circuitry. The analogue circuitry consists of the astable multivibrator and the AND gate implemented in CMOS. The astable multivibrator is built by cascading three inverters and using a resistor and capacitor to generate a pulse signal for the clock. The inverters act as a buffer, and the direction of the capacitor's charging and discharging plays an important role in switching the inverters' inputs and outputs. The digital circuitry of MOD - 10 is made up of four JK flipflops with synchronous clear. The truth table is written and reduced using the K-map to obtain the boolean functions for the input and output to the flipflops. Using the Boolean function, the Verilog code for the digital circuit is written. Finally, the analog and digital circuits are integrated to form a mixed signal circuit.

## II. IMPLEMENTED CIRCUIT

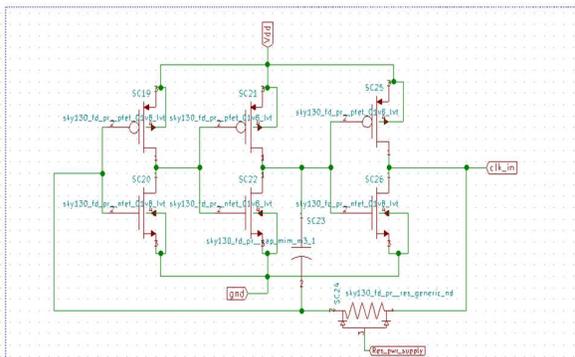


Figure 1: Astable Multivibrator Circuit

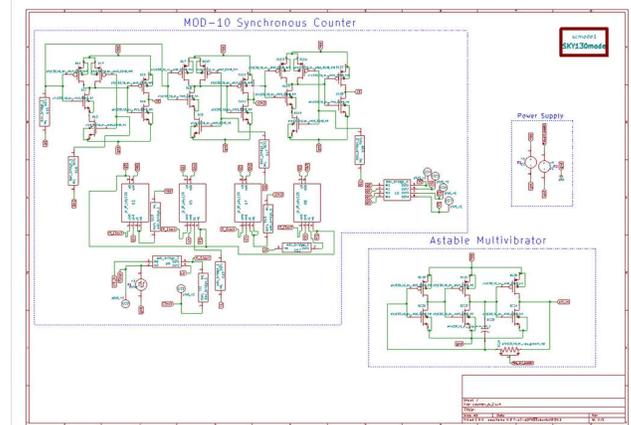


Figure 2: Mixed signal MOD-10 Synchronous counter

## III. IMPLEMENTED WAVEFORMS

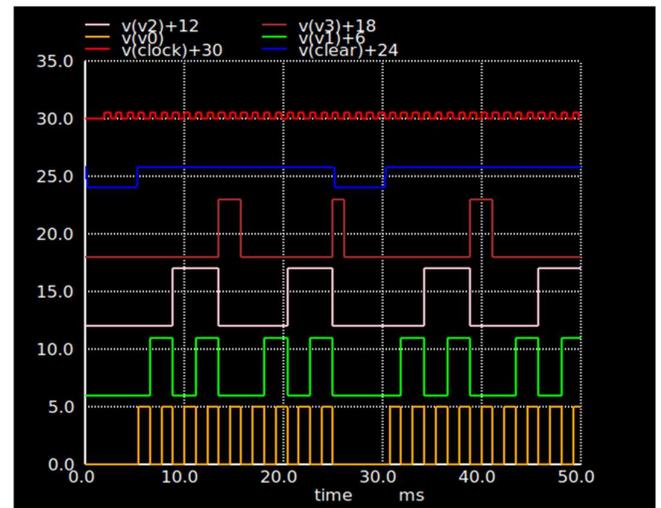


Figure 3: MOD-10 Synchronous Counter Waveform

## IV. REFERENCES

- Morris Mano & Michael D Ciletti, "Digital Design: With an Introduction to Verilog HDL, 5th Edition, Pearson Education, 2013  
Neil H.E. Weste, David Money Harris —CMOS VLSI Design: A Circuits and Systems Perspective.  
<https://skywater-pdk.readthedocs.io/en/main/>  
<https://www.homemade-circuits.com/cmos-astable-bistable-monostable-circuits-explained/>  
[https://www.youtube.com/watch?v=M8EqkE4G9IE&ab\\_channel=SimplyPut](https://www.youtube.com/watch?v=M8EqkE4G9IE&ab_channel=SimplyPut)