

# Design of Master Slave D flipflop with an analog clock circuit

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**Abstract**— This paper presents design of a Master slave D flipflop which works on a level triggered clock. clock circuit is made with OPamp Astable multivibrator. Design is done using esim, Makerchip-Ngveri and sky130 pdk. This design provides stable output irrespective of glitches at input and used as an alternative to negative edge triggered D flipflop

**Keywords**— Master slave, OPamp, Edge triggered

## REFERENCE CIRCUIT DETAILS

Fig.1 Shows the topology of Master Slave D flipflop. We have two D flip flop blocks first one termed as Master and second one as Slave. The clock is connected directly to Master and an inverted clock is connected to Slave. Also output of Master is given as input to the Slave. This is a digital block and is designed using Verilog in Makerchip-Ngveri.

Fig.2 Shows an analog block which is an OPamp Astable multivibrator. It provides clock signal to Master Slave D flipflop. It generates a continuous square wave having fixed time period. By adjusting the R and C values we can vary the clock time period. Time period of clock is expressed as

$$T = 2RC \ln \left( 1 + \frac{2R_1}{R_2} \right)$$

Fig.3 The waveforms of Master slave design is shown. Here QM is the output of Master and QS is the Slave output and also final output. In the positive level of clock Master will be active. Slave will take Qm only in negative level of clock. It takes a full clock cycle to get output from Slave.

During positive level clock, input may change multiple times due to which QM might get some glitches. But these glitches aren't passed to output as Slave is inactive. When Slave is active, QM doesn't change and reaches a stable value and output will be QM.

Here QN is the output of negative edge triggered D flipflop with the same input. From waveform we can observe the output QS and QN are same. From this we can infer that Master Slave D-Flipflop also act as negative edge triggered D flipflop.

## REFERENCES

Behavior of master Slave D Flipflop

<https://www.youtube.com/watch?v=5ykewHgHYBI>

OPAMP Astable multivibrator

<https://www.electronics-tutorials.ws/opamp/op-amp-multivibrator.html>

## CIRCUIT DIAGRAMS AND WAVEFORM

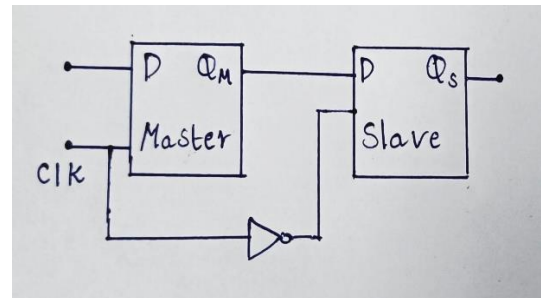


Fig1: Master Slave D Flipflop

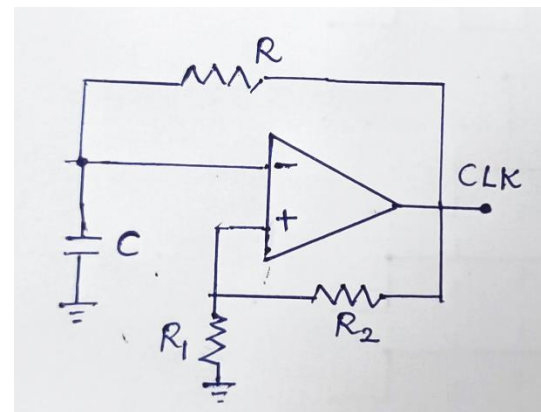


Fig2: OPamp Astable multivibrator

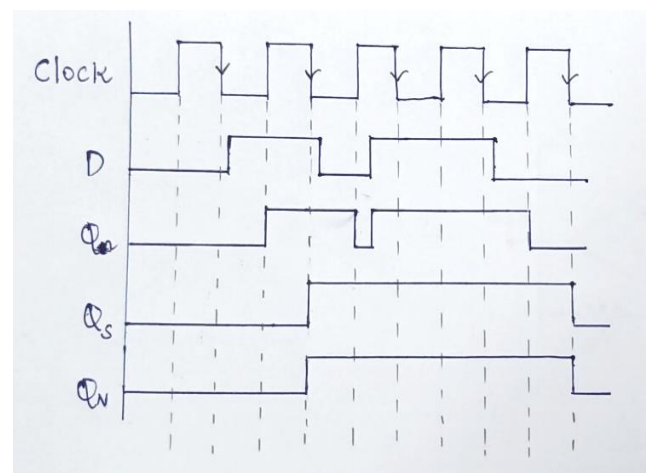


Fig3: Waveforms