Design of D-Flip Flop using MTCMOS Technique

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Abstract

CMOS provide low power dissipation, comparatively high speed, high noise margin. D-flip flop is designed using mtcmos technique in which one transistor being clocked by short pulse train which is true single phase clocking (tspc) flip flop. In this paper D-flip flop implemented with mtcmos method is built using tanner eda software and the output is verified. In tanner, schematic diagram is designed in s-edit, truth table is observed on t-edit, the required waveforms are shown in w-edit, layout is specified in L-edit.

Keywords: TSPC, tanner eda, CMOS, S-edit, T-edit, W-edit, L-edit

I. INTRODUCTION

Flip flop are electronic device which stores state information. It is bistable multivibrator, having two states and a feedback path that allows it to store a bit of information. Flip flops differ from latches, latches are asynchronous, and the outputs can change as soon as the inputs do (or at least after a small propagation delay). While the flip flop is edge-triggered and only changes state when a control signal goes from high to low or low to high. This distinction is comparatively recent and is not formal, with several authorities still referring to flip-flops as latches and vice versa, but it is a useful distinction to make for the sake of clarity[1].

There are several different types of flip-flop each with its own uses and peculiarities. The four major types of flip-flop are: SR, JK, D, and T.

II. D-FLIP FLOP

The D flip-flop tracks the input, it makes transitions with match those of the input D. D represents "data" or "delay"; it stores the value that is on the data line. A D flip-flop can be made from a set/reset flip-flop by tying the set to the reset through an inverter. The result may be clocked.

III. TSPC FLIP FLOPS

For low power consumption and high performance, TSPC flip flop is used. It has only one clock, and do not need an inverted clock. TPSC circuit technique uses only one phase of the clock and avoids skew problems thereby improving the performance of a digital system. It consists of 3 NMOS transistors and 2 PMOS transistors[2].

IV. CMOS

Short for complementary metal oxide semiconductor, it is a kind of semiconductor which is widely used. CMOS composed of NMOS (negative polarity) and PMOS (positive polarity) circuits. CMOS has low power dissipation, comparatively high speed, offers good noise margins in each states and can operate over a wide range of source and input voltages (provided the source voltage is fixed).

V. MTCMOS

- Multi-threshold complementary metal oxide semiconductor
- Low power consumption efficiently reduces leakage power
- Operates in two modes
  - High threshold
  - Low threshold
High threshold means less leakage power
Low threshold means fast switching

VI. SOFTWARE TOOL

Tanner Tools is a software used to design, layout and verification. It includes s-edit where schematic diagram is designed, truth table is observed on t-edit, the required waveforms are shown in w-edit, layout is specified in L-edit.

A. S-Edit:
In S-Edit, schematic style of circuit permits us to visualize common errors like undropped nets, unjoined pins and nets driven by multiple outputs therefore we’ll catch errors early before running simulations.

![TPSC Flip-flop](image1)

**Table -1:**
Truth table of D-Flip-flop

<table>
<thead>
<tr>
<th>CLK</th>
<th>IN</th>
<th>M1</th>
<th>M2</th>
<th>M3</th>
<th>M4</th>
<th>M5</th>
<th>OUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>0</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
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<td>0</td>
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<td>ON</td>
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<td>ON</td>
<td>1</td>
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<tr>
<td>LOW</td>
<td>0</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>0</td>
</tr>
<tr>
<td>LOW</td>
<td>1</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>0</td>
</tr>
</tbody>
</table>

![MTCMOS Flip-flop](image2)
Table-2:
Truth table of MTCMOS-Flip-flop

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<tr>
<th></th>
<th>CLK</th>
<th>IN</th>
<th>SLEEP</th>
<th>M1</th>
<th>M2</th>
<th>M3</th>
<th>M4</th>
<th>M5</th>
<th>M6</th>
<th>M7</th>
<th>OUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
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<td>0</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
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<tr>
<td>High</td>
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<td>1</td>
<td>ON</td>
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<td>High</td>
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<td>OFF</td>
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<td>High</td>
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<td>Low</td>
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<td>ON</td>
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</table>

B. T-Spice:
T-Spice allows us to characterize circuit behavior mistreatment virtual knowledge measurements. For larger potency and productivity, T-Spice controls over our simulation method with Associate in Nursing easy-to-use graphical interface[3].

C. W-Edit:
The W-Edit waveform analysis tool is used for comparing, displaying and analyzing simulation results.

VII. SIMULATION RESULT

A. Waveform:
VIII. CONCLUSION

In this paper the performance and analysis of TSPC flip flop and MTCMOS flip flop is simulated using tanner eda software. In which TPSC flip flop developed using 6 transistors and MTCMOS of 7 transistors. MTCMOS based Flip flop has least power delay product and best performance. Thus the circuit designed using MTCMOS are used for high performance applications like microprocessors, registers, digital vlsi clocking systems, etc.

REFERENCE