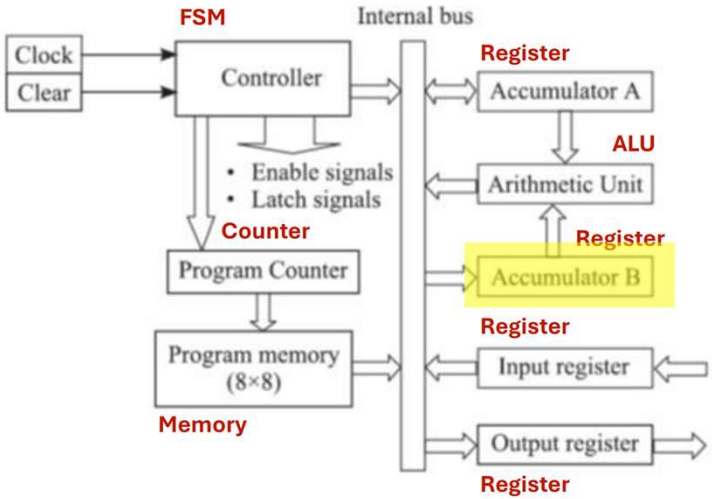
Accumulator B for a Very Simple Microprocessor

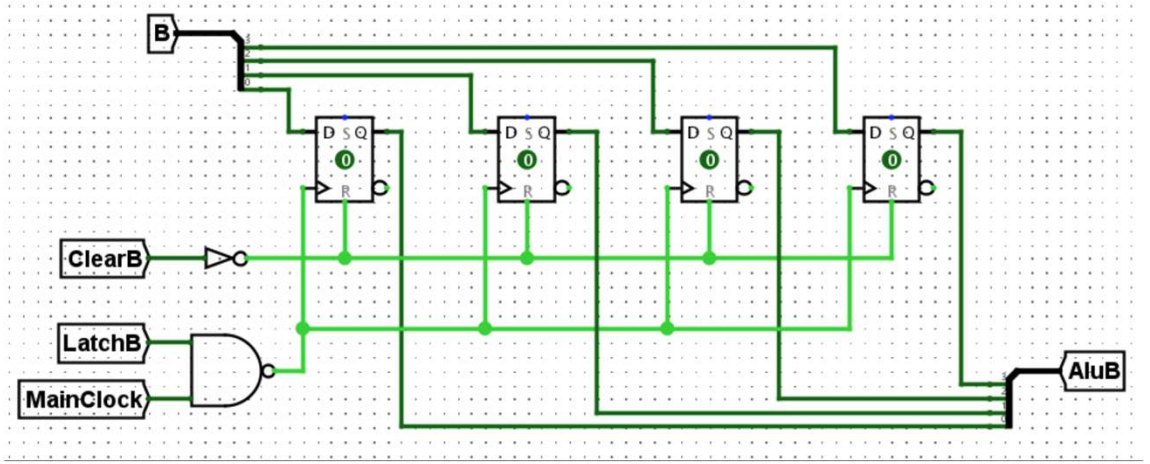
Jeremy Trafas

Accumulator B

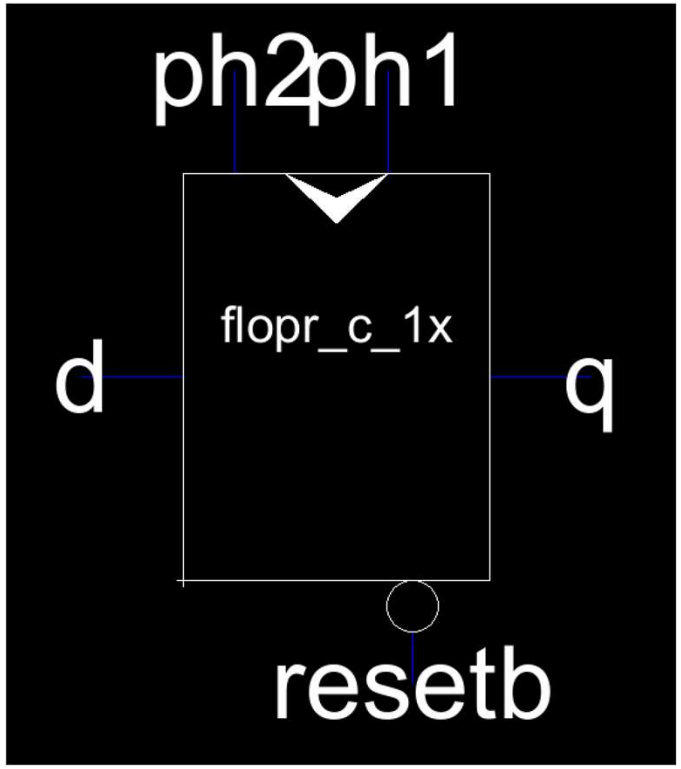
Necessary Components

- D Flip-flops
- NAND
- Inverter





Design Challenge 1: What is ph1 and ph2?



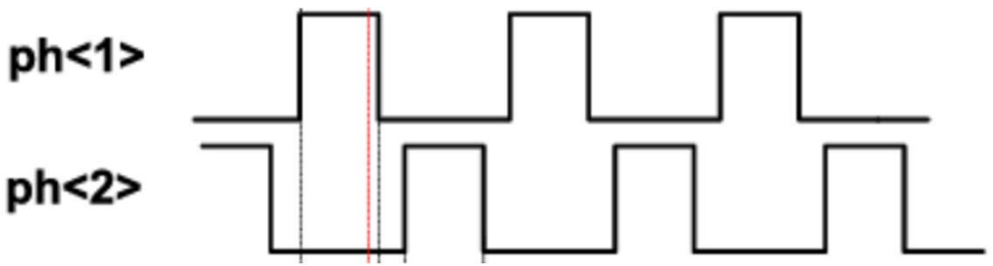
Let’s Ask Gemini

How a Two-Phase Clock Works

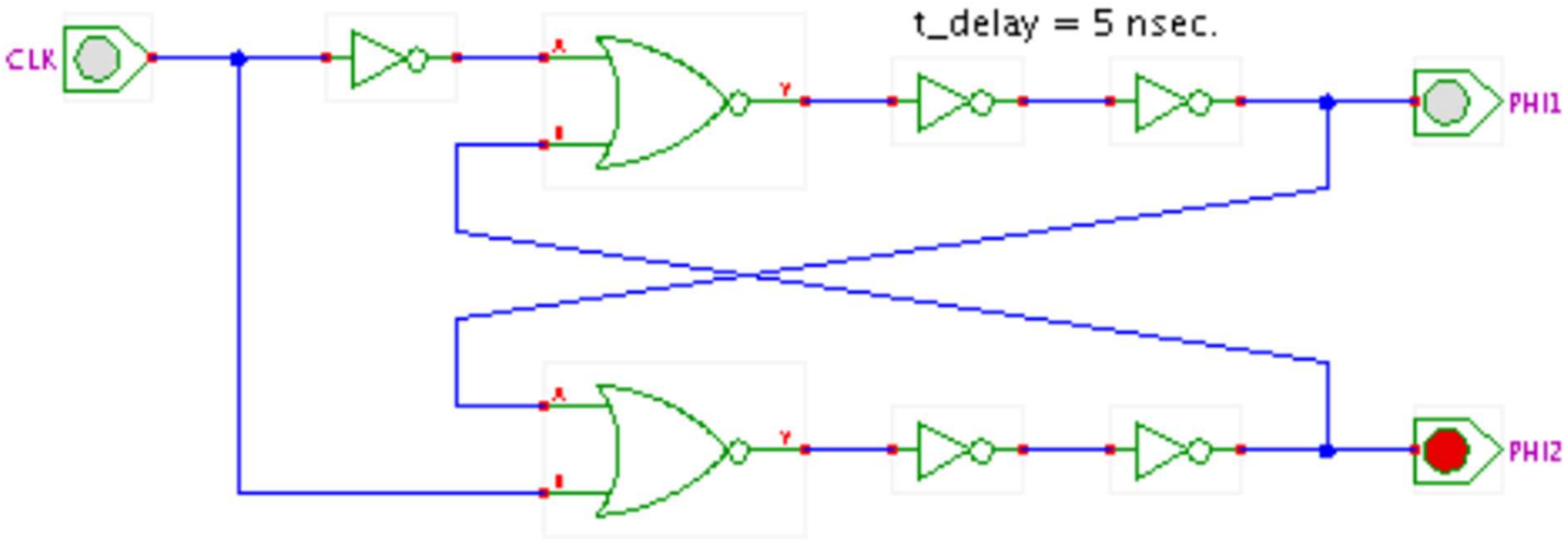
This type of flip-flop is typically a master-slave design:

1. **When** `ph1` **is high:** The "master" latch accepts the value from the `d` input.
2. **When** `ph1` **goes low:** The "master" latch holds the value.
3. **When** `ph2` **is high:** The "slave" latch accepts the value *from the master latch* and outputs it to `q`.
4. **When** `ph2` **goes low:** The "slave" latch holds the value, and the output `q` is stable.

The key is that `ph1` and `ph2` must have a **non-overlap** period (where both are low) to ensure the master latch closes before the slave latch opens.

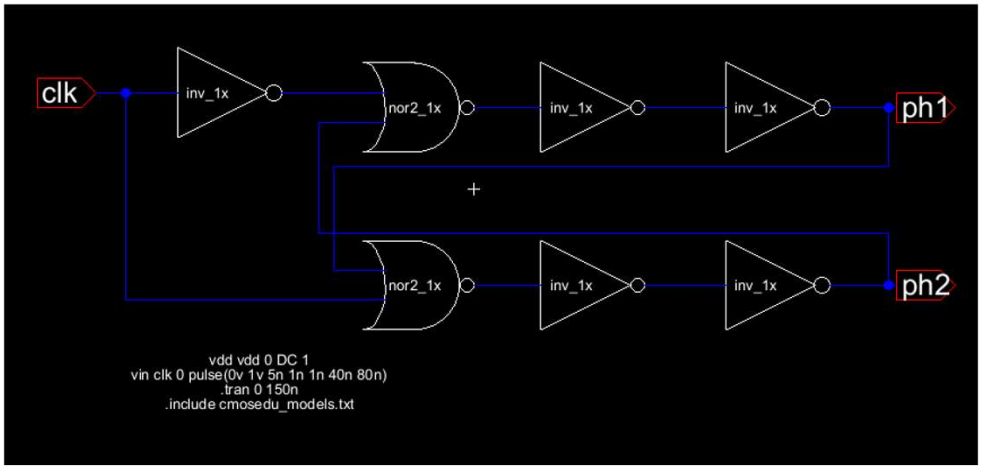


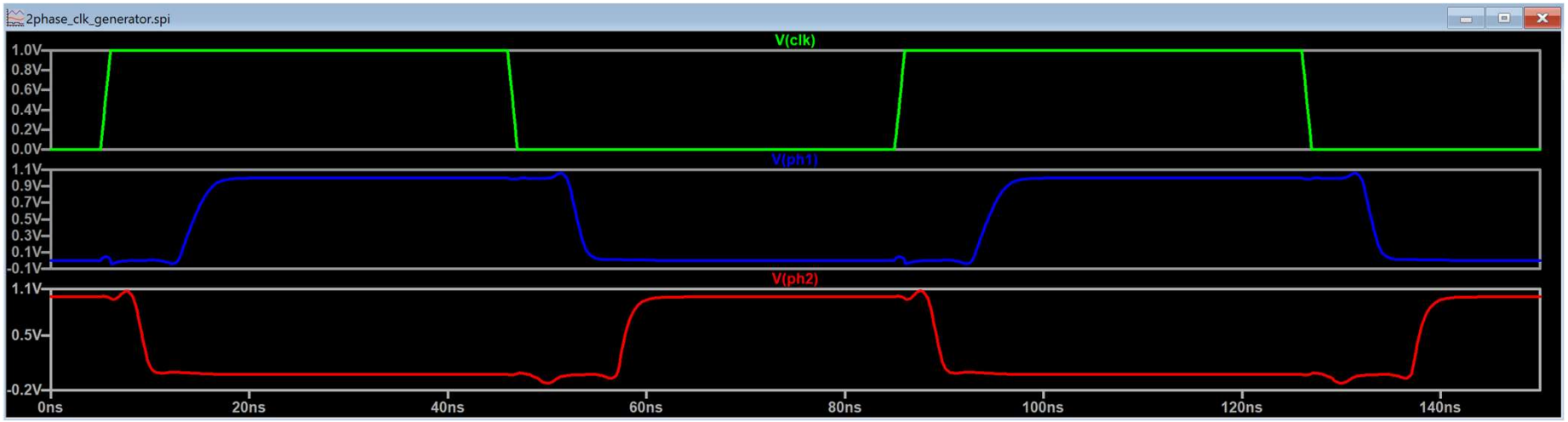
Two-Phase Clock Generator Circuit



Two-phase Clock Generator

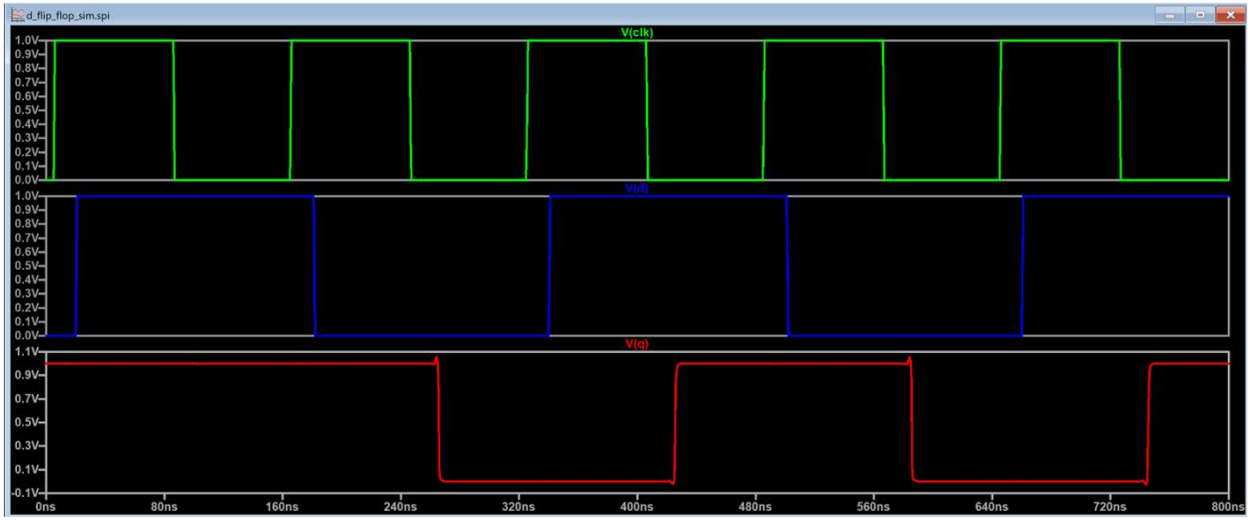
Two-Phase Clock Generator Schematic and Simulation



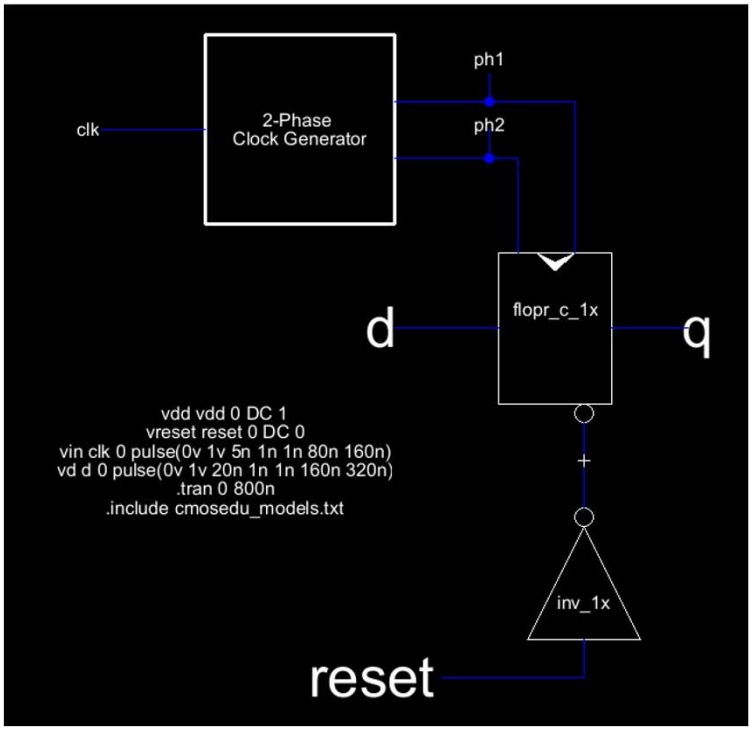


Inverted and non-overlapping!

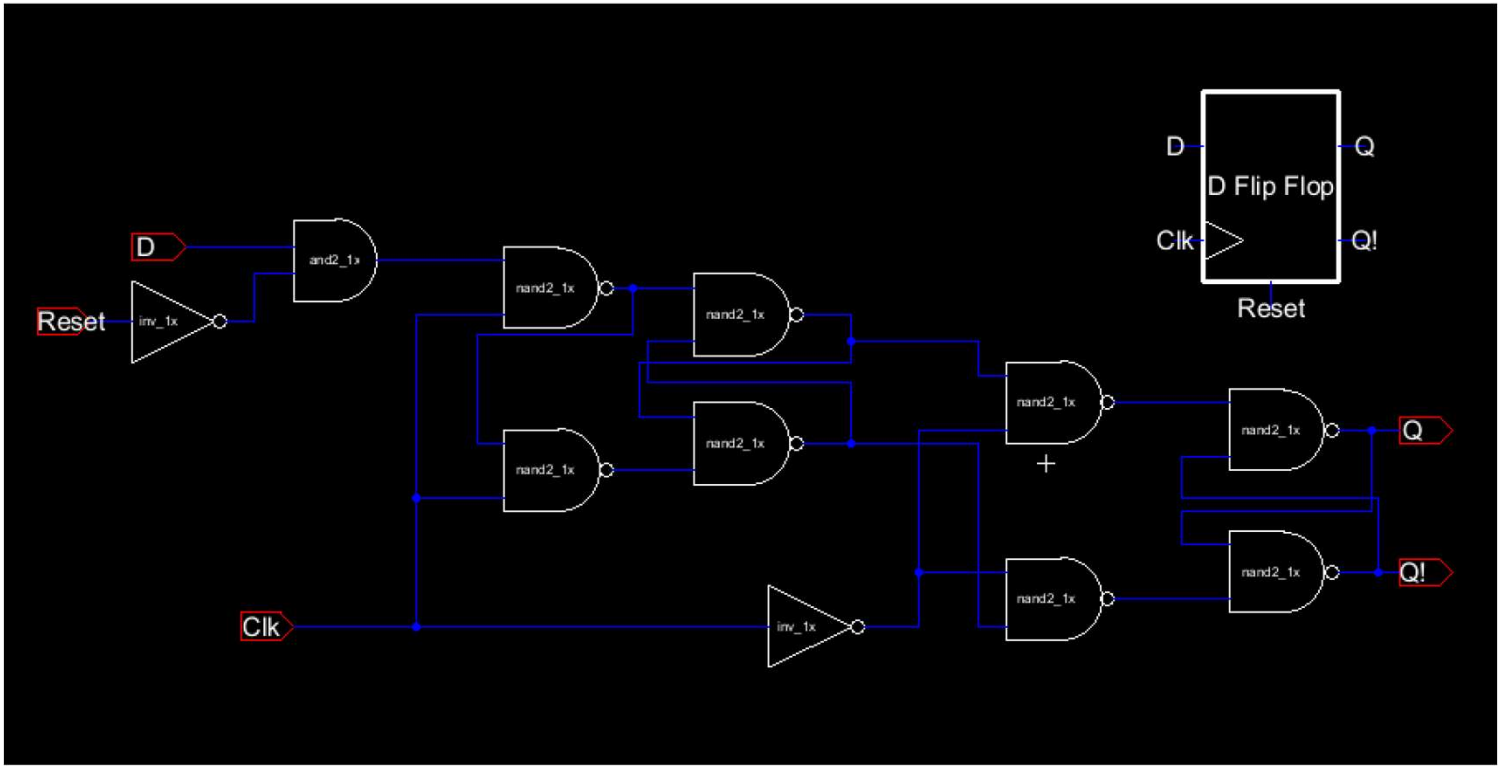
Testing D Flip-flop



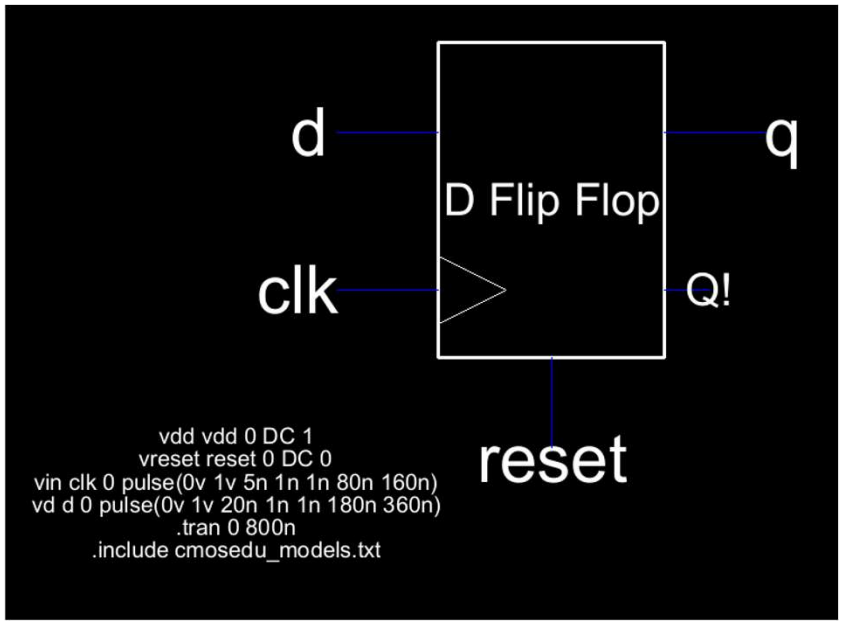
Negative edge, I gave up

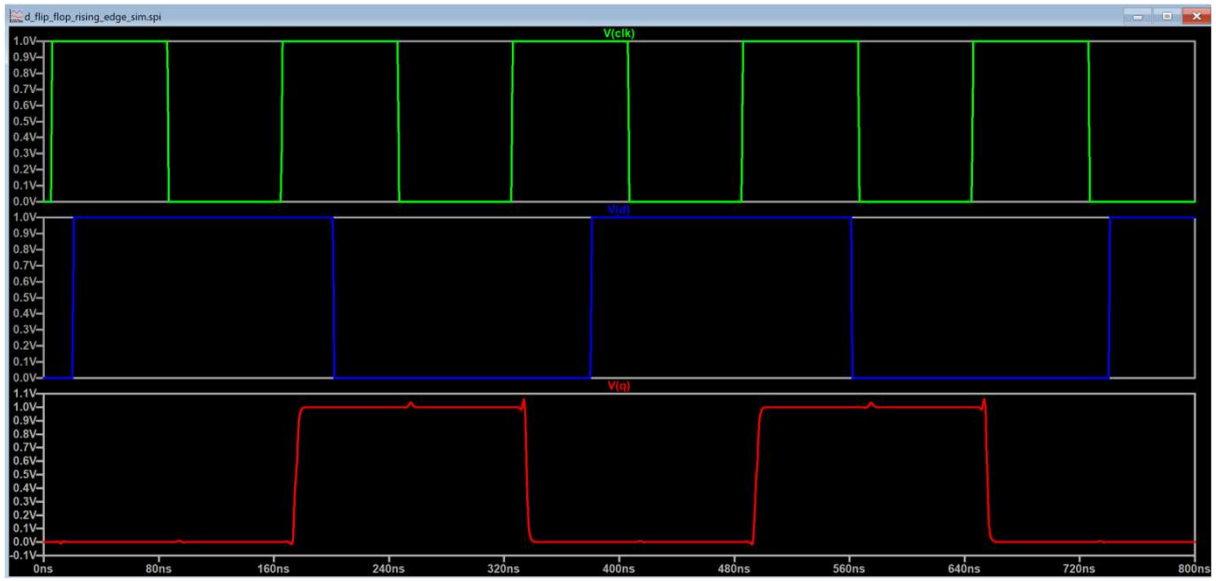


Making my own D Flip-flop

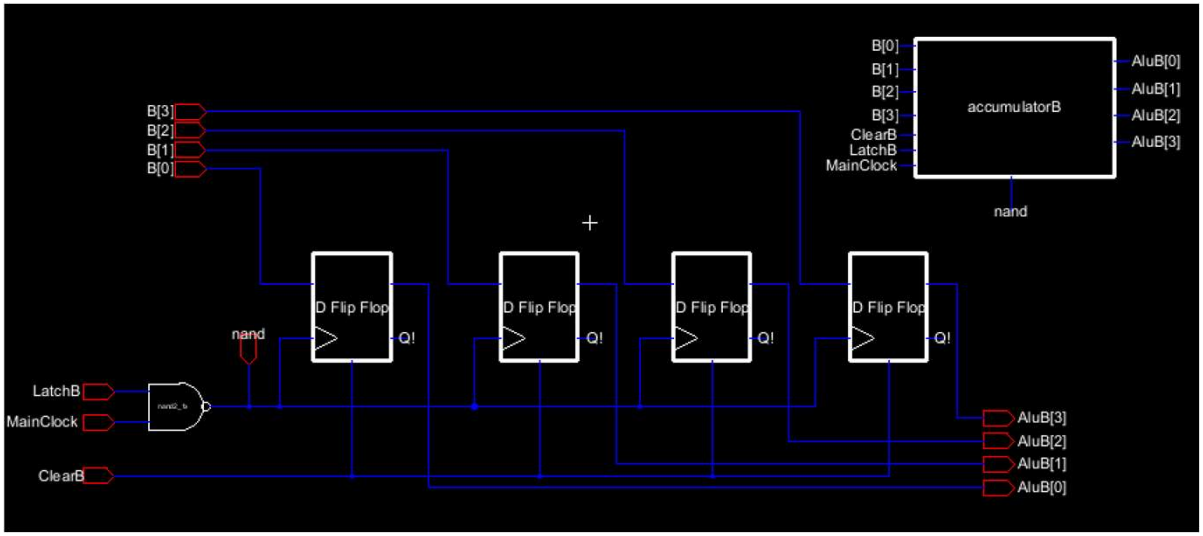


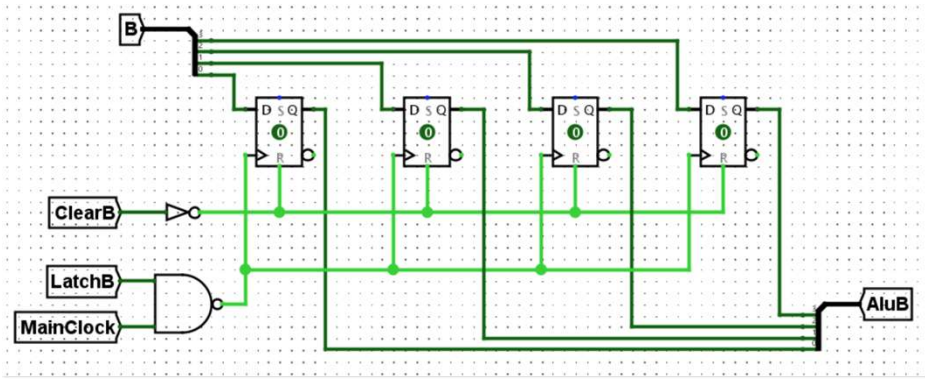
Making my own D Flip-flop



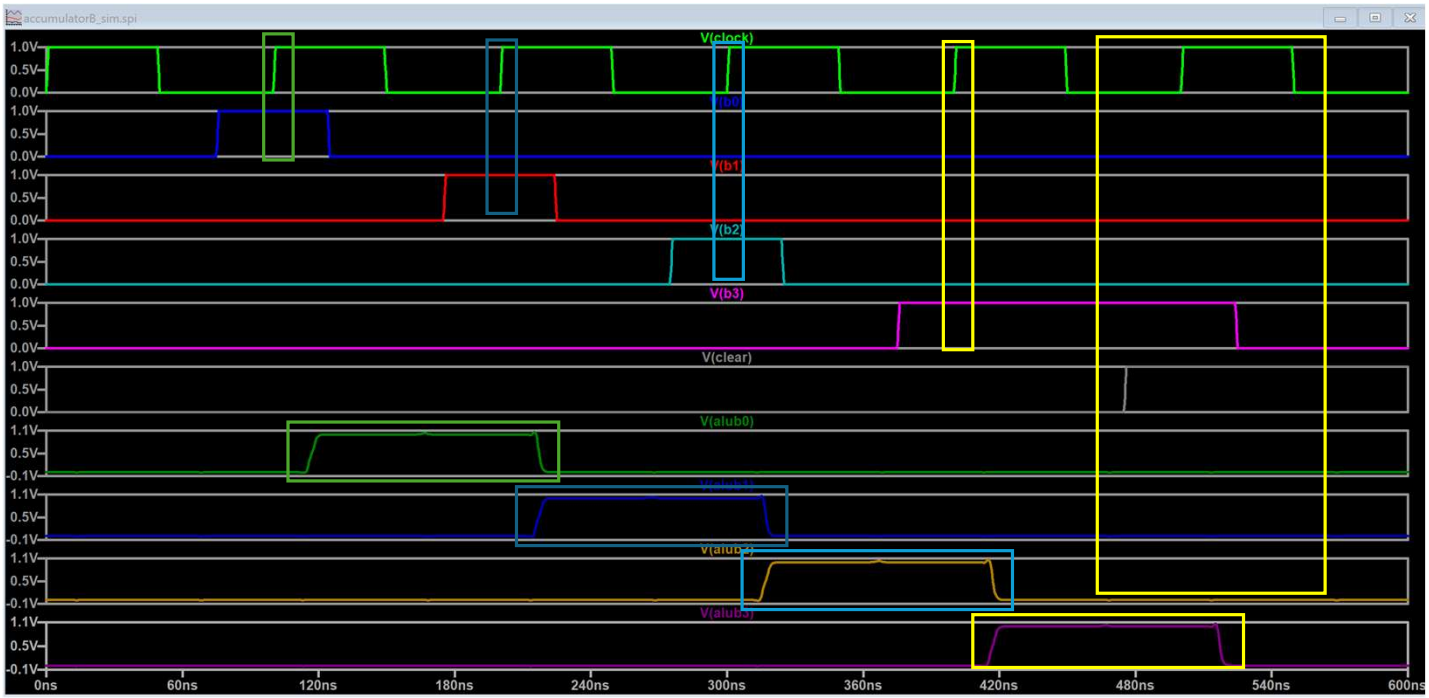


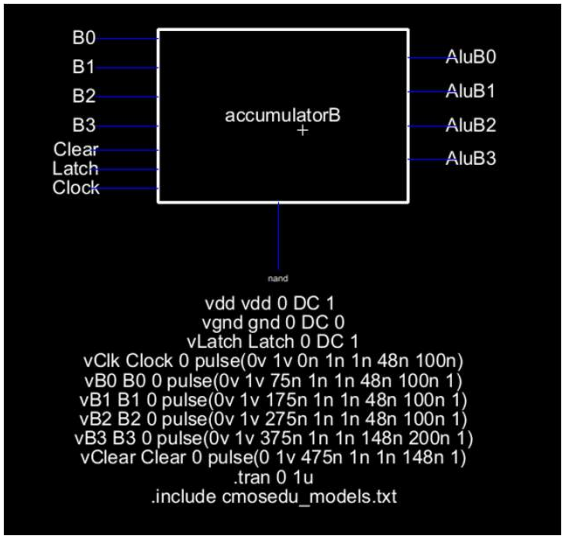
At last! Accumulator B



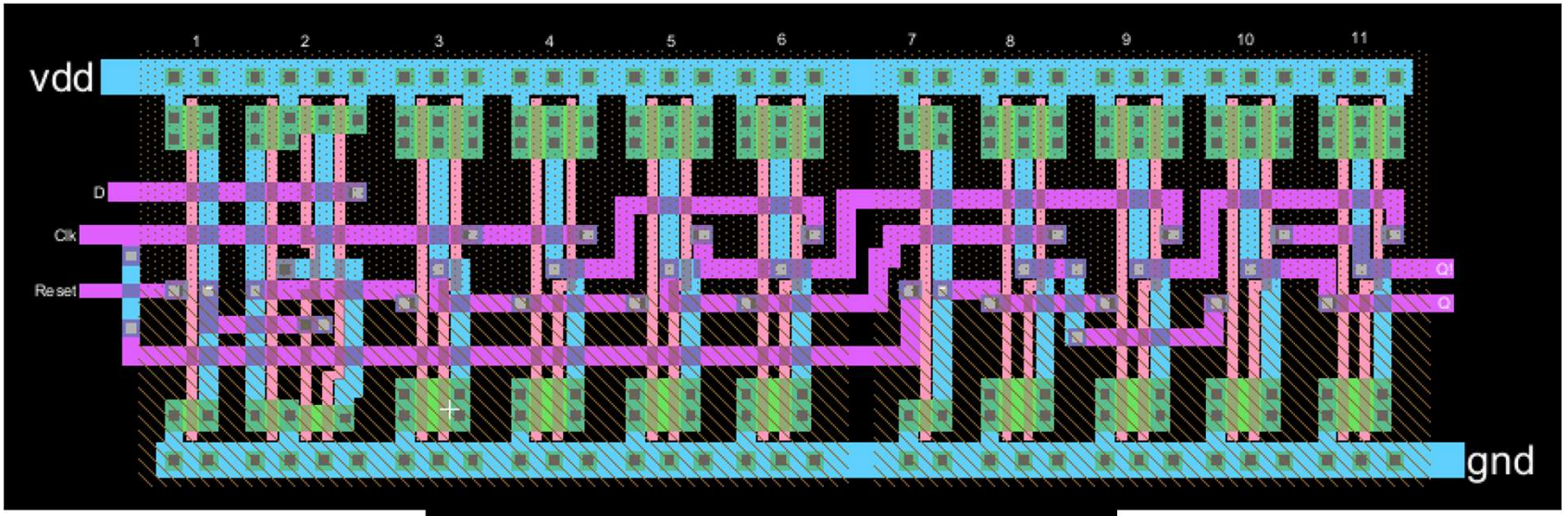


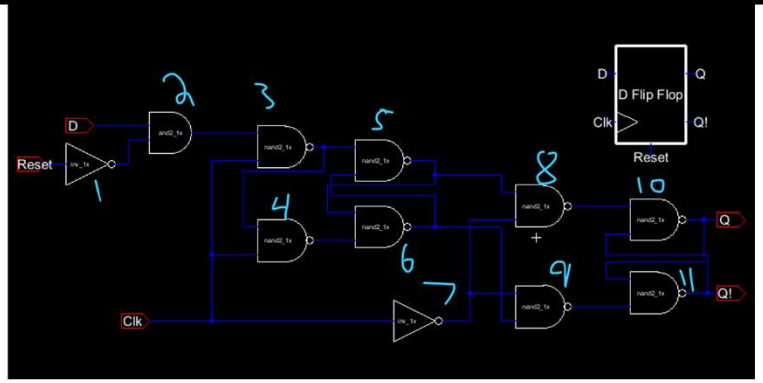
Testing Accumulator B



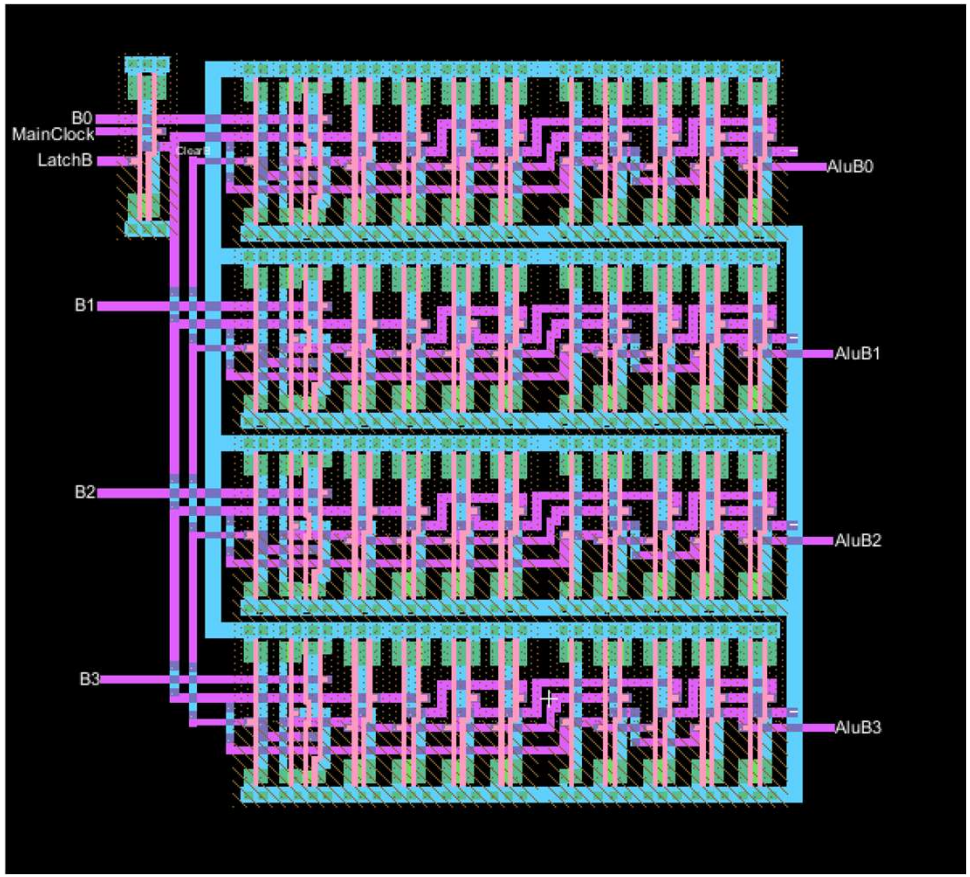


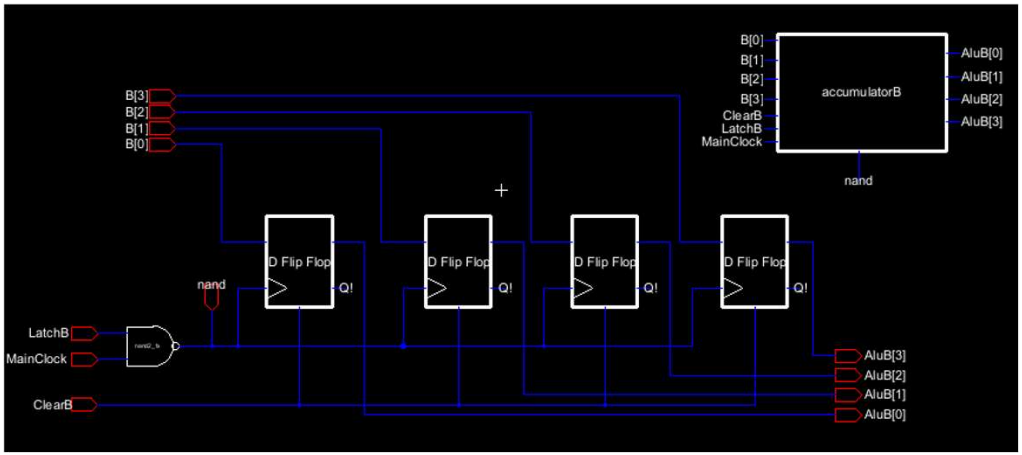
Positive Edge D Flip-flop Layout





Accumulator B Layout





Thank you!