

Draw a stick diagram of the master-slave D-flipflop. Optimize and count the number of:

1. Transistors
2. Diffusion Region
3. Metal Diffusion Contacts

In this problem, we are choosing to assume that the rest of the system provides the negated clock. The transistor schematic of the system is available in figure 1.

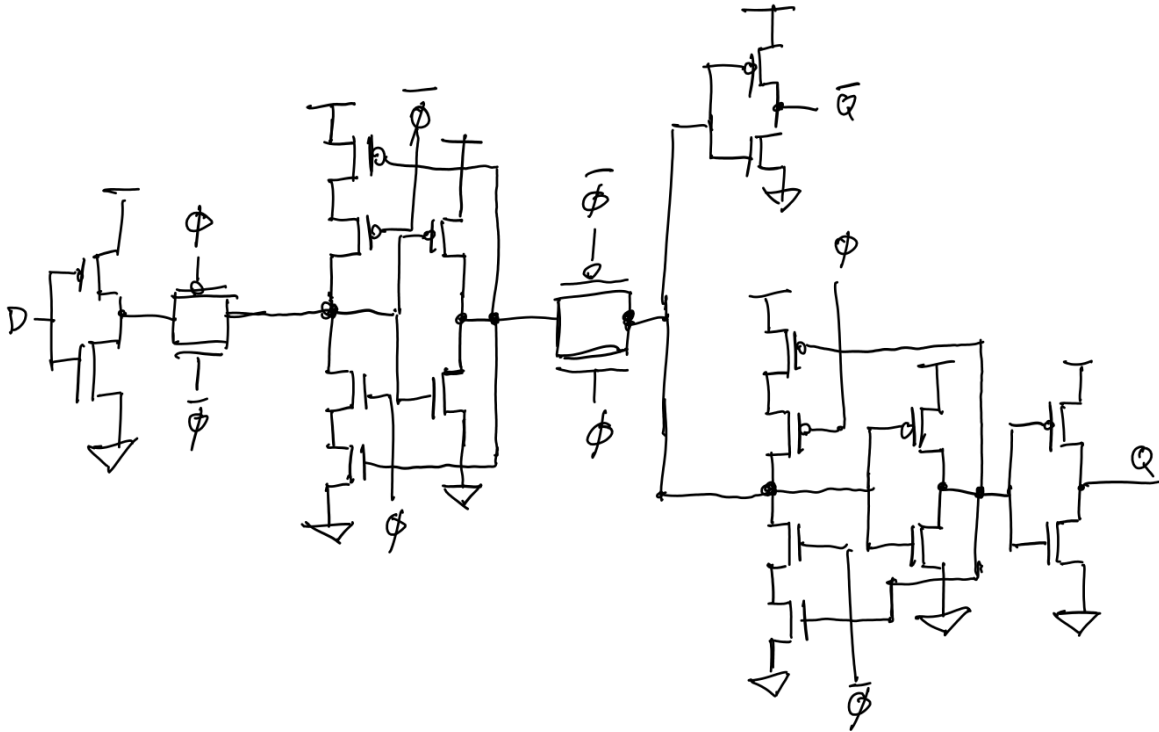


Figure 1: The transistor schematic of the D-flipflop. There are 22 transistors in this schematic.

Converting this schematic into a layout is tricky, as it is a large design. We are going to start by making a set of smaller cells. The final layout for the system is available in figure 6. The total count of the required components are available in table 1.

Table 1: Count of components of the design.

Value	Count
Transistor	22
Diffusion Region	4
Metal Diffusion contacts	22

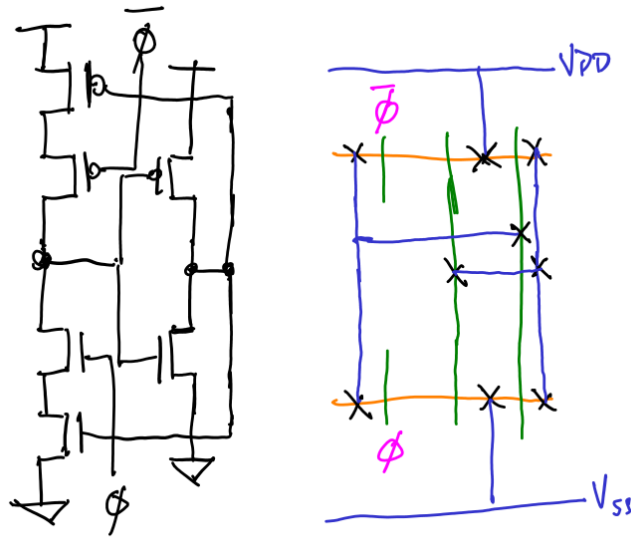


Figure 2: The layout for the feedback loop component of a latch.

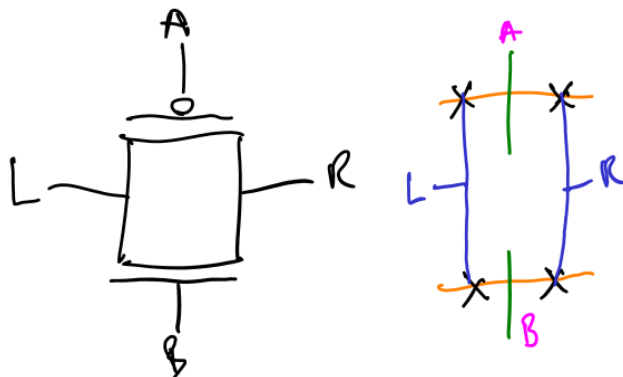


Figure 3: The layout for the transmission gate.

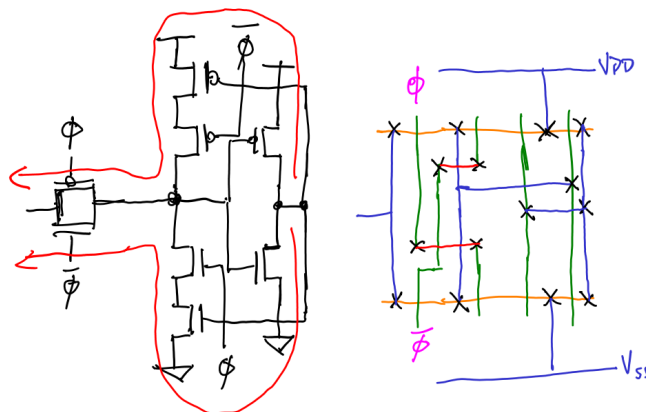


Figure 4: The layout for the latch, which combines the transmission gate with the feedback loop component.

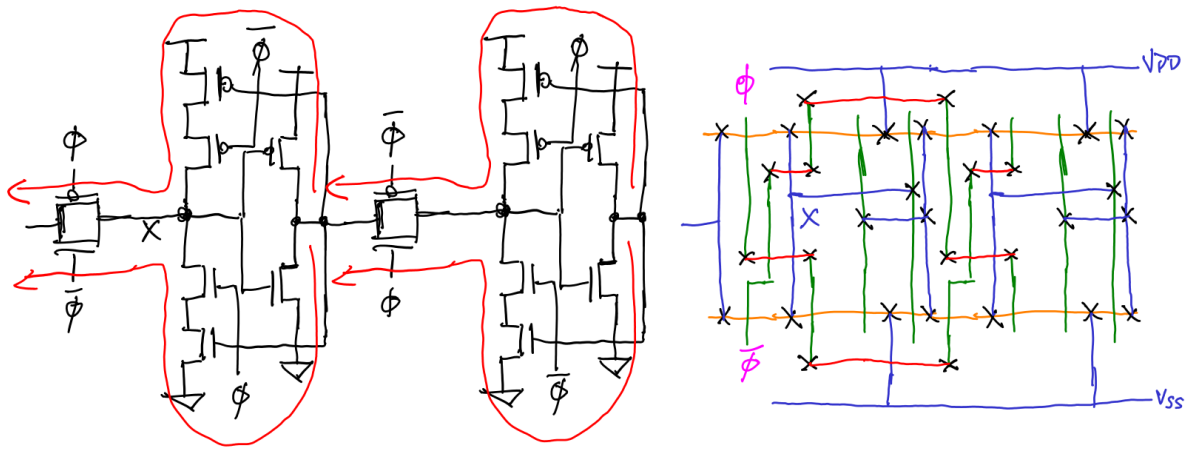


Figure 5: The layout for both the master and slave latch, implemented with a combined diffusion.

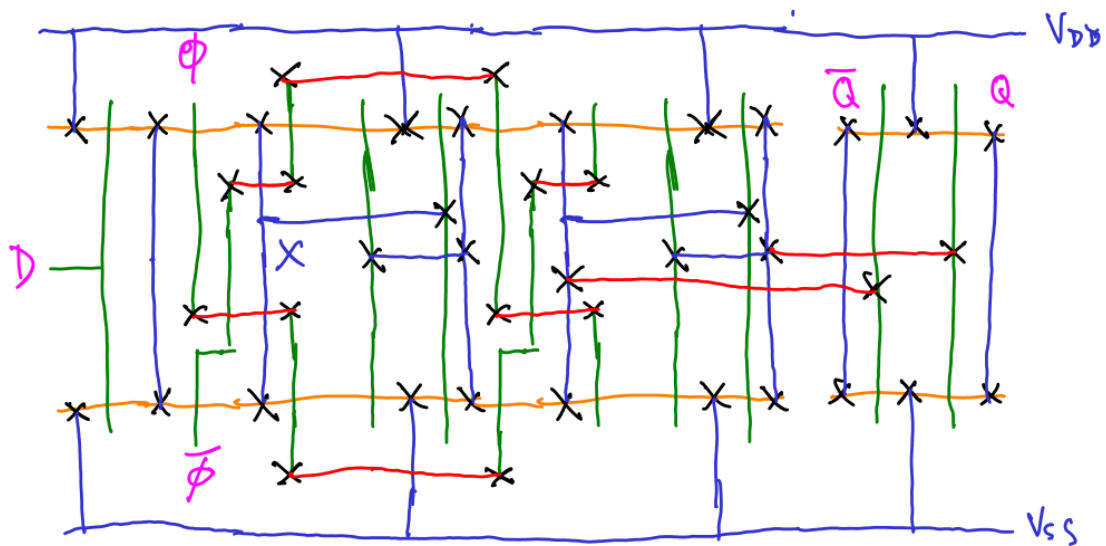


Figure 6: The layout for the full D-flipflop. Implemented with 4 diffusions. All the flipflop interface are labeled in magenta.