

LAB 13: FLIP FLOP

1 Goals

- Understand the working principle of D and J-K type flip flops.
- Know how to build type D and J-K flip flops from basic logic gates.

2 Exercises

A *flip flop* is a sequential logic circuit that remains its output states unchanged indefinitely until something is applied to change these output states. In sequential logic, flip flops are mainly used as the basic data storage element. There are 4 common types of flip flops: **SR** (*set-reset*), **D** (*data*), **T** (*toggle*), and **JK** (*Jack Kilb*).

2.1. D Flip Flop

Figure 1 shows the symbol, truth table, and logic implementation of a D flip flop. When there is a rising edge at the Clock, the output Q is updated to the input D.

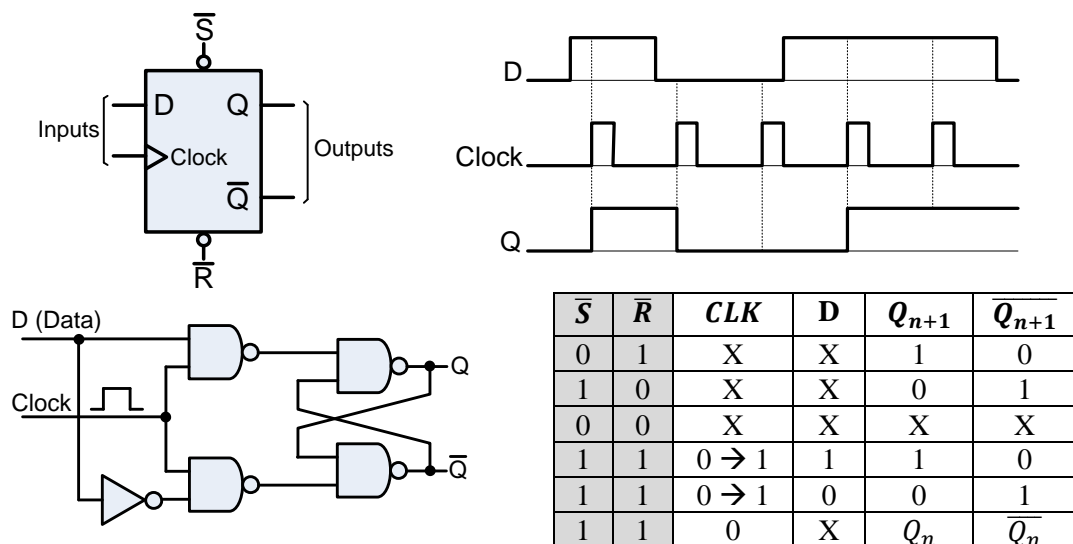


Figure 1. D flip flop

Requirements:

- Test all ICs and equipment.
- Assemble a D flip flop on the breadboard using the given ICs (74HC00-NAND, 74HC04-NOT), resistors, LEDs, and buttons (or switches).
- Supply 5V/GND power to the circuit.
- Define the circuit's activities and verify the truth table of a D flip flop.
- Write comments on the experimental results.

2.2. J-K Flip Flop

Figure 2 shows the symbol, truth table, and logic implementation of a J-K flip flop, with inputs J, K and Clock, outputs Q and Q'.

When there is a rising edge at the Clock:

- If $J = K = 1$, the outputs of the flip flop are preserved, i.e., $Q_{n+1} = Q_n$ and $Q'_{n+1} = Q'_n$.
- If $J = 1$ and $J = 0$, $Q_{n+1} = 1$ and $Q'_{n+1} = 0$.
- If $J = 0$ and $J = 1$, $Q_{n+1} = 0$ and $Q'_{n+1} = 1$.
- If $J = K = 0$, the outputs of the flip flop toggle (i.e., $0 \rightarrow 1$ or $1 \rightarrow 0$).

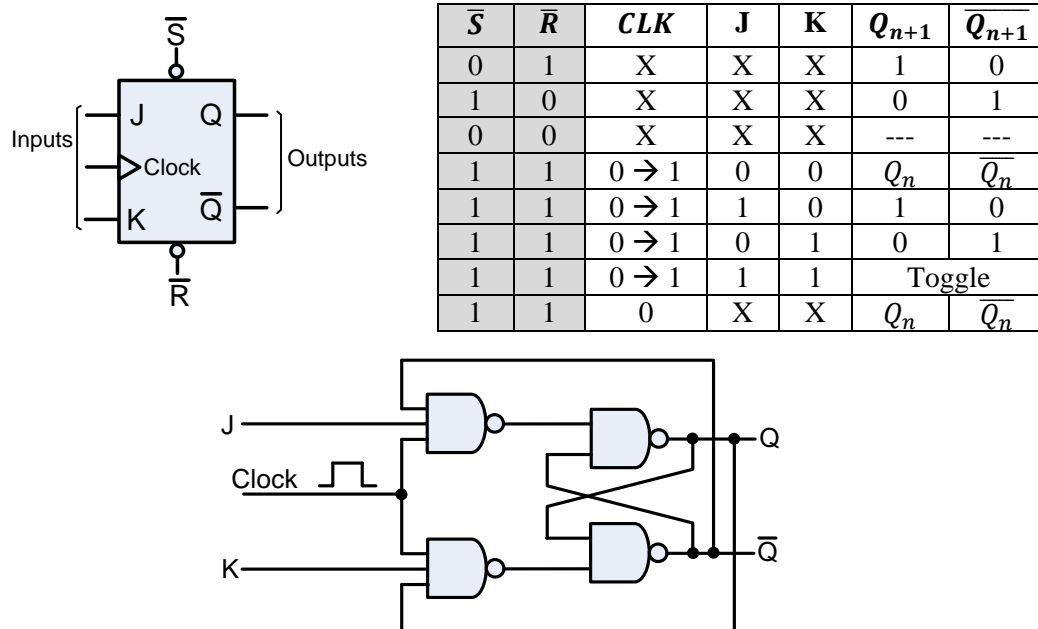


Figure 2. J-K flip flop.

Requirements:

- Test all ICs and equipment.
- Assemble a J-K flip flop on the breadboard using the given ICs, resistors, LEDs, and buttons (or switches).
- Supply 5V/GND power to the circuit.
- Define the circuit's activities and verify the truth table of a J-K flip flop.
- Write comments on the experimental results.

Components/Equipment	Description	Quantity
74LS(HC)08	4× 2-input AND	1
74LS(HC)04	6× NOT	1
74LS(HC)00	4× 2-input NAND	2
Resistor	330Ω	Few
LED	2V-2.5V, 20mA	Few
Buttons (or switches)	3-pin/4-pin	Few
Power Supply	Aditeg PS-3030DD	1
Breadboard		1
Connecting Wires		Few
Multimeter		1