LAB 14: COUNTER

1 Goals

- Understand the working principle of asynchronous and synchronous counters.
- Build a 4-bit up/down counter using D and J-K flip flops.

2 Exercises

2.1. Asynchronous Counter

Use D flip flops to implement a 4-bit *asynchronous up/down counter*. Refer to the counter in Figure 1, which counts from 0000 to 1111.

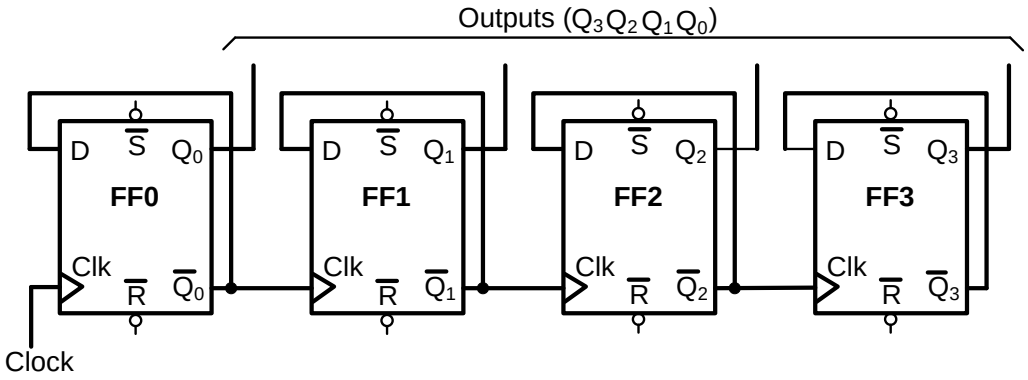

Figure 1. 4-bit asynchronous up counter using D flip flops.

Requirements:

- Test all ICs and equipment.
- Use the given ICs (74HC74-D flip flop, 74HC247-BCD to 7-segment decoder), 7-segment display, and resistors to assemble a 4-bit asynchronous up/down counter on a breadboard.
  - If the *Sel. Signal* = 0, the counter counts from 0000 to 1111.
  - If the *Sel. Signal* = 1, the counter counts from 1111 to 0000.

    Note: the counter value is displayed on a 7-segment display.
- Supply 5V/GND power to the circuit.
- Define the circuit's activities and explain its operation.
- Write comments on the experimental results.
- Explain the working of the counter in detail.

2.2. Synchronous Counter

Use J-K flip flops to implement a 4-bit *synchronous up counter* in Figure 2, which counts from 0000 to 1111.

Requirements:

- Test all ICs and equipment.

- Use the given ICs (74HC76-JK flip flop, 74HC247-BCD to 7-segment decoder, 74LS08-AND), 7-segment display, and resistors to assemble the counter on a bread-board. The counter value is displayed on a 7-segment display.
- Supply 5V/GND power to the circuit.
- Define the circuit's activities and explain its operation.
- Write comments on the experimental results.
- Explain the working of the counter in detail.

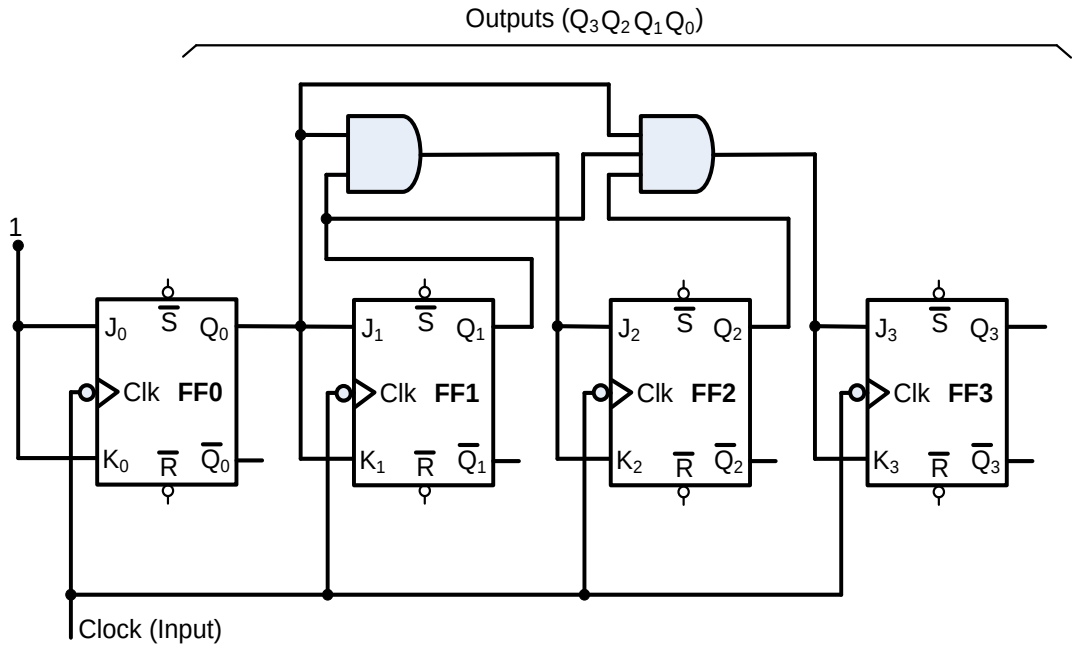

Figure 2. 4-bit synchronous up counter using J-K flip flops.

Components/Equipment	**Description**	**Quantity**
74LS74	2× D flip-flop	2
74LS76 (or 74LS73)	2× J-K flip flop	2
74LS247	1× BCD-to-7-Segment Decoder	1
74LS08	4× 2-input AND	1
Resistor	330Ω	Few
7-Seg Display	Common Cathode (–)/Anode (+)	1
Buttons (or switch)	2-pin/4-pin	Few
Power Supply	Aditeg PS-3030DD	1
Breadboard		1
Connecting Wires		Few
Multimeter		1