# (DE3-1) BCD Counter

## Aim of experiment

To demonstrate the operation of an integrated circuit BCD counter.

## Apparatus

Prototyping Board– DC Power Supply 5V or 9V Battery – Light Emitting Diodes (LEDs) – IC 7490 as a Decade Counter with BCD Count Sequence– Connection Wires.

## Theory of experiment

Digital circuits can be classified into two types: combinational, in which the circuit outputs are determined by the logical input states at any particular moment; and sequential, in which the outputs depend on logic input states and the prior states of outputs. There are two types of sequential circuit, synchronous and asynchronous. Synchronous types use a clock input to drive all the circuit operations. Asynchronous sequential circuits do not use a clock signal, Instead the circuit is driven by the pulses of the inputs.

A decade counter is one that counts in decimal digits, rather than binary. A decade counter may have each digit binary encoded (that is, it may count in binary-coded decimal (BCD), as the 7490 integrated circuit did*), figure 1.*

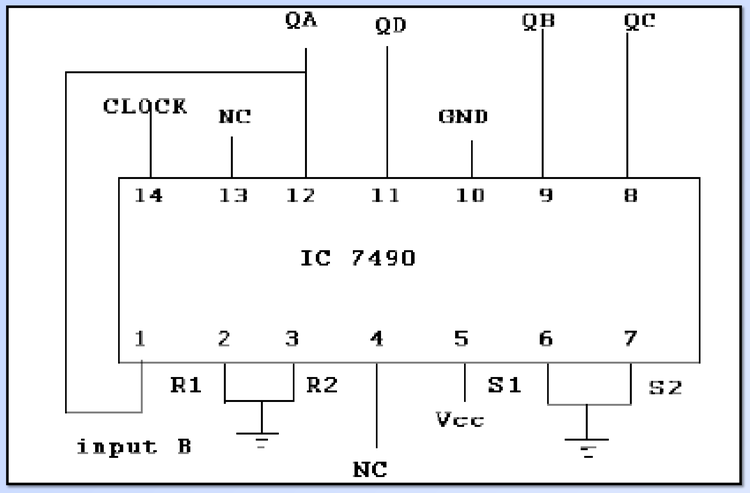


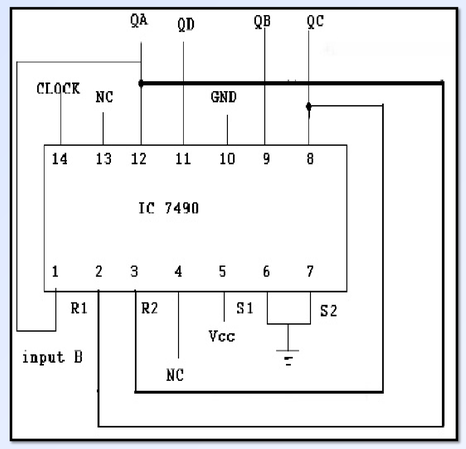

**Figure 1.** Decade Counter

| $Q_D$ | $Q_C$ | $Q_B$ | $Q_A$ |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 |
| 0 | 0 | 0 | 0 |

**Truth Table**

IC 7490 is a decade counter which drives input by 10 and provides BCD outputs 0 to 9, this is also called as decimal counter. This counter comprises of a divide-by 2 and divide-by 5 counters. To use as decade counter we have to cascade divide-by 2 and divide-by 5.

Outputs $Q_0$ to $Q_3$ are BCD outputs, inputs A and B are clock inputs to the, divide-by 2 and divide-by 5 counters respectively. $R_{01}$ and $R_{02}$ are the reset inputs, when these are activated counter output goes to 0000. S91 and S92 are the set inputs to the counter, when these inputs are activated counter output goes to 1001.




| $Q_D$ | $Q_C$ | $Q_B$ | $Q_A$ |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 |
| 0 | 0 | 0 | 0 |

**Figure 2.** Divided by 5 counter and its truth table

## Procedures

1. Connect the 7490 in the Prototyping board.
2. Connect the circuit as shown in the following figure.
3. Be sure the data switches $SW_1$ and $SW_2$ are in the binary 0 position. Next, apply power to the circuit. Observe the states on the LED indicators. Momentarily move $SW_1$ to the binary 1 position and then back to binary 0.
4. In the first position of Table 2, record the counter state that you observed after actuating $SW_1$ in Step 3 above. Then step the counter with the A logic switch. After each actuation of logic switch A, note the LED indicator states and record them in Table 2. Apply a total of ten input pulses with the A logic switch and complete Table 2.

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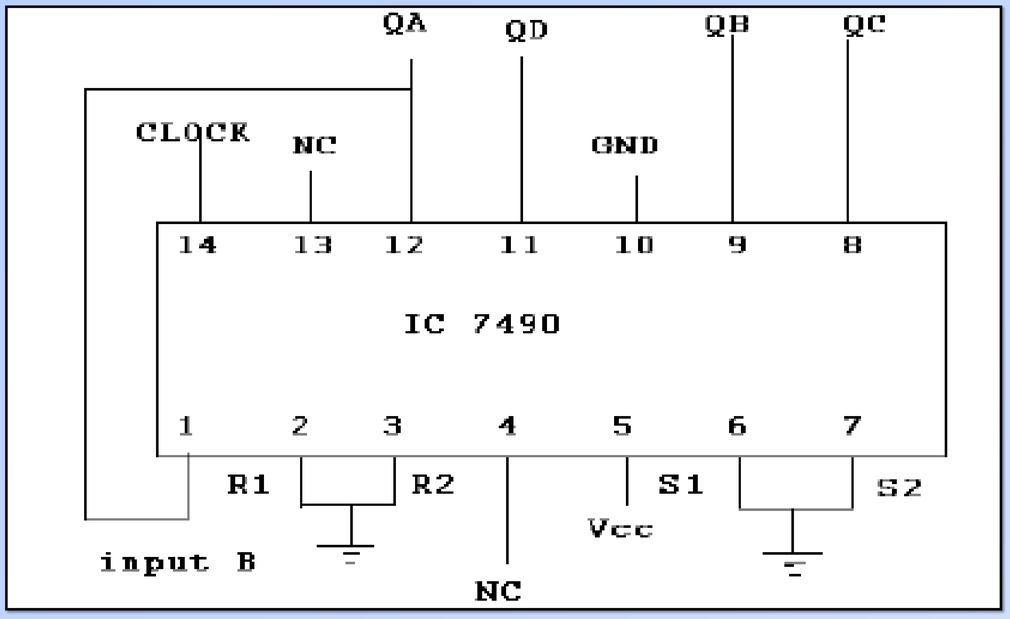
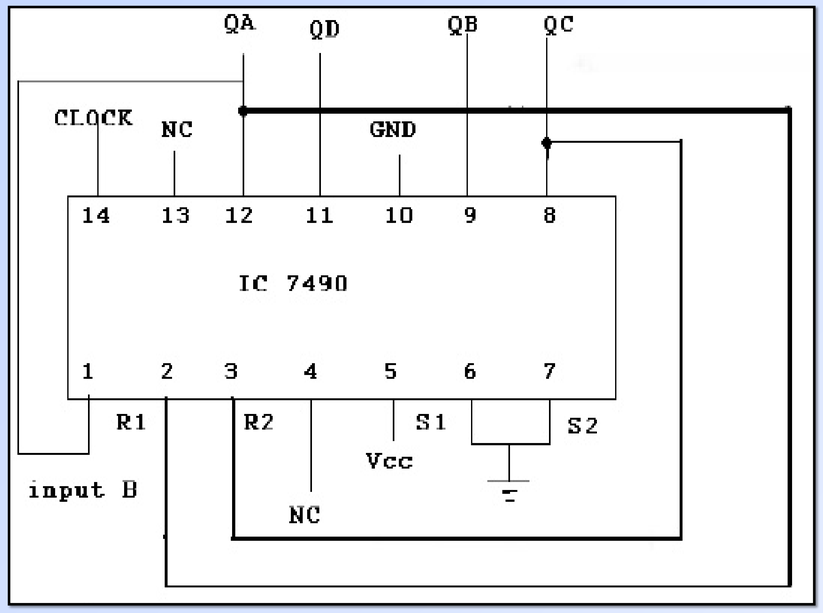



**Figure 1.** Decade Counter

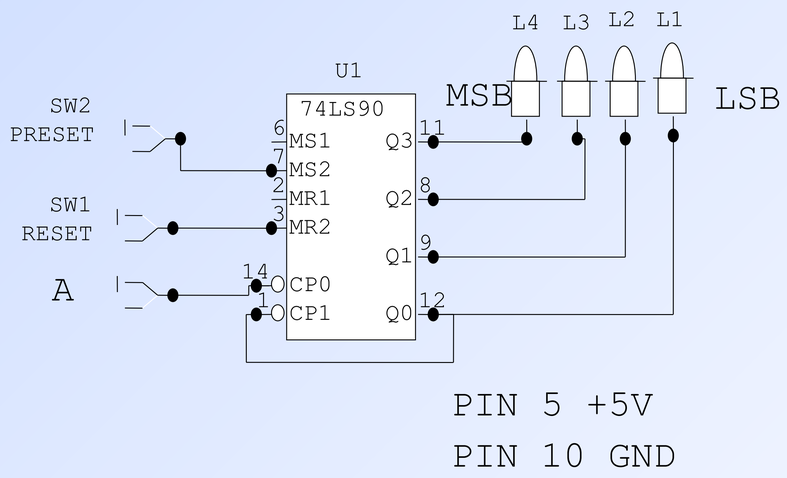



| $Q_D$ | $Q_C$ | $Q_B$ | $Q_A$ |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 0 | 1 |

**Figure 2.** Divided by 5 counter and its truth table

| $Q_D$ | $Q_C$ | $Q_B$ | $Q_A$ |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 |
| 0 | 0 | 0 | 0 |

**Truth Table**




## Results

| DECIMAL | $L_1$ | $L_2$ | $L_3$ | $L_4$ |
|---|---|---|---|---|
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**Table 2**

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