

Practical No.17: Implement Decade counter using digital IC

I Practical Significance

Counter is a sequential circuit used for counting the number of clock pulses. It is a group of Flip-Flops with a clock signal applied to it. A counter has natural count of 2^n where "n" is number of flip-flop in the counter. Decade counter is a counter which has ten states from 0 to 9.

II Industry/Employer Expected Outcome(s)

Students will be able to test the functionality of the digital circuits/system.

III Course Level Learning Outcome(s)

Develop sequential logic circuits using Flip-Flops.

IV Laboratory Learning Outcome(s):

1. Interpret timing diagram of Decade Counter (MOD-10).

V Relevant Affective Domain related outcome(s)

Handle the component and equipment carefully.

Follow all safety precaution

VI Relevant Theoretical Background

Decade counter is the one that goes through 10 unique combinations of output and then resets as the clock proceeds further. Since it is MOD -10 counters, it can be constructed with a minimum of four flip-flops. A four bit counter would have 16 states. By skipping any of six states by using some kind of feedback or some kind of additional logic, we can convert a normal four bit binary counter into a decade counter.

IC 7490 is a BCD asynchronous counter. It consists of 4 flip flops, internally connected so as to provide Mod-2 and Mod -5 counter functions. These ICs have set and reset inputs. These inputs help in designing a modulus -M counter. The Mod -2 and Mod -5 counters can be used independently or in combinations. Flip flop FFA operates as a mod-2 counter whereas the combination of flip flops FFB, FFC, and FFD form a mod-5 counter. There are two reset inputs R1 and R2 both of which are to be connected to logic 1 level to reset the flip flops. The two set inputs S1 and S2, when connected to logic 1 level, are used for setting the counter to 1001. for normal operation set and rest inputs are connected to 0.

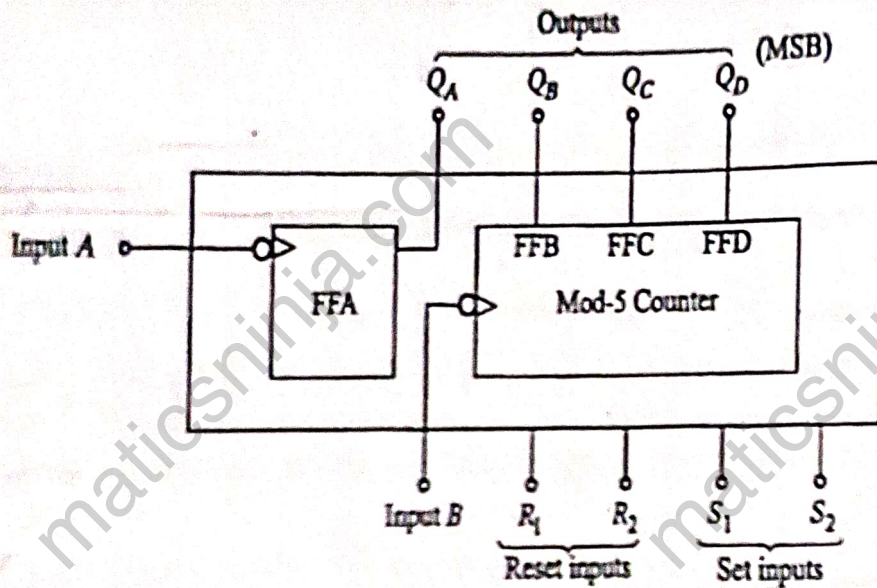


Fig 17.1 Block diagram of IC 7490

VII

Circuit diagram
a) Sample circuit

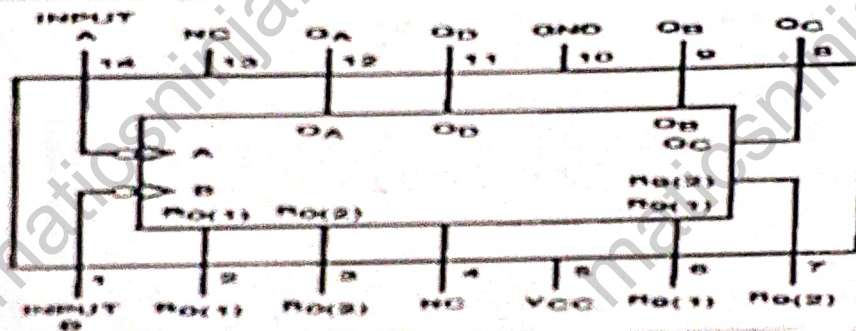


Fig 17.2 Pin configuration of IC 7490

Cutesy: <https://pdf1.alldatasheet.com/datasheet-pdf/download/50915/FAIRCHILD/7490.html>

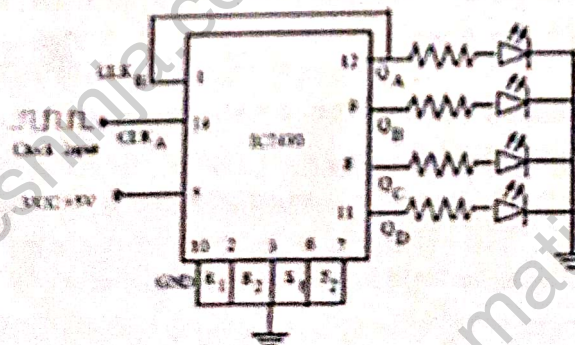
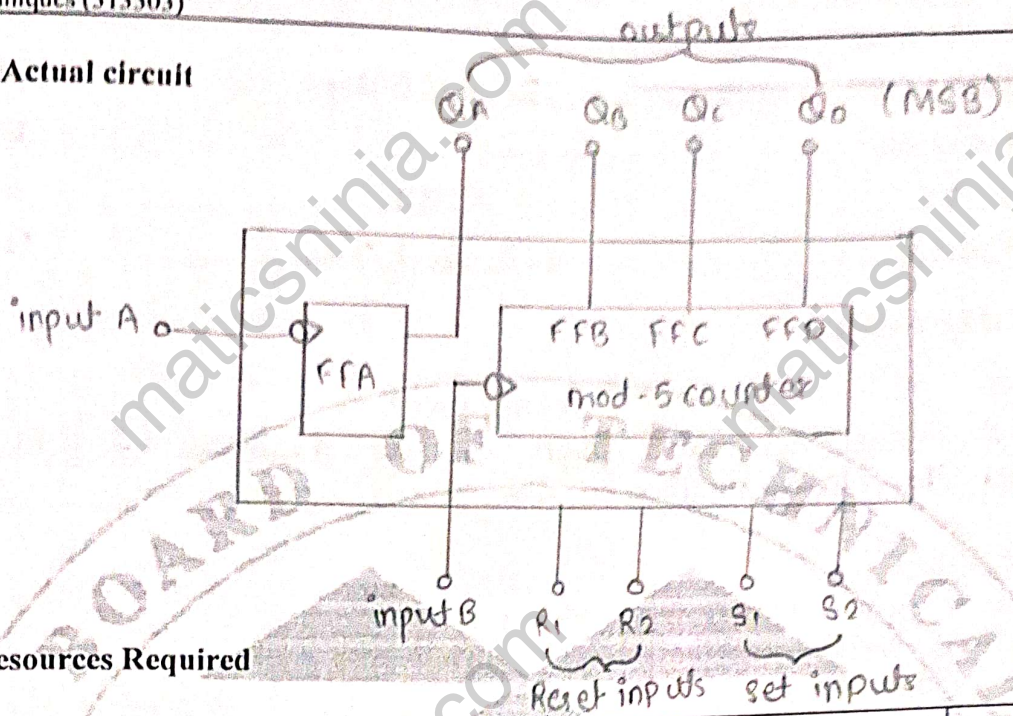


Fig 17.3 Decade Counter using 7490

b) Actual circuit



VIII Resources Required

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Digital Multimeter	3 ½ digit display	1 or 2
2	Digital IC Tester	Tests a wide range of digital IC's such as 74 series, 40/45 series of CMOS IC's	1
3	DC Power supply	+5 V fixed-power supply or Variable DC power supply (0-30V)	1
4	Breadboard	5.5cm X 17cm	1
5	Connecting Wires	Single strand wires of 0.6 mm	As per Requirement
6	IC	7490	1
7	LED	Red/Yellow color 5 mm	4
8	Resistor	220Ω/330Ω	4
9	Clock Pulse	Function/Pulse Generator	1

IX Precautions to be followed

- 1) Check IC before use.
- 2) Set power supply to 5V (Variable DC Power Supply) before connecting.
- 3) Check all the connections as per circuit diagram

X Procedure

1. Mount IC 7490 on breadboard
2. Make the connection for given circuit diagram.(figure 17.3)
3. Apply the clock input.
4. Observe and record the outputs on LEDs (ON/OFF).

XI Resources Used

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
01.	digital multimeter	3 1/2 display	1 or 2
02.	Breadboard	5.5 cm x 17 cm	1
03.	IC	7490	1
04.	Resistor	990 Ω, 1.330 Ω	4

XII Actual Procedure:

- 1) Mount IC 7490 on breadboard.
- 2) Make connections for given circuit diagram (fig. 17.3)
- 3) Apply the clock input

XIII Observation:

Observation Table 17.1: Decade Counter

Input No. of clock pulses	Output				Decimal Equivalent
	Q _B	Q _C	Q _A	Q _D	
0	0	0	0	0	0
1	0	0	0	1	1
2	0	0	1	0	2
3	0	0	1	1	3
4	0	1	0	0	4
5	0	1	0	1	5
6	0	1	1	0	6
7	0	1	1	1	7
8	1	0	0	0	8
9	1	0	0	1	9
10	0	0	0	0	0

XI Resources Used

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
01.	digital multimeter	3 1/2 display	1 or 2
02.	Breadboard	5.5 cm x 17 cm	1
03.	IC	7490	1
04.	Resistor	220 Ω / 330 Ω	4

XII Actual Procedure:

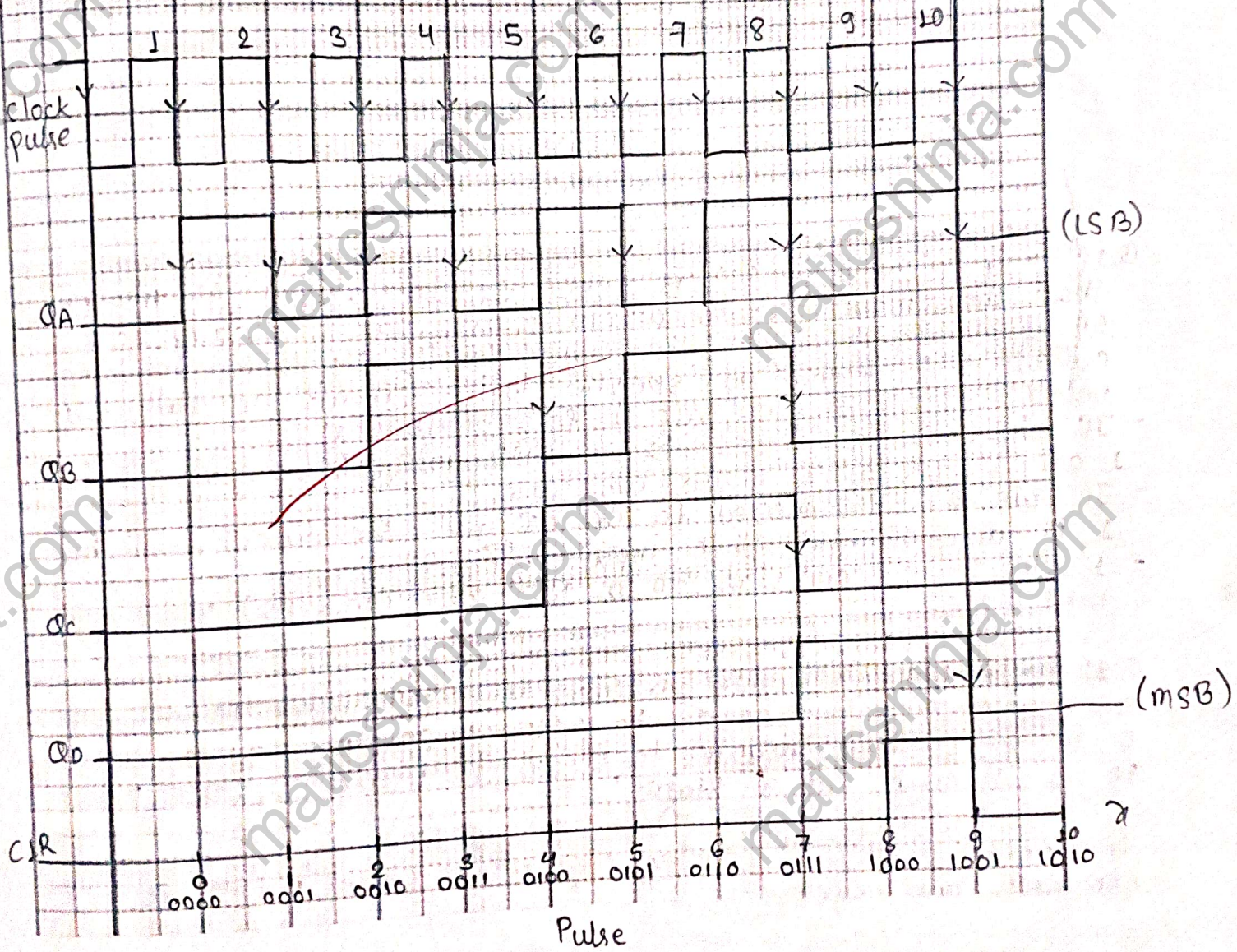
- 1> Mount IC 7490 on breadboard.
- 2> Make connections for given circuit diagram (fig. 17.3).
- 3> Apply the clock input.

XIII Observation:

Observation Table 17.1: Decade Counter

Input No. of clock pulses	Output				Decimal Equivalent
	Q _D	Q _C	Q _B	Q _A	
0	0	0	0	0	0
1	0	0	0	1	1
2	0	0	1	0	2
3	0	0	1	1	3
4	0	1	0	0	4
5	0	1	0	1	5
6	0	1	1	0	6
7	0	1	1	1	7
8	1	0	0	0	8
9	1	0	0	1	9
10	0	0	0	0	0

Decade Counter



XIV Result(s)

In this practical we learnt about to implement decade counter using digital IC.

XV Interpretation of results

In this practical we observe the implementation of decade counter using digital IC.

XVI Conclusion and recommendation

Hence, we learnt to implement decade counter using digit. IC.

XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. What will be the output if pin no. 2 R1 is connected to logic 1
2. Draw mod-2 counter using IC 7490.
3. How many clock pulses are required for MOD 9 counter?

[Space for Answers]

Q.1) \rightarrow If pin no. 2 (R1) is connected to logic 1, it means that the input voltage at pin 2 is high (typically 5V or 3.3V depending on the logic level). In this case, the output will depend on specific logic circuit or gate connected to pin 2. Here are a few possibilities:

- If pin 2 is connected to an AND gate, the output will be 1 only if all other inputs are also 1.
- If pin 2 is connected to an OR gate, the output will be 1 if any of the other inputs are 1.
- If pin 2 is connected to a NOT gate (inverter), the output will be 0.

Q.2) \rightarrow A MOD-9 counter requires 9 clock pulses to complete one cycle. This is because to MOD-9 counter counts from 0 to 8 & then resets to 0, so it needs 9 clock pulses to go through all 9 states.

In general, a MOD-n counter requires n clock pulses to complete one cycle.

XVIII References/Suggestions for further reading

1. <https://he-coep.vlabs.ac.in/exp/shift-registers/index.html> (Virtual Lab Link on counters/Refer refrence material for better understanding)
2. <https://www.youtube.com/watch?v=gAotbVkeFe8> (NPTEL Video Link)
3. <https://pdf1.alldatasheet.com/datasheet-pdf/download/50915/FAIRCHILD/7490.html>

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	identification of components	20%
3	Measuring value using suitable instrument	20%
4	working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Marks Obtained			Dated signature of Teacher
Process related (15)	Product related (10)	Total (25)	
13	10	23	