



Lab no 09: Shift Register & Ring Counter

The Purpose of this Lab is to: learn about 555-Timer, CD4017 Counter IC “Johnson 10 stage decade counter”, and Proteus Simulator.

In this lab, we will simulate a circuit that counts a one-hot code that shifts a lighting LED with each generated pulse from the 555-timer.

Then your task is to implement the circuit and test it on the breadboard.

Required Components

- Breadboard.
- 5V battery.
- Jumper wires.
- 330-ohm Resistor.
- 50k-ohm Resistor.
- 44k-ohm Resistor.
- 10nF (nano-farad) Capacitor
- 10uF (micro-farad) Capacitor.
- LEDs.
- 555 Timer.
- CD4017 Counter.

Parts:

1. Introduction to 555 Timer and Ring Counter using “CD4017” IC.
2. Simulate the Running-LEDs circuit using 555 Timer, Counter “CD4017”, and LEDs on Proteus.



Part 1: Introduction to 555 Timer & Ring Counter using “CD4017” IC.

➤ 555 Timer

- Refer to Lab 8 to revise the 555 Timer

➤ Ring Counters

- The easiest way to design a ring counter is by connecting n number of D flip-flops in series to create a [shift register](#). Then you connect the output of the last flip-flop back into the input of the first one, as shown in Figure.1. Also, you need to set the first flip-flop to one and the rest flip-flops to zero on reset.
- Figure.1 illustrates an example of a 4-bit ring counter.

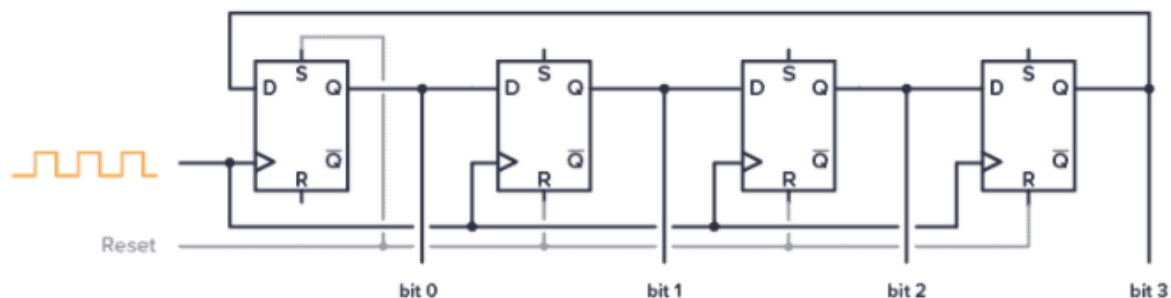


Figure 1: 4-Bit Ring Counter.

➤ CD4017

- The CD4017 is a CMOS Decade counter IC.
- CD4017 is used for low-range counting applications. It can count from 0 to 9 (the decade count). The counter increases with one for every rising clock pulse. After the counter has reached 9, it starts again from 0 with the next clock pulse.
- The counter circuit in the CD4017 however, is not a standard ring counter. Instead, it uses a technique called a “[Johnson counter](#)” that makes it possible to achieve the same with [only 5 flip-flops plus some logic gates](#). CD4017 is known as the “[Johnson 10-stage decade counter](#)”.
- Figures 2 & 3 illustrate the circuit and time diagram of CD4017.

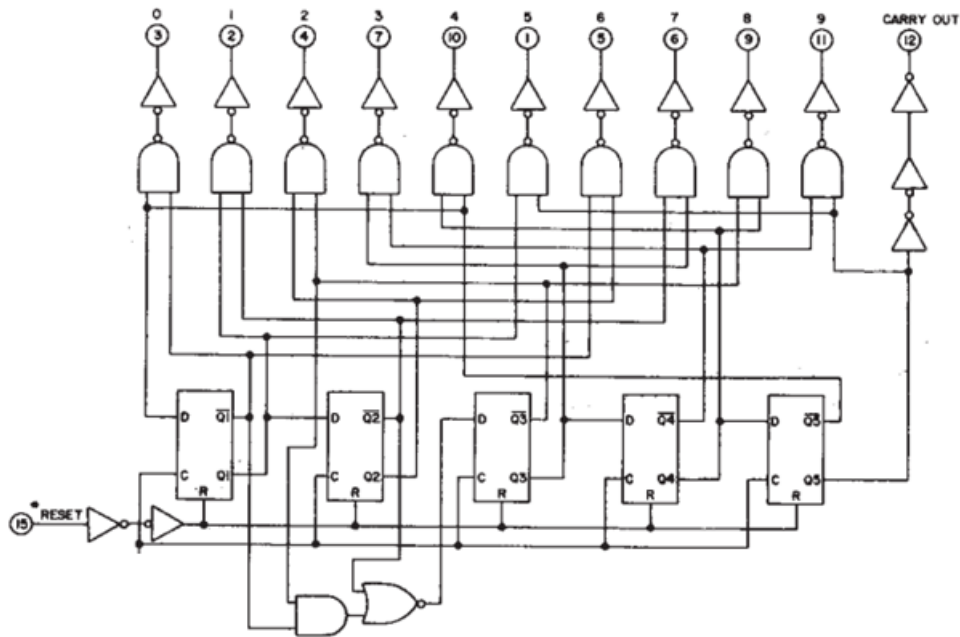


Figure 2: CD4017 Circuit Diagram.

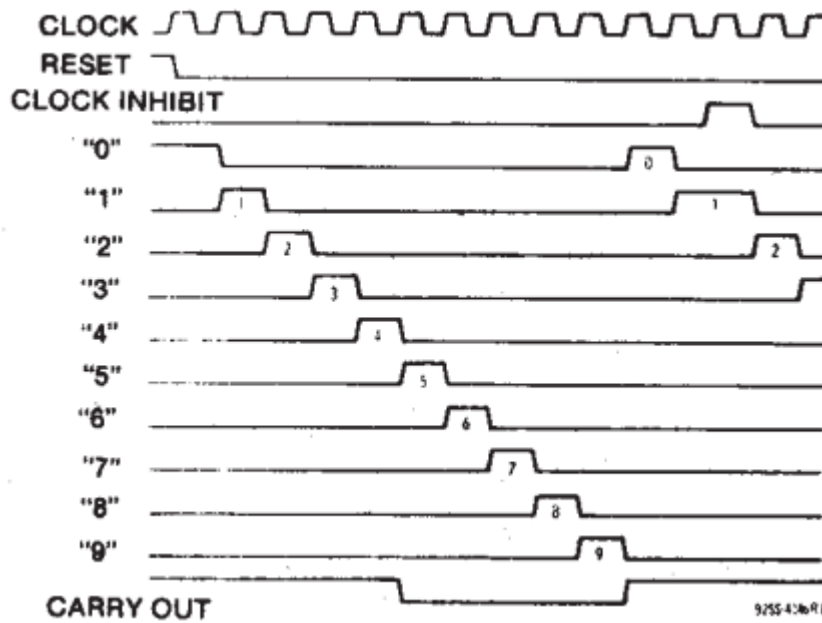


Figure 3: CD4017 Time Diagram.



Part 2: - Simulate the Running-LEDs circuit using 555 Timer, Counter “CD4017”, and LEDs on Proteus.

➤ **Timer 555**

- Refer to Lab 8 to revise the 555 Timer

➤ **Counter “CD4017”**

- CD4017 IC is a decade counter that counts to ten. It has 10 outputs that represent the numbers 0 to 9.
- Figure 4 illustrates the pinout of CD4017 IC.

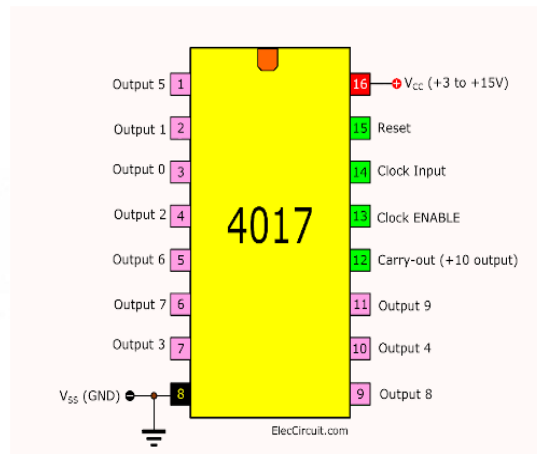


Figure 4: CD4017 IC & Pin Configuration.

- Figure 5 illustrates the schematic of Decade Counter CD4017.

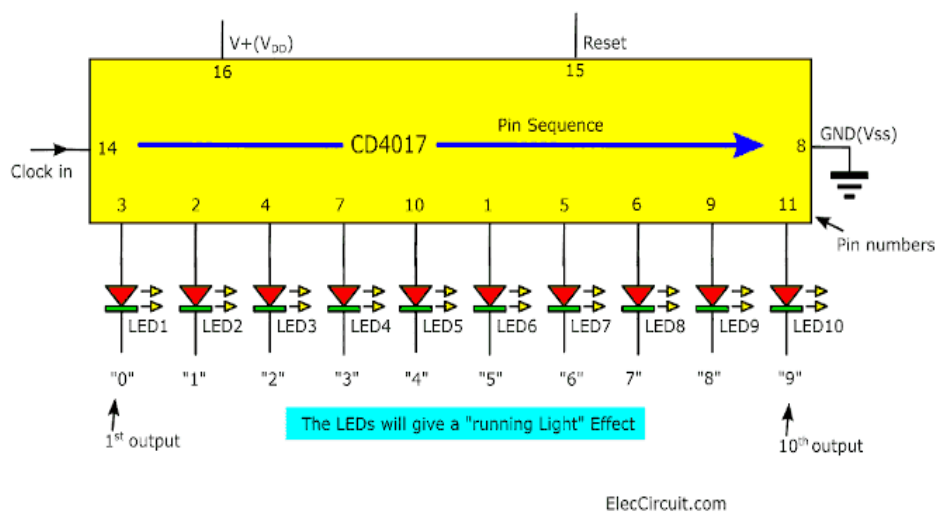


Figure 5: Schematic of CD4017 IC.



- Table 1 illustrates the pin overview of CD4017 IC.

Pin Name	Pin #	Type	Description
VDD	16	Power	Supply Voltage (+3 to +15V)
GND	8	Power	Ground (0V)
Q0-Q9	1-7 and 9-11	Output	Qx is high when the counter is x
CO	12	Output	Carry Out. Goes high after ten clock pulses
CI	13	Input	Clock Inhibit. Ignores clock inputs
CLK	14	Input	Clock Input. Increases the counter with one
MR	15	Input	Resets the counter to 0

Table 1: Pin overview of CD4017 IC.

- Table 2 illustrates truth table of CD4017 IC. You can notice the ring counting, there is only one output is active per time.

Repeat

Clock Pulse No	Out 0	Out 1	Out 2	Out 3	Out 4	Out 5	Out 6	Out 7	Out 8	Out 9
1	1	0	0	0	0	0	0	0	0	0
2	0	1	0	0	0	0	0	0	0	0
3	0	0	1	0	0	0	0	0	0	0
4	0	0	0	1	0	0	0	0	0	0
5	0	0	0	0	1	0	0	0	0	0
6	0	0	0	0	0	1	0	0	0	0
7	0	0	0	0	0	0	1	0	0	0
8	0	0	0	0	0	0	0	1	0	0
9	0	0	0	0	0	0	0	0	1	0
10	0	0	0	0	0	0	0	0	0	1

Table 2: Truth Table of CD4017 IC.

➤ Steps to simulate the Running-LEDs circuit In Proteus.

- To simulate 555-timer in Proteus Software, Refer to Lab 8 to revise the simulation of the 555 Timer.

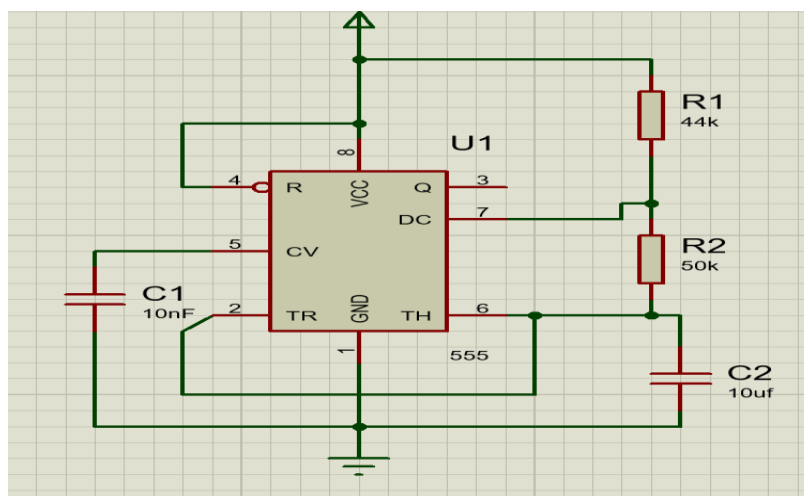
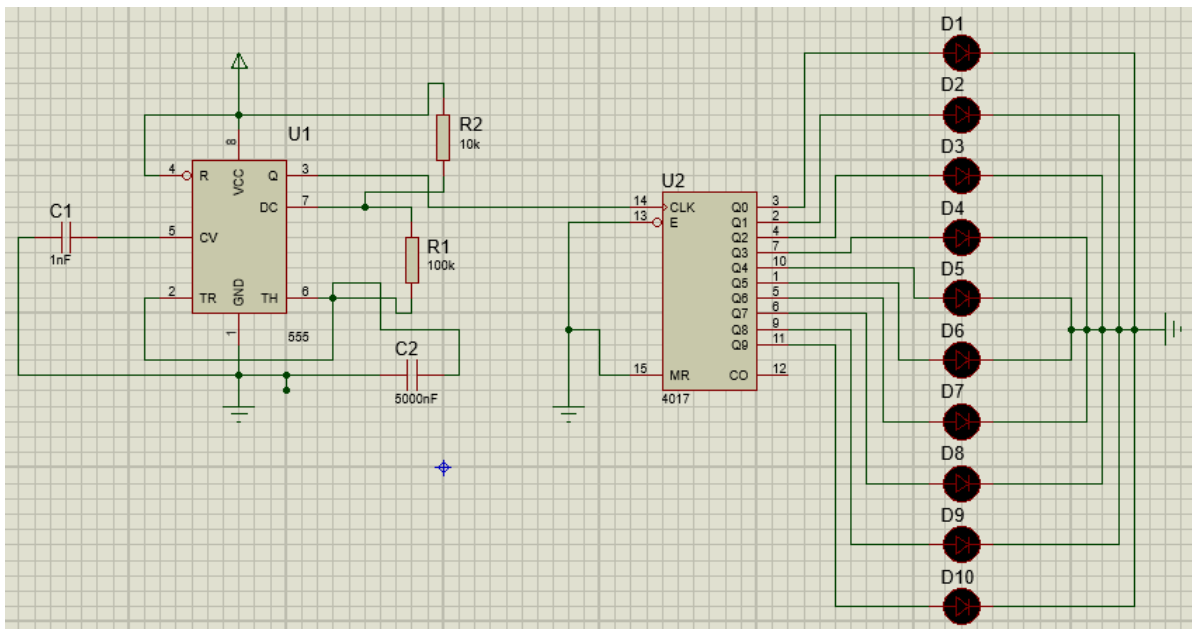


Figure 6: 555-timer in Proteus



- To Simulate 4017-decade counter in Proteus.
Figure 6 illustrates how to connect and simulates 4017-decade counter in Proteus. Follow the steps below:
 - After connecting 555-timer, as shown in Figure 6, the pin 3 isn't connected yet. So, **Connect** Timer-555 Pin 3 to Pin 14 in 4017-decade counter.
 - **Connect** Pin 8, 13 and 15 in 4017-decade to the ground.
 - **Connect** Pin 16 to the 5v.
 - **Connect** Pin 1 to 7 and 9 to 11 to ten LEDs, as shown in the Figure 7.
 - Then click **Run** to simulate.



Task: Hardware Connections.

Now, it is your turn. On the breadboard, **Connect** the above circuit. Then **Test** the function of Ring Counter using CD4017 IC.

Note

- Portus Source. [Link](#)
- Install Proteus [Steps Link](#)
- 4017-decade Counter in Proteus video [Lab Link](#)