

Digital Electronic Circuits Lab.

Experiment: 2

By now, you are familiar with the term 'minterm' from your theory class and also, what is sum of product (SOP) representation of truth table. You also have noted compact representation of SOP by using Σ symbol.

A 3-to-8 decoder takes 3 inputs and generates 8 outputs which are the 8 minterms that can be generated from 3 variables. A decoder-OR (any other combinatorial logic which is equivalent) combination can generate multiple outputs in a simple way. An example follows.

Example 4.7

Show how using a 3-to-8 decoder and multi-input OR gates following Boolean expressions can be realized simultaneously.

$$F_1(A, B, C) = \Sigma m(0, 4, 6); F_2(A, B, C) = \Sigma m(0, 5); F_3(A, B, C) = \Sigma m(1, 2, 3, 7)$$

Solution Since at the decoder output we get all the minterms we use them as shown in Fig. 4.17 to get the required Boolean functions.

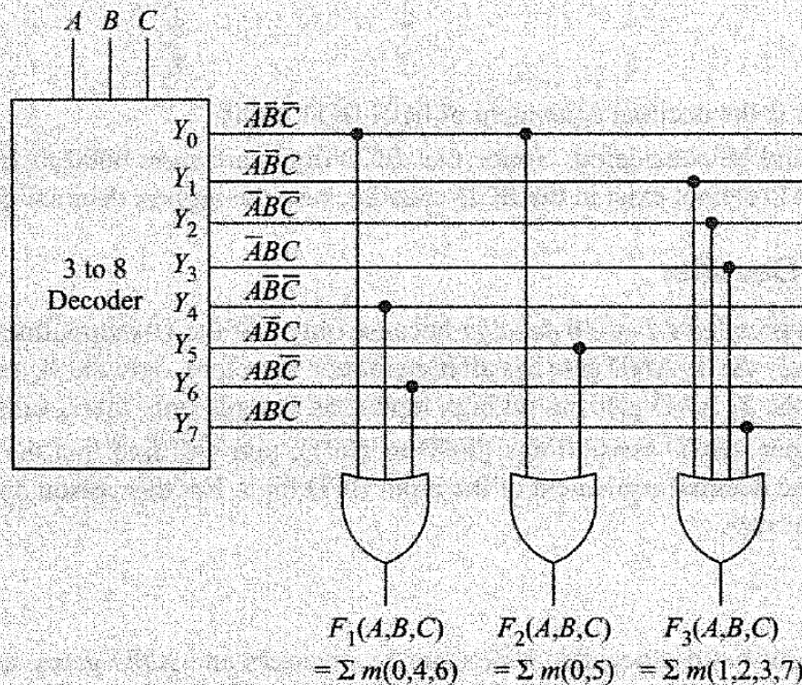
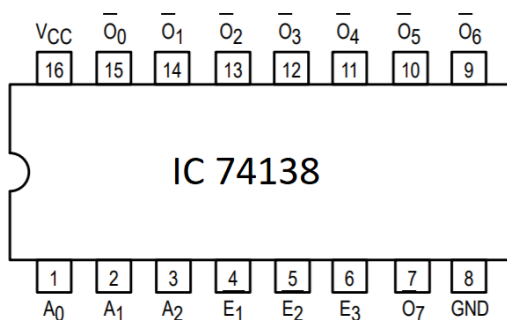


Fig. 4.17

Solution for Example 4.7

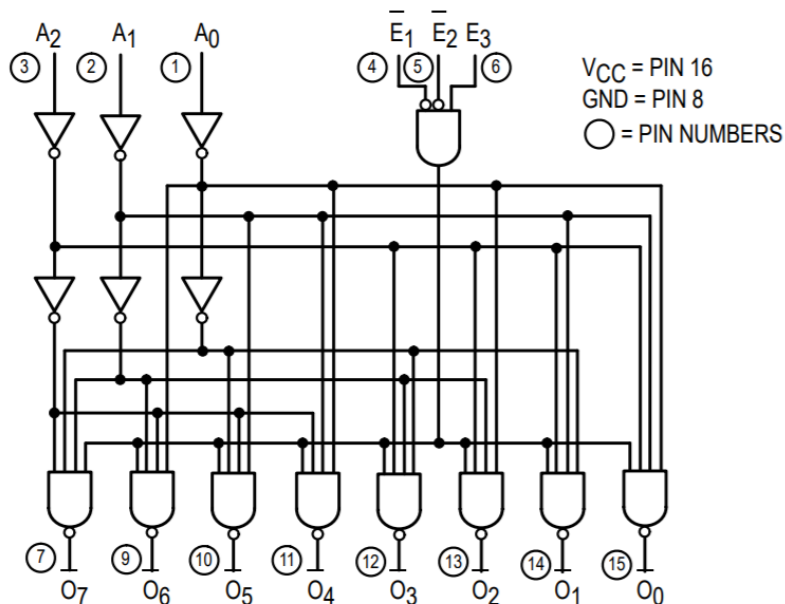
A 3-to-8 decoder IC will have additional control inputs to enhance its functionality.



A_0-A_2
 E_1, E_2
 E_3
 O_0-O_7

Address Inputs
 Enable (Active LOW) Inputs
 Enable (Active HIGH) Input
 Active LOW Outputs (Note b)

1 TTL Unit Load (U.L.) = 40 μ A HIGH/1.6 mA LOW.



TRUTH TABLE

INPUTS						OUTPUTS							
E ₁	E ₂	E ₃	A ₀	A ₁	A ₂	O ₀	O ₁	O ₂	O ₃	O ₄	O ₅	O ₆	O ₇
H	X	X	X	X	X	H	H	H	H	H	H	H	H
X	H	X	X	X	X	H	H	H	H	H	H	H	H
X	X	L	X	X	X	H	H	H	H	H	H	H	H
L	L	H	L	L	L	L	H	H	H	H	H	H	H
L	L	H	H	L	L	H	L	H	H	H	H	H	H
L	L	H	L	H	L	H	H	L	H	H	H	H	H
L	L	H	H	H	L	H	H	H	L	H	H	H	H
L	L	H	L	L	H	H	H	H	H	L	H	H	H
L	L	H	H	L	H	H	H	H	H	H	L	H	H
L	L	H	L	H	H	H	H	H	H	H	H	L	H
L	L	H	H	H	H	H	H	H	H	H	H	H	L

H = HIGH Voltage Level

L = LOW Voltage Level

X = Don't Care

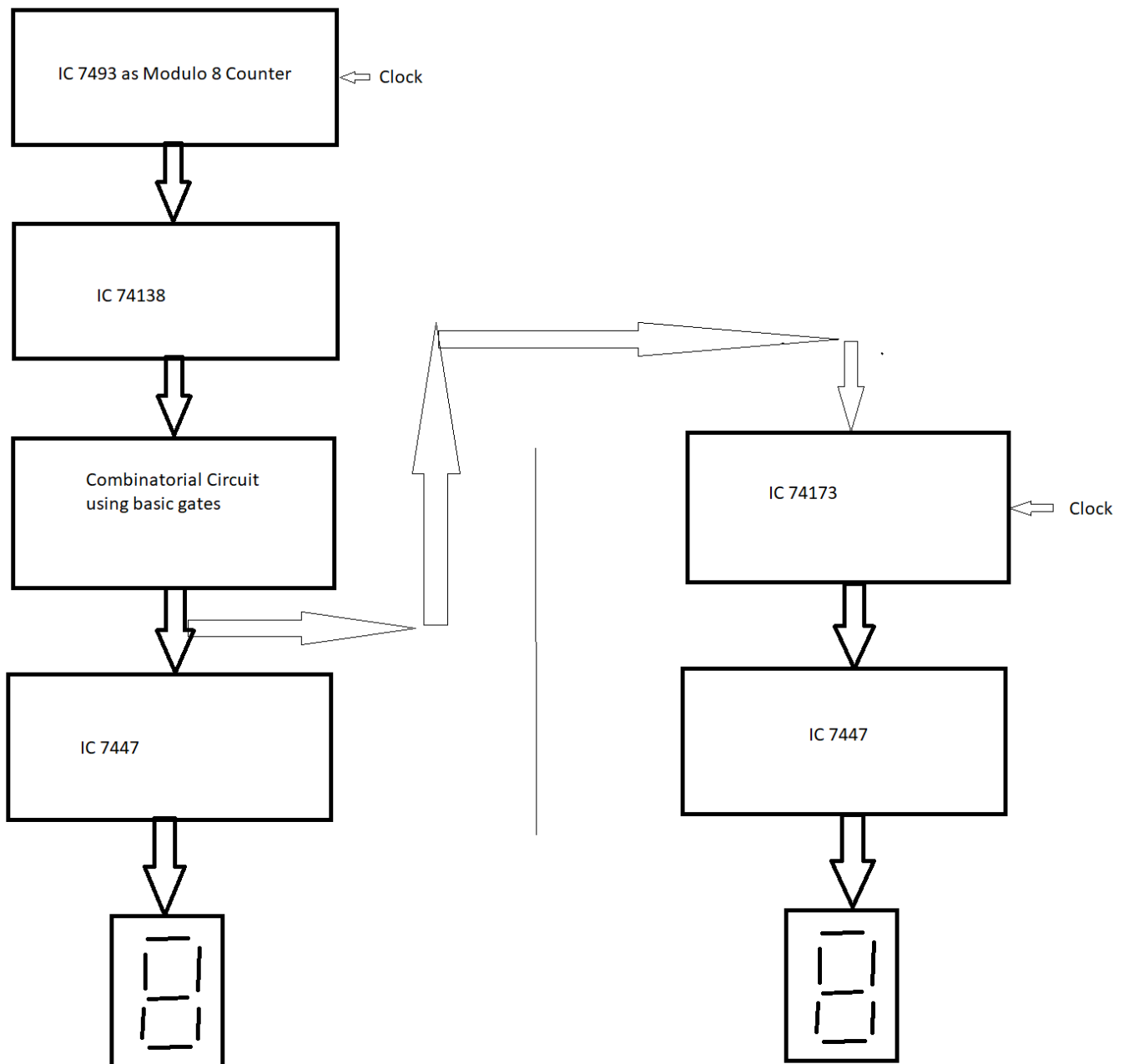
Refer to the next diagram, the first part which is there in the left hand side of the dinner dividing line.

First, you are to display 8 characters of your roll no. (excluding a middle '0' i.e. 16EE10010 is to be displayed as 16EE1010. You may consider a character which is close to E or C for display from the available set.) one after another with progress of the clock.

We shall discuss how to display a better looking E which may not be part of available characters displayed by directly connecting IC 7447 to LT 542 (Hint lies in this statement). Can you think of a solution yourself? If yes, please show the solution before implementation.

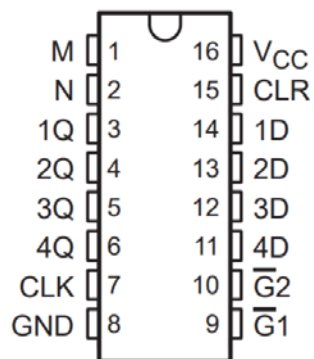
Next, consider developing a rolling display but with 2 display units only. This means the second display will be delayed by one clock pulse. It gives a feel of numbers gradually shifting in one direction (appear-shift-disappear)

The delay can be generated by storing the to-be-displayed character in a register for one clock duration. IC 74173 is a 4 bit register which can be used for this purpose.



Note that IC 74173 output can be tri-stated for a specific combination of the control input.

The tri-state buffer passes a high impedance (or hi-Z) signal, which effectively disconnects its output from the circuit. Tri-state buffers are often connected to a bus which allows multiple signals to travel along the same connection. In TTL, it can be achieved by making both the transistors of output totempole stage cut-off when the output is disabled. When enabled, it does normal operation.



IC 74173

FUNCTION TABLE

CLR	CLK	DATA ENABLE		DATA D	OUTPUT Q
		$\overline{G1}$	$\overline{G2}$		
H	X	X	X	X	L
L	L	X	X	X	Q_0
L	\uparrow	H	X	X	Q_0
L	\uparrow	X	H	X	Q_0
L	\uparrow	L	L	L	L
L	\uparrow	L	L	H	H

When either M or N (or both) is (are) high, the output is disabled to the high-impedance state; however, sequential operation of the flip-flops is not affected.

