2020

DELHI TECHNOLOGICAL UNIVERSITY

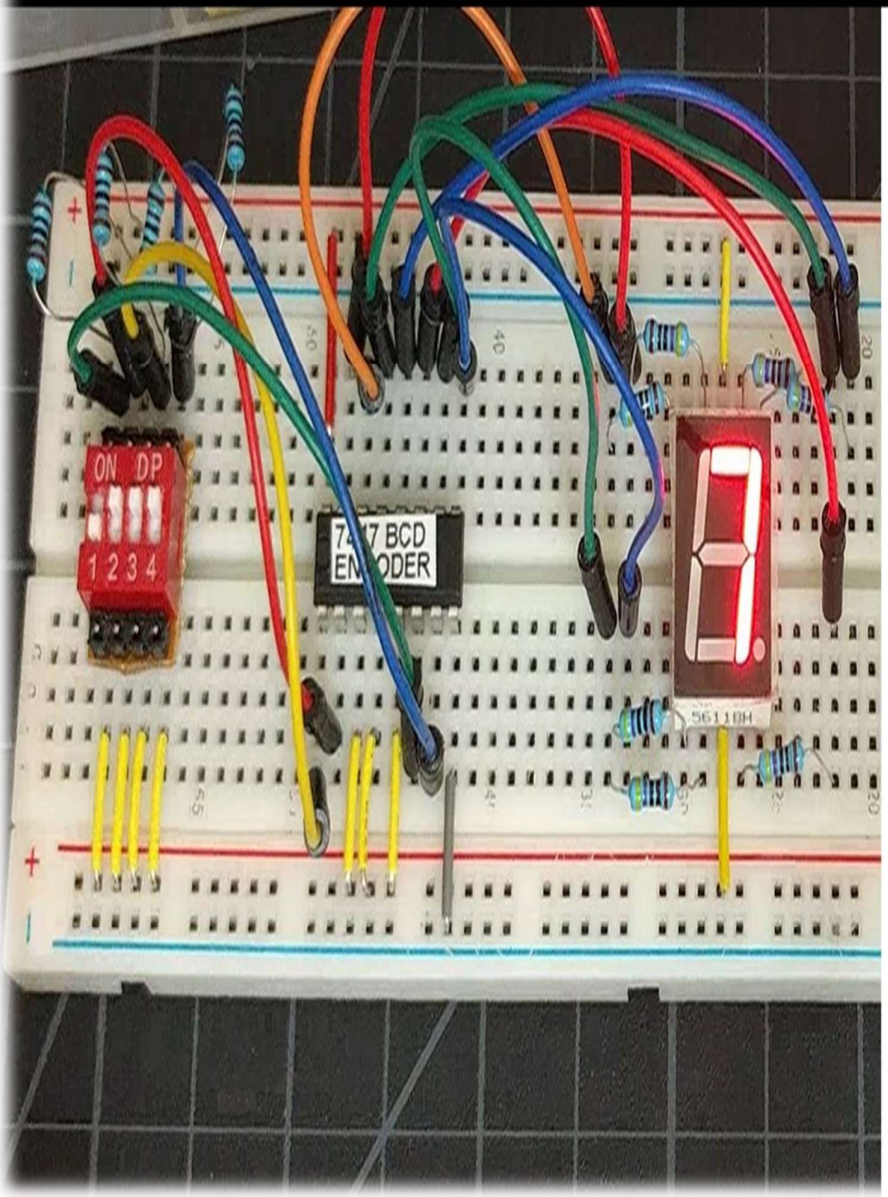
REPORT FILE

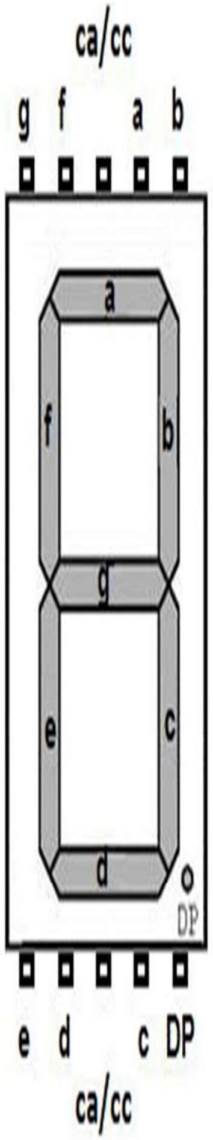
DIGITAL DESIGN -I

Project – BCD to 7 Segment Display Decoder.

Made By – Lokesh (2K19/EC/101) & Mohammad Sameer (2K19/EC/110)
Section-D
Group-D3
Submitted to – Prof. Rajesh Rohilla

BCD to 7 Segment Display





DECLARATION

WE, **LOKESH AND MOHAMMAD SAMEER**, hereby solemnly declare that project report **"BCD to 7 Segment Display Decoder"** is based on my work carried out during the course of study under the supervision of **RAJESH ROHILLA SIR**.

We assert the statements made and conclusions drawn are an outcome of my research work.

We further certify that:

I. The work contained in the report is original and has been done by me under the general supervision of my supervisor.

II. The work has not been submitted to any other Institution for any other degree/diploma/certificate in this university or any other University of India or abroad.

III. I have followed the guidelines provided by the university in writing the report.

IV. Whenever I have used materials (data, theoretical analysis, and text) from other sources, I have given due credit to them in the text of the report and giving their details in the references.

SUPERVISOR	MADE BY
RAJESH ROHILLA SIR	LOKESH (2K19/EC/101)
	MOHAMMAD SAMEER (2K19/EC/110)

CERTIFICATE

This is to certify that the project report entitled **"BCD TO 7 SEGMENT DISPLAY DECODER"**, submitted to the Department of Electronics and Communication Engineering, Delhi Technological University, in partial fulfilment for the award of the degree of B.Tech , is a record of work carried out by **Lokesh (2K19/EC/101) and Mohammad Sameer (2K19/EC/110).**

No part of this report has been submitted elsewhere for award of any other degree.

SUPERVISOR

RAJESH ROHILLA SIR

SUBMITTED BY

LOKESH (2K19/EC/101)

MOHAMMAD SAMEER (2K19/EC/110)

ABSTRACT

In this project we have designed a" **BCD to 7 Segment Display Decoder**". The main purpose of this project is to achieve a successful working prototype that is capable to display the numbers (in order to produce the decimal readout) using seven-segment displays. These displays are driven by the output stages of digital ICs.

A display decoder is used to convert a BCD or a binary code into a 7-segment code. It generally has 4 input lines and 7 output lines. Here we design a simple display decoder circuit using logic gates. This circuit can be modified using timers and counters to display the number of clock pulses. This circuit can be modified to develop an alphabet display system instead of a decimal number display system. It can be used as a timer circuit.

As a conclusion, this project has given the opportunity for students to integrate theories into solving the problems related with the engineering scope of work.

Seven-segment displays are used to display the digits in calculators, clocks, various measuring instruments, digital watches and digital counters.

ACKNOWLEDGEMENT

We would like to take this opportunity to give special thanks to Mr. Rajesh Rohilla Sir for giving me the golden opportunity to perform this project. We are so thankful for all the new things that we got to learn through this project. All the research papers and documents that we went through in order to complete this project were extremely helpful. We are sure that these things will prove to be of great use in the future as well. Once again, we would like to thank Rajesh Rohilla Sir for always being so supportive and helpful. None of this would have been possible without his guidance.

A special thanks to all our colleagues who have been so supportive during this time. We feel that words will fall short in expressing how grateful we that we got to perform this project and that we were given the chance to explore and expand my horizons.

Thank you everyone.

Regards

Lokesh (2K19/EC/101)

Mohammad Sameer (2K19/EC/110)

CONTENTS

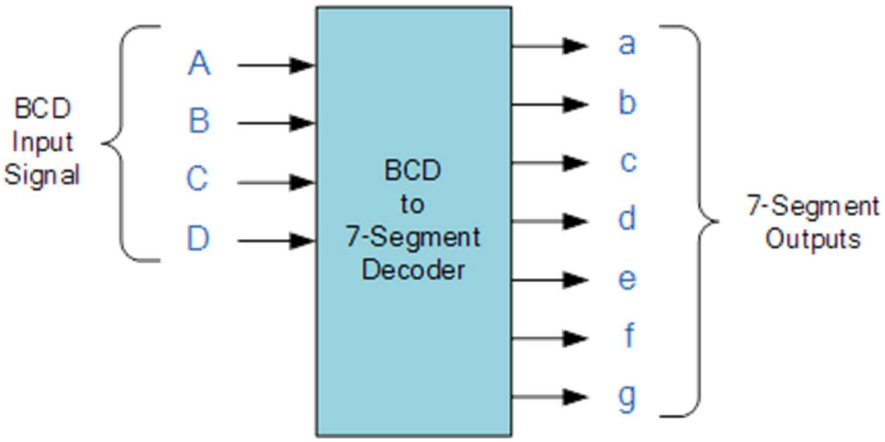
INTRODUCTION

Most often seven-segment displays are used to display the digits in digital watches, calculators, clocks, measuring instruments and digital counters, etc. Generally, LCD and LED segments provide the display output of numerical numbers and characters.

But these outputs are in the form of 4-bit binary coded decimal (BCD), and not suitable for directly driving the **seven-segment displays**.

A **Digital Decoder** IC, is a device which converts one digital format into another and one of the most commonly used devices for doing this is called the Binary Coded Decimal (BCD) to 7-Segment Display Decoder.

Binary Coded Decimal (BCD or "8421" BCD) numbers are made up using just 4 data bits similar to the Hexadecimal numbers we saw in the binary tutorial, but unlike hexadecimal numbers that range in full from 0 through to F, BCD numbers only range from 0 to 9.



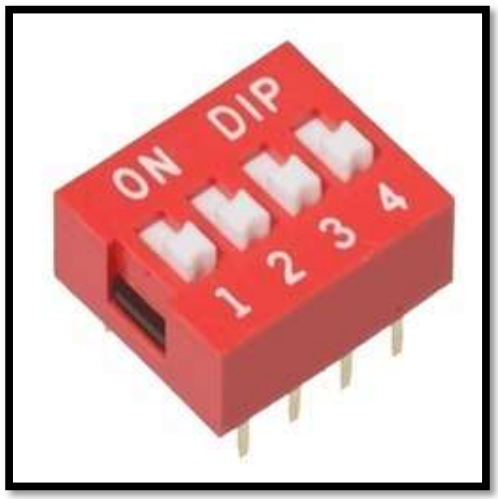
For Common Anode type seven segment LED display, we only have to interchange all '0s' and '1s' in the output side i.e., (for a, b, c, d, e, f, and g replace all '1' by '0' and vice versa) and solve using K-map.
Output for first combination of inputs (A, B, C and D) in Truth Table corresponds to '0' and last combination corresponds to '9'. Similarly rest corresponds from 2 to 8 from top to bottom.
BCD numbers only range from 0 to 9,thus rest inputs from 10-F are invalid inputs.

The basic idea involves driving a common anode 7-segment LED display using combinational logic circuit. The logic circuit is designed with 4 inputs and 7 outputs, each representing an input to the display IC. Using Karnaugh's map, logic circuitry for each input to the display is designed.

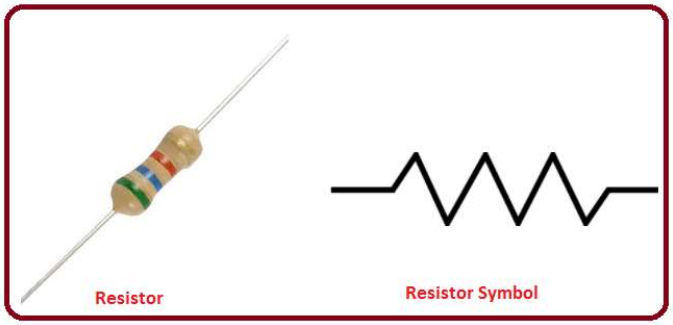
CHAPTER-1

LIST OF COMPONENTS :

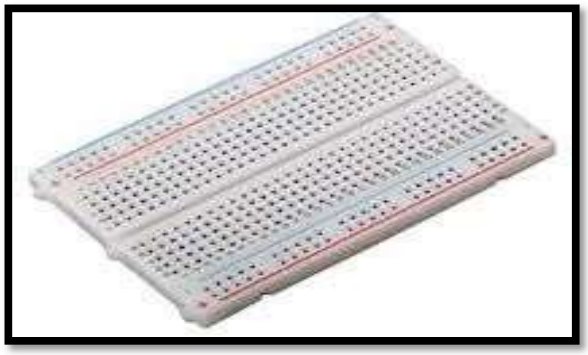
1) **DIP SWITCHES:** A DIP switch is a manual electric switch that is packaged with others in a group in a standard dual in-line package (DIP). The term may refer to each individual switch, or to the unit as a whole. This type of switch is designed to be used on a printed circuit board along with other electronic components and is commonly used to customize the behaviour of an electronic device for specific situations. DIP switches are an alternative to jumper blocks. Their main advantages are that they are quicker to change and there are no parts to lose. A DIP switch is a relatively simple and cost-effective component.



2) **RESISTOR (4 pcs – 1 KOhm & 7 pcs – 470 Ohm):** A resistor is a passive bilateral electrical component that implements electrical resistance as a circuit element. It reduces current flow, at the same time.it may act to lowers voltage level within circuit. This is the most common component in electronics. It is used mainly to control current and voltage within the circuit. Its function is to reduce the flow of electric current. The resistance of resistor is given by R=V/I; where R=resistance, V=voltage, I=current. The value of the resistor can be verified by the color-coding scheme.



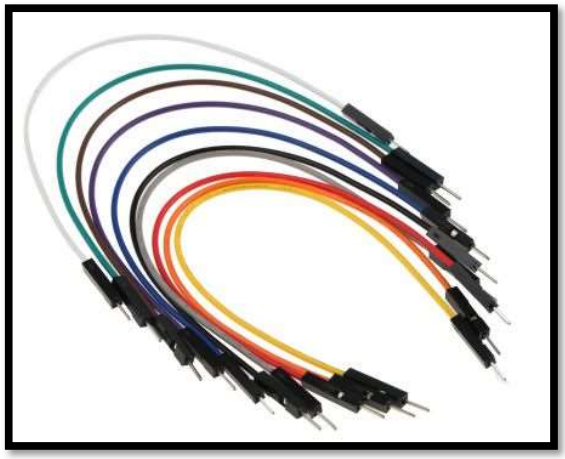
3) BREADBOARD: A breadboard is a rectangular plastic board with a bunch of tiny holes in it. These holes let you easily insert electronic components to prototype (meaning to build and test an early version of) an electronic circuit, like this one with a battery, sensor, buzzer and Arduino board. One of the breadboards is that it can be reused and various projects can eb assembled on the very same breadboard.



4) JUMPER WIRE: Jumper wires help in connecting various electronic components with each other. They have connector pins at the end. They are of three kinds and can be used accordingly:

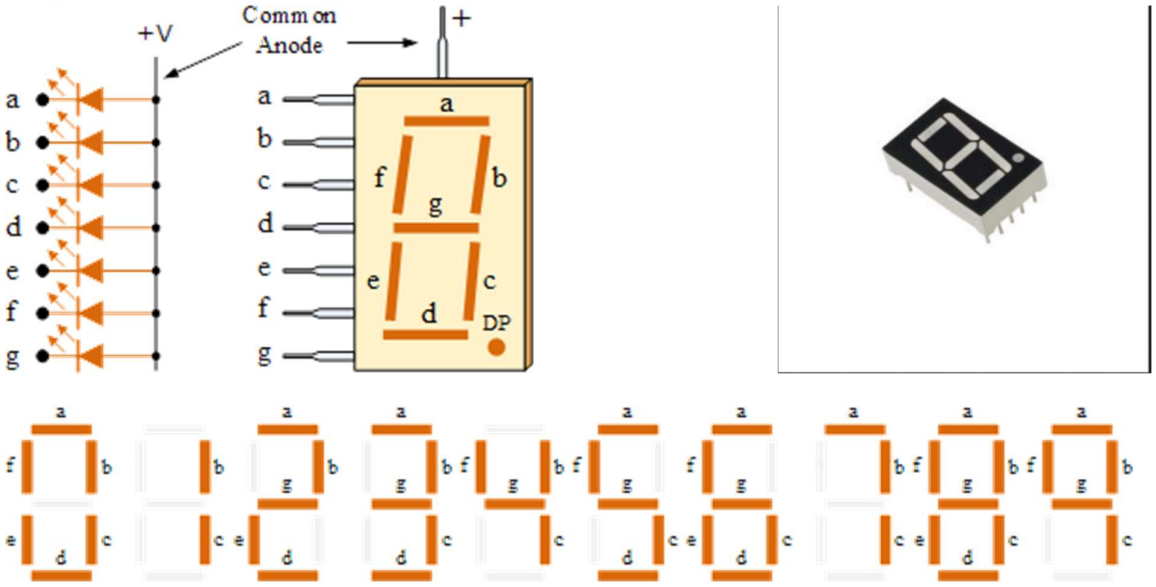
- Male to male
- Male to female
- Female to female

This classification is based on the kind of connector pin present at the ends.



5) COMMON ANODE DISPLAY: The emission of these photons occurs when the diode junction is forward biased by an external voltage allowing current to flow across its junction, and this process known as electroluminescence. The 7-segment display consists of seven LEDs arranged in a rectangular fashion. Each of the seven LEDs is called a segment because when illuminated the segment forms part of a numerical digit to be displayed. An additional 8th LED is sometimes used within the same package thus allowing the indication of a decimal point when two or more 7-segment displays are connected together to display numbers greater than ten. In the

common anode display, all the anode connections of the LED segments are joined together to logic "1". The individual segments are illuminated by applying a ground, logic "0" or "LOW" signal via a suitable current limiting resistor to the Cathode of the particular segment (a-g).

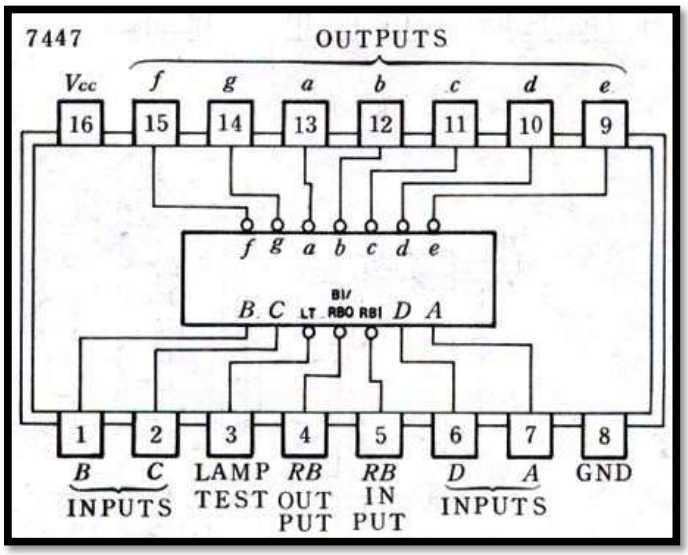


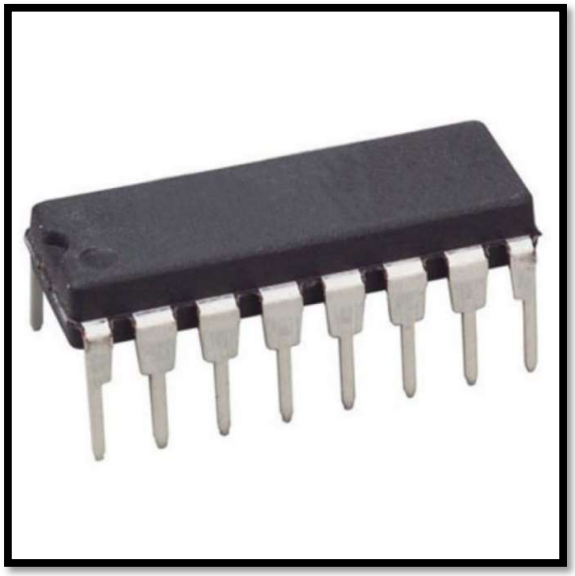
6) <u>7447 DECODER IC (74LS47N):</u> 7447 or 74LS47 decodes BCD into 7 Segments, which means it accepts a binary coded decimal or BCD Values as input and decoded into a pattern that drives a 7-segment for displaying digits 0 to 9, so its name is BCD to 7 segment driver or decoder. Its input is 4 lines BCD data and generates complements as output. Maximum Voltage supply: 5.25V; Minimum Voltage supply: 4.75V.

The input to the 74LS47 is a binary number DCBA where D is 8s, C is 4s, B is 2s and A is 1s.

The inputs **BI/RBO , RBI** and **LT** are usually connected to 5v. **LT** stands for **Lamp Test**. When LT is low all the segments on the 7-seg display are lit regardless of DCBA. **BI** stands for **Blanking Input**. When BI is low the display is blank so all the segments on the 7seg display are off regardless of DCBA. **RBI** stands for **Ripple Blanking Input**.

When RBI is low and DCBA=0000 the display is blank otherwise the number is displayed on the display. To use with more than one display connect **RBO (Ripple Blanking Output)** from most significant 74LS47 to the RBI of the next 74LS47. Connect RBI of the least significant 74LS47 to 5v unless you want the display to turn off when the number is 0.



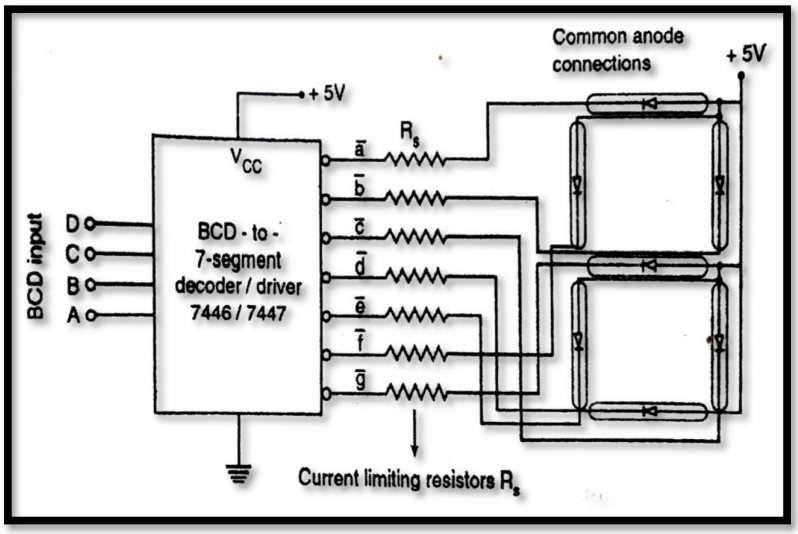


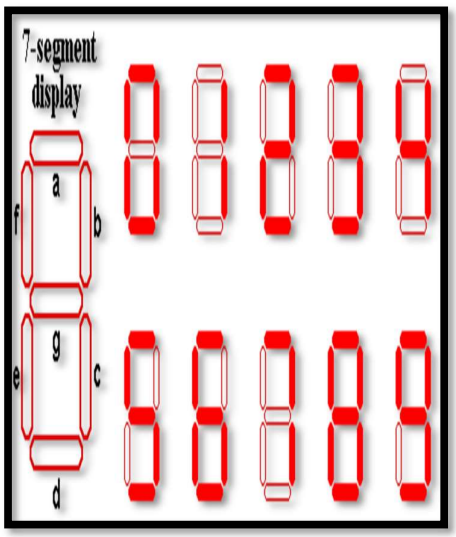
OBSERVATION:

CIRCUIT DIAGRAM AND WORKING :

BASIC PRINCIPLE:

A Display Decoder is a combinational circuit which decodes and n-bit input value into a number of output lines to drive a display. A **Digital Decoder** IC, is a device which converts one digital format into another and one of the most commonly used devices for doing this is called the Binary Coded Decimal (BCD) to 7-Segment Display Decoder.7-segment **LED** (Light Emitting Diode) or **LCD** (Liquid Crystal Display) type displays, provide a very convenient way of displaying information or digital data in the form of numbers, letters or even alpha-numerical characters.

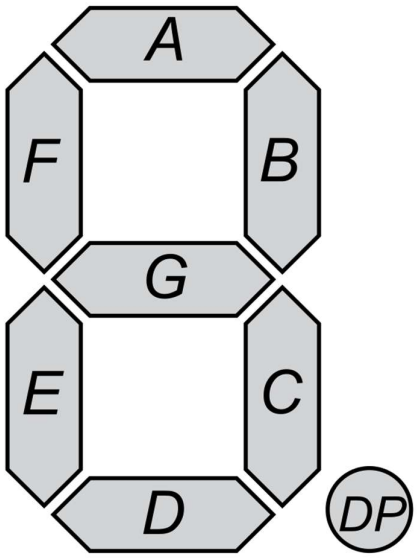




WORKING:

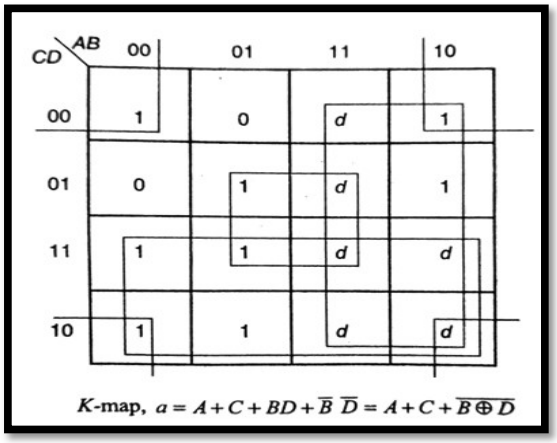
BCD to seven segment decoder is a circuit used to convert the input BCD into a form suitable for the display. It has four input lines (A, B, C and D) and 7 output lines (a, b, c, d, e, f and g). Since only BCD inputs are valid combinations, the other input combination of four variables corresponding to 10, 11, 12, 13, 14 and 15 can be termed as don't care combinations to aid the simplification of logic expressions. Now, the logic expressions corresponding to 7-segment can be written from truth table.

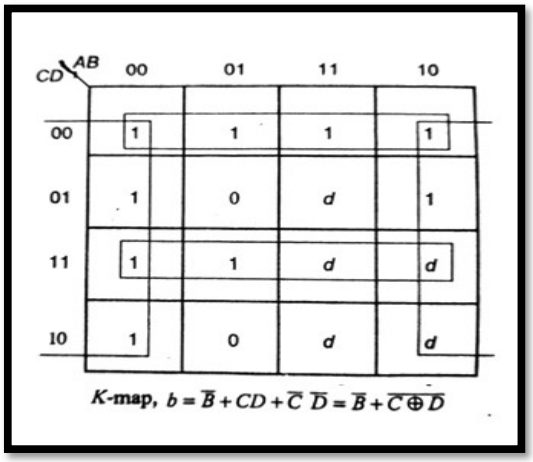
Decimal Digit	Input lines				Output lines							Display pattern
	A	B	C	D	a	b	c	d	e	f	g	
0	0	0	0	0	1	1	1	1	1	1	0	
1	0	0	0	1	0	1	1	0	0	0	0	
2	0	0	1	0	1	1	0	1	1	0	1	
3	0	0	1	1	1	1	1	1	0	0	1	
4	0	1	0	0	0	1	1	0	0	1	1	
5	0	1	0	1	1	0	1	1	0	1	1	
6	0	1	1	0	1	0	1	1	1	1	1	
7	0	1	1	1	1	1	1	0	0	0	0	
8	1	0	0	0	1	1	1	1	1	1	1	
9	1	0	0	1	1	1	1	1	0	1	1	

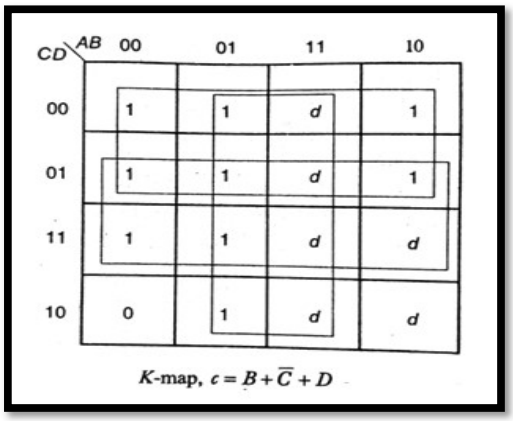


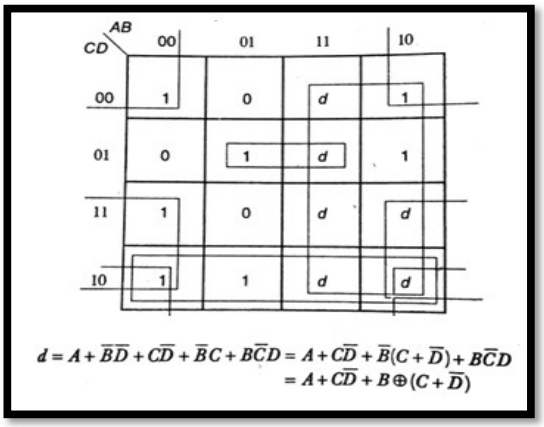
$$a = \Sigma_m(0,2,3,5,6,7,8,9) + \Sigma_d(10,11,12,13,14,15)$$
$$b = \Sigma_m(0,1,2,3,4,7,8,9) + \Sigma_d(10,11,12,13,14,15)$$
$$c = \Sigma_m(0,1,3,4,5,6,7,8,9) + \Sigma_d(10,11,12,13,14,15)$$
$$d = \Sigma_m(0,2,3,5,6,8,9) + \Sigma_d(10,11,12,13,14,15)$$
$$e = \Sigma_m(0,2,6,8) + \Sigma_d(10,11,12,13,14,15)$$
$$f = \Sigma_m(0,4,5,6,8,9) + \Sigma_d(10,11,12,13,14,15)$$
$$g = \Sigma_m(2,3,4,5,6,8,9) + \Sigma_d(10,11,12,13,14,15)$$

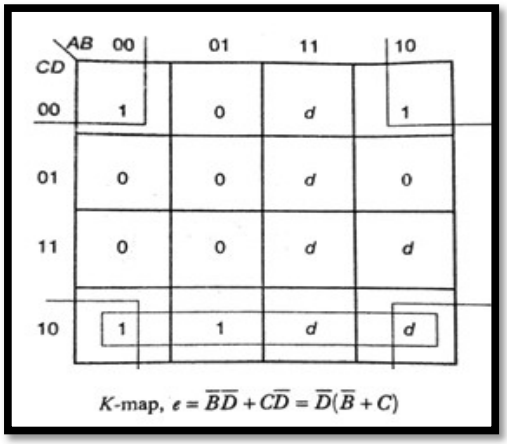
Using KMAPS to find equation from a-g and no of gates required.

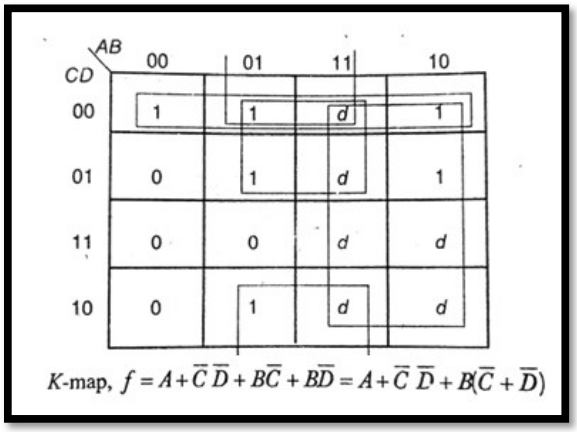


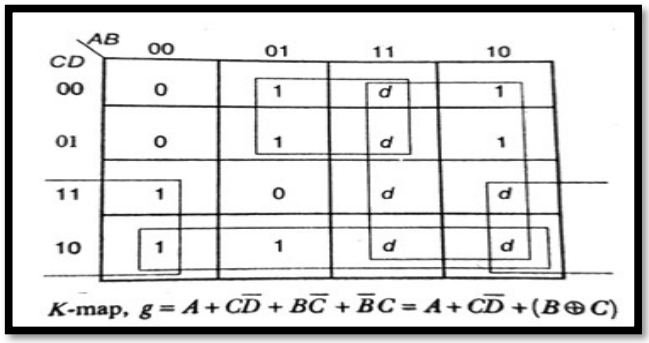




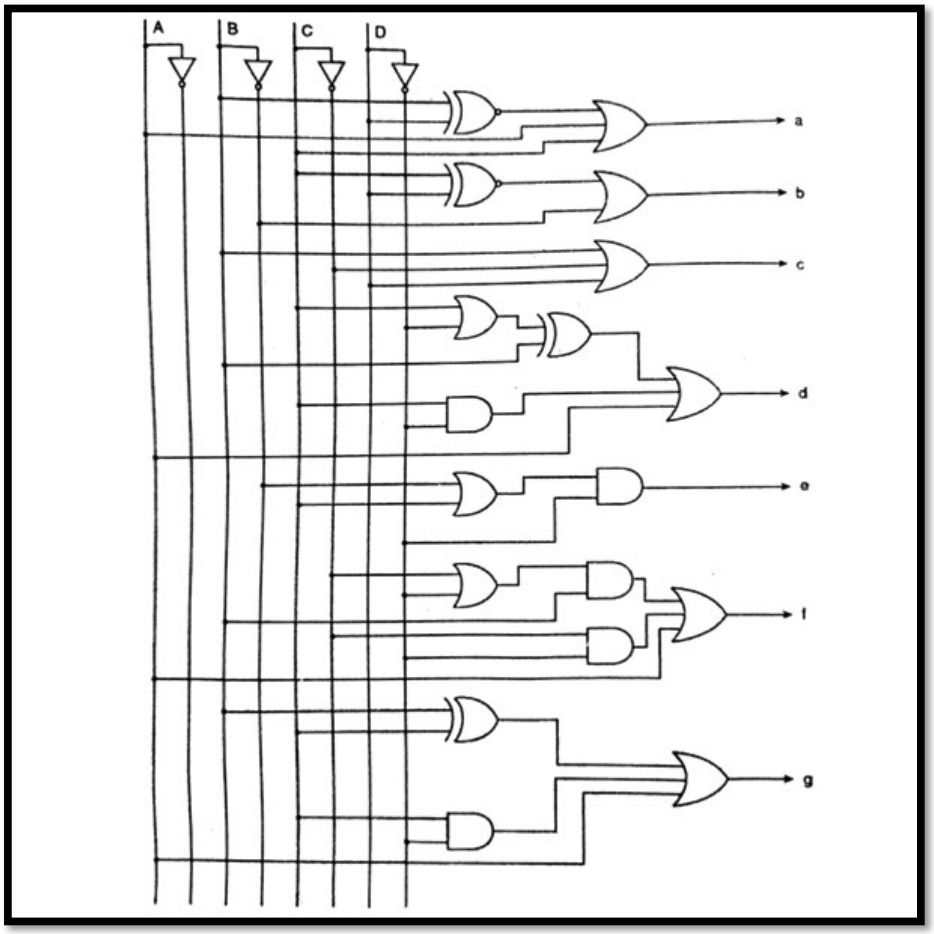




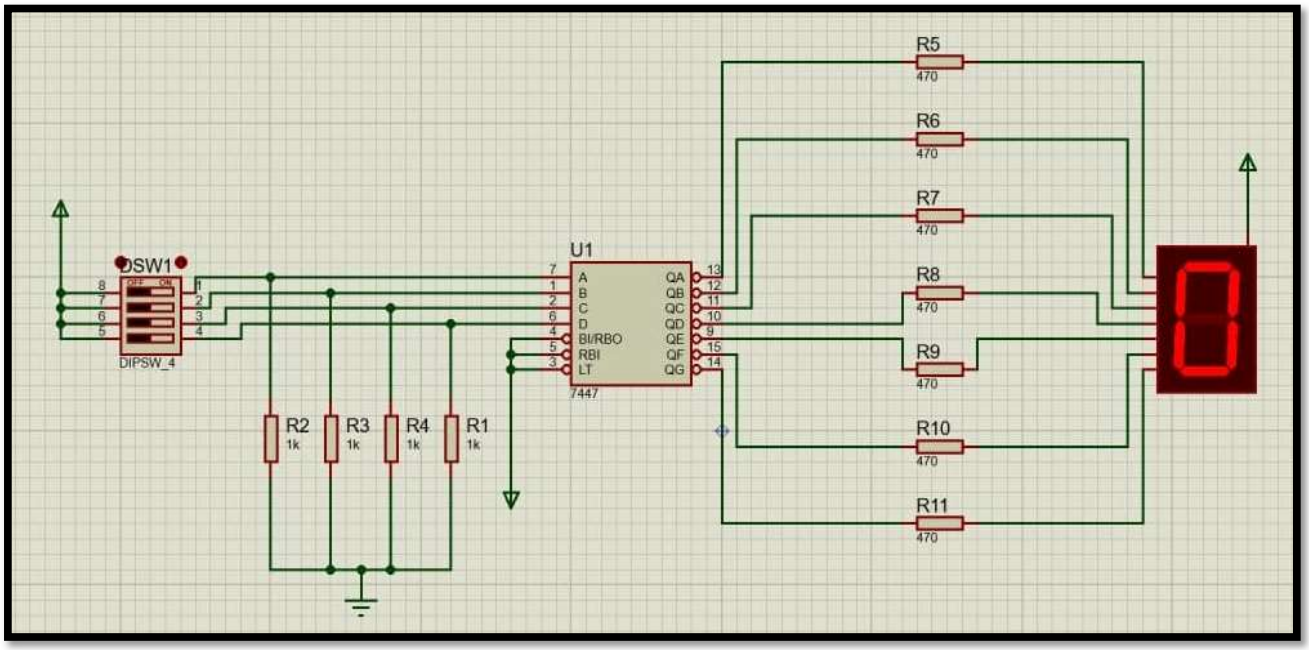




CIRCUIT DIAGRAM FROM ABOVE KMAP EQUATIONS:

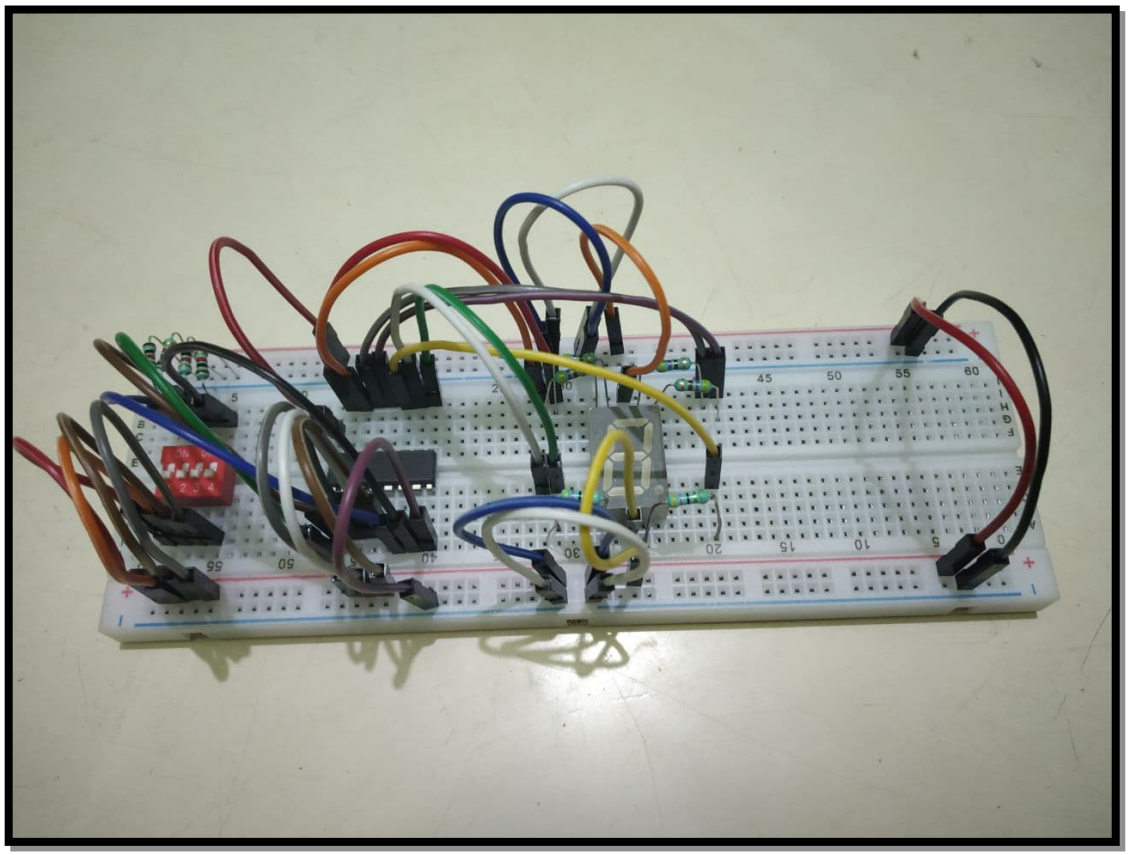


CIRCUIT DIAGRAM:

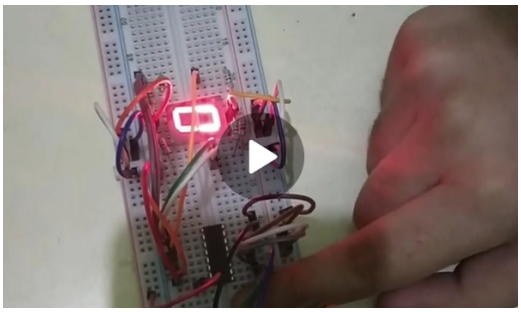


CHAPTER-2

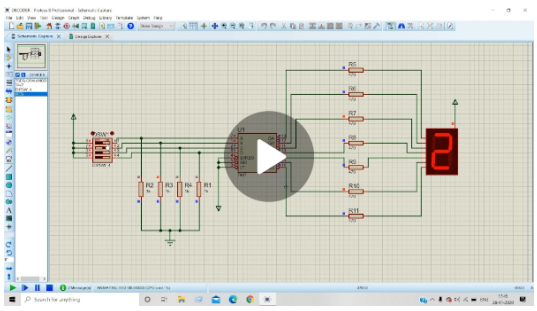
SIMULATION AND HARDWARE:



VIDEO OF HARDWARE SIMULATION:



VIDEO OF PROTEUS 8 SIMULATION:



APPLICATIONS

1) The applications of seven segments are mostly in digital calculators, electronic meters, digital clocks, odometers, digital clocks, clock radios, etc.
2) Today most of the 7 segment applications are using LCDs, because of low current consumption.
3) This circuit can be modified using timers and counters to display the number of clock pulses.
4) This circuit can be modified to develop an alphabet display system instead of a decimal number display system.
5) It can be used as a timer circuit.

CONCLUSION:

It is possible to display any single digit number on a 7-segment display by sending a high digital signal to the specific segments that make up the number. However, this method requires us to encode the letters manually. It is not the best solution to output changing numbers for application such as counters.
It is possible to display the decimal value of a binary number on a 7-segment display using a BCD decoder.
However, this method will allow displaying only digits from 0 to 9 and letters A to F.
The only way to display number more than 9 is to use a display that has more than 7 segments or just using multiple 7-segment displays at once with the corresponding BCD decoder.

In the case of the decoder circuit, any binary number between 1010 through 1111 (A to F) is an invalid input and would provide distorted shapes on the LCD display.

Current limiting resistors of 470 ohms are connected in series between the decoder and each of the LED display segment. They serve to limit the maximum current flow and have no impact on the LCD display.

The usage of a 7-segment display paired with a BCD decoder is opening the door for an application using digital computation requiring a human-readable That application can be for instance: “a clock, a timer, a calculator, counter”

APPENDIX-I

DM74LS47

Absolute Maximum Ratings(Note 6)

Supply Voltage	7V
Input Voltage	7V
Operating Free Air Temperature Range	0°C to +70°C
Storage Temperature Range	−65°C to +150°C

Note 6: The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

Recommended Operating Conditions

Symbol	Parameter	Min	Nom	Max	Units
V_{CC}	Supply Voltage	4.75	5	5.25	V
V_{IH}	HIGH Level Input Voltage	2			V
V_{IL}	LOW Level Input Voltage			0.8	V
I_{OH}	HIGH Level Output Current $\overline{a} - \overline{g}$ @ 15V = V_{OH} (Note 7)			−250	μA
I_{OH}	HIGH Level Output Current $\overline{BI}$ /$\overline{RBO}$			−50	μA
I_{OL}	LOW Level Output Current			24	mA
T_A	Free Air Operating Temperature	0		70	°C

Note 7: OFF-State at $\overline{a}$–$\overline{g}$.

Electrical Characteristics

Over recommended operating free air temperature range (unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ (Note 8)	Max	Units
V_I	Input Clamp Voltage	V_{CC} = Min, I_I = −18 mA			−1.5	V
V_{OH}	HIGH Level Output Voltage	V_{CC} = Min, I_{OH} = Max, V_{IL} = Max, $\overline{BI}$ /RBO	2.7	3.4		V
I_{OFF}	Output HIGH Current Segment Outputs	V_{CC} = 5.5V, V_O = 15V $\overline{a} - \overline{g}$			250	μA
V_{OL}	LOW Level Output Voltage	V_{CC} = Min, I_{OL} = Max, V_{IH} = Min, $\overline{a} - \overline{g}$		0.35	0.5	V
		I_{OL} = 3.2 mA, $\overline{BI}$ /$\overline{RBO}$			0.5	
		I_{OL} = 12 mA, $\overline{a}$ –$\overline{g}$		0.25	0.4	
		I_{OL} = 1.6 mA, $\overline{BI}$ /$\overline{RBO}$			0.4	
I_I	Input Current @ Max Input Voltage	V_{CC} = Max, V_I = 7V			100	μA
		V_{CC} = Max, V_I = 10V				
I_{IH}	HIGH Level Input Current	V_{CC} = Max, V_I = 2.7V			20	μA
I_{IL}	LOW Level Input Current	V_{CC} = Max, V_I = 0.4V			−0.4	mA
I_{OS}	Short Circuit Output Current	V_{CC} = Max (Note 9), I_{OS} at $\overline{BI}$/$\overline{RBO}$	−0.3		−2.0	mA
I_{CC}	Supply Current	V_{CC} = Max			13	mA

Note 8: All typicals are at V_{CC} = 5V, T_A = 25°C.

Note 9: Not more than one output should be shorted at a time, and the duration should not exceed one second.

Switching Characteristics

at V_{CC} = +5.0V, T_A = +25°C

Symbol	Parameter	Conditions	R_L = 665Ω, C_L = 15 pF		Units
			Min	Max	
t_{PLH}	Propagation Delay			100	ns
t_{PHL}	An to $\overline{a}$ –$\overline{g}$			100	
t_{PLH}	Propagation Delay			100	ns
t_{PHL}	$\overline{RBI}$ to $\overline{a}$ –$\overline{g}$ (Note 10)			100	

Note 10: $\overline{LT}$ = HIGH, A0–A3 = LOW

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