BBM233: Logic Design Lab
2021 Fall
Lab Experiment 3 Report

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1 Answer these questions:

What is a 7-segment display and how it works?
7-segment display is a solid state pn-junction diode that contains 7 LEDs, each LED is called a segment. If a particular LED is forward biased, that LED or segment will light and produces a bar of light. By combination of these bars, 7-segment display displays various symbols.
How many types of 7-segment display and are there and what differentiates them from one another?
There are two types of configurations of seven segment displays: common anode display and common cathode display. In common cathode 7-segment displays, all the cathode connections of LED segments are connected together to logic 0 or ground. We use logic 1 through a current limiting resistor to forward bias the individual anode terminals a to g. Whereas all the anode connections of the LED segments are connected together to logic 1 in common anode 7-segment display. We use logic 0 through a current limiting resistor to the cathode of a particular segment a to g.
Why do we need a decoder to use 7-segment displays?
A decoder is a circuit that changes a code into a set of signals, 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. Since 7-segment display has some input segments, we need a circuit to convert primitive inputs to inputs of the 7-segment display. This circuit would be either a common decoder or a custom decoder. Because we try to use 7-segment display for displaying some letters instead of numbers, we have to construct a custom decoder for this problem.
If this assignment were about designing a common anode instead of common cathode, would there be any change in truth table and if yes what kind of change?
If this what if condition occured, values of output lines would shift completely(0's to 1's and 1's to 0's). Truth table of this imaginary condition is shown below:

Letters	Input Lines				Output Lines							Display Pattern
	A	B	C	D	a	b	c	d	e	f	g	
A	0	0	0	0	0	0	0	1	0	0	0	A
E	0	0	0	1	0	1	1	0	0	0	0	E
L	0	0	1	0	1	1	1	0	0	0	1	L
M	0	0	1	1	0	0	0	1	0	0	1	n
N	0	1	0	0	1	1	0	1	0	1	0	n
P	0	1	0	1	0	0	1	1	0	0	0	P
R	0	1	1	0	1	1	1	1	0	1	0	r
S	0	1	1	1	0	1	0	0	1	0	0	S

Figure 1: Truth Table of Imaginary Common Anode Condition

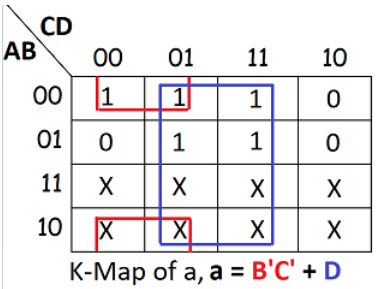
What happens if you apply inputs for which you used don't cares (X), i.e. 8-15? What is shown on the 7-segment display and why?
Since we have 4 inputs, we have 2^4 outputs. By using don't cares for 8 eight input for this problem, we eliminated 8 display patterns. If we apply inputs for 8-15, we will have 8 more display patterns on 7-segment display and these patterns depends on the remaining 8 input combinations.

2 Truth Table

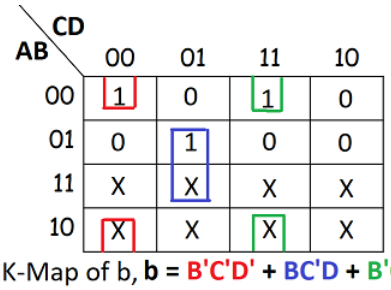
Letters	Input Lines				Output Lines							Display Pattern
	A	B	C	D	a	b	c	d	e	f	g	
A	0	0	0	0	1	1	1	0	1	1	1	A
E	0	0	0	1	1	0	0	1	1	1	1	E
L	0	0	1	0	0	0	0	1	1	1	0	L
M	0	0	1	1	1	1	1	0	1	1	0	n
N	0	1	0	0	0	0	1	0	1	0	1	n
P	0	1	0	1	1	1	0	0	1	1	1	P
R	0	1	1	0	0	0	0	0	1	0	1	r
S	0	1	1	1	1	0	1	1	0	1	1	S

Figure 2: Truth Table of AS-Decoder

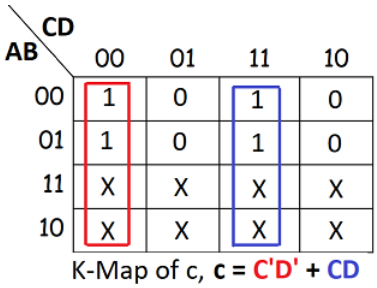
3 Karnaugh Maps and Minimized Boolean Functions in Sum-of-Products Form of Outputs(a-f)



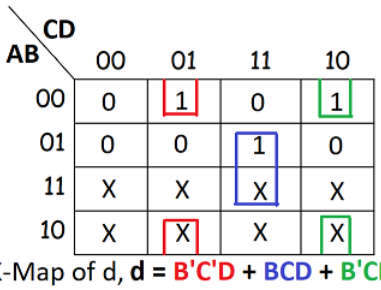
K-Map of a, **a** = B'C' + D



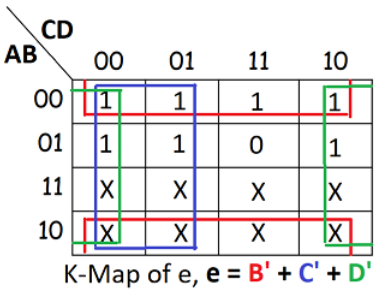
K-Map of b, **b** = B'C'D' + BC'D + B'CD



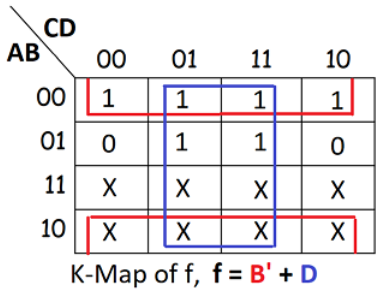
K-Map of c, **c** = C'D' + CD



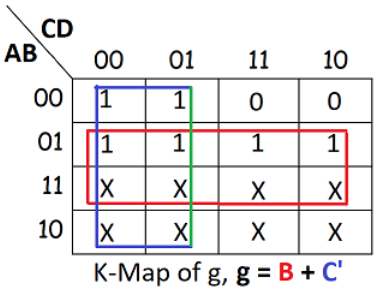
K-Map of d, **d** = B'C'D + BCD + B'CD'



K-Map of e, **e** = B' + C' + D'

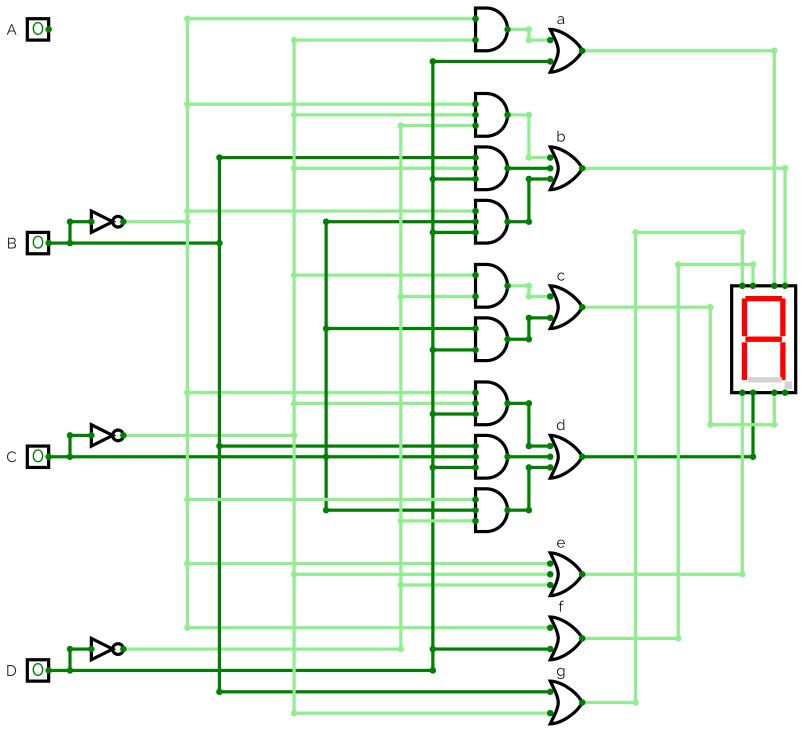


K-Map of f, **f** = B' + D



K-Map of g, **g** = B + C'

4 Implementation of the AS-Decoder Circuit



References

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- https://instrumentationtools.com/seven-segment-display-working-principle/