

## Logic circuit simplification

k-map -> to draw the logic circuit diagram from the Boolean expression we perform the following steps

1. Simplify the given Boolean expression using karnaugh map(k-map)
2. Identify the variables present in the simplified Boolean expression
3. Draw the input line corresponding each Boolean variable
4. Draw the corresponding logic gate using AND,OR,NOT or any other gates remaining.

K-Map → It is the technique to simplifying the Boolean expression using graphical tabular representation. It simplify by combining the similar expression and deleting the repeated variables. It expresses all input and all output values given in truth table in tabular form. As :-

For two variables :- 2 X 2

Truth table

A	B	Y
0	0	0
0	1	1
1	0	0
1	1	1

K-map

A B →

0	1
00	01
0	1
10	11
0	1

For Three Variable  $2^3 \rightarrow (2 \times 4) \rightarrow F(A,B,C) = \Sigma 3, 6, 2, 7) \rightarrow 010$

A \ BC	00	01	11	10
0	0	0	1	1
1	0	0	1	1

k-Map for Four variable :-  $2^4 \rightarrow (4 \times 4) \rightarrow F(A,B,C,D) \rightarrow \Sigma (10,3,7,9,12,14)$

AB \ CD	00	01	11	10
00	0	0	1 3	0
01	0	0	1 7	0
11	1 12	0	0	1 14
10	0	1 9	0	1 10

## SIMPLIFYING EXPRESSION THROUGH K-MAP

To simplify the Boolean expression through k-map we group the 0's and 1's present in the k-map. When adjacent 1's are grouped, SOP of Boolean expression is obtained and when adjacent 0's are grouped, POS form of Boolean expression is obtained.

After the groups of 1's and 0's are marked in a k-map, the groups are analyzed for change of state of input variables. If the variable changes in state from 1 to 0 or vice versa then the variable is eliminated from the term of simplified Boolean expression.

1<sup>st</sup> possibility :- group of two adjacent 1.

	A	BC			
A'B		00	01	11	10
0		0	0	1	1
1		0	0	0	0

	A	BC			
BC		00	01	11	10
0		0	0	1	0
1		0	0	1	0

$$A \quad BC$$

$$AB'C' + ABC' \rightarrow AC'(B+B') \rightarrow AC'$$

	00	01	11	10
0				
1	1			1

$$A \quad BC \quad A'B'C' + A'B'C$$

$$AB'C \rightarrow A'B' + B'C$$

	00	01	11	10
0	1	1		
1		1		

Eq. Simplify the following expression

$$A'BC'D + A'BCD + ABC'D' + AB'C'D' \rightarrow A'B$$

$$D + AC'D'$$

$$AB \quad CD$$

	00	01	11	10
00				
01		1	1	
11	1			
10	1			

Grouping of four adjacent 1's :-

1.

$$A'B'C' + A'B'C + A'BC + A'BC' \rightarrow A'$$

$$A \quad BC$$

	00	01	11	10
0	1	1	1	1
1				

$$A'B'C' + A'B'C + A'BC + A'BC' \rightarrow$$

$$A'B'(C+C') + A'B(C+C') \rightarrow A'B' + A'B \rightarrow A'(B+B') \rightarrow A'$$

2.

$$A'B'C' + A'B'C + AB'C' + AB'C \rightarrow B'$$

A \ BC		00	01	11	10
0	1	1			
1	1	1			

$$A'B'(C+C') + AB'(C+C') \rightarrow A'B' + AB' \rightarrow B'(A+A') \rightarrow B'$$

3.

$$A'B'C' + A'B'C + A'BC + AB'C' + AB'C + ABC \rightarrow B' + BC \rightarrow C + B'C'$$

$$A'B'(C+C') + BC(A+A') + AB'(C+C') \rightarrow A'B' + BC + AB' \rightarrow B'(A+A') + BC$$

A \ BC		00	01	11	10
0	1	1	1		
1	1	1	1		

$$A'B'C' + AB'C' + A'B'C + A'BC + AB'C + ABC \rightarrow B'C'(A+A') + B'C(A+A') + BC(A+A')$$

$$\rightarrow B'C' + B'C + BC \rightarrow B'C' + C(B+B') \rightarrow B'C' + C$$

C

4..

$$A'B'C' + A'BC' + AB'C' + ABC' \rightarrow C'$$

→

A \ BC	00	01	11	10
0	1			1
1	1			1

5..

$$\rightarrow A'B'C'D + A'BC'D + ABC'D + AB'C'D \rightarrow C'D$$

AB \ CD	00	01	11	10
00		1		
01		1		
11		1		
10		1		

$$F(A,B,C) = \Sigma(0,2,3,4,5,6)$$

$$\rightarrow C' + A'B + AB'$$

A \ BC	00	01	11	10
0	1		1	1
1	1	1		1

## Grouping of Eight 1's from K-map

$$\rightarrow A'B'C'D + A'B'CD + A'BC'D + A'BCD + ABC'D + ABCD + AB'C'D + AB'CD \rightarrow D$$

AB \ CD	00	01	11	10
00		1	1	
01		1	1	
11		1	1	
10		1	1	

$$\rightarrow A'B'D(C'+C) + A'BD(C+C') + ABD(C+C') + AB'D(C+C')$$

$$\rightarrow A'B'D + A'BD + ABD + AB'D \rightarrow A'D(B+B') + AD(B+B')$$

$$\rightarrow A'D + AD \rightarrow D(A+A') \rightarrow D$$

2 A'

$$\rightarrow A'B'C'D' + A'B'C'D + A'B'CD + A'B'CD' + A'BC'D' + A'BC'D + A'BCD + A'BCD'$$

AB \ CD	00	01	11	10
00	1	1	1	1
01				
11				
10	1	1	1	1

1.

$$B' \rightarrow A'B'C'D' + A'B'C'D + A'B'CD + A'B'CD' + AB'C'D' + AB'C'D + AB'CD + AB'CD'$$

$$\rightarrow A'B'C'(D+D') + A'B'C(D+D') + AB'C'(D+D') + AB'C(D+D')$$

$$\rightarrow A'B'C' + A'B'C + AB'C' + AB'C$$

$$\rightarrow A'B'(C+C') + AB'(C+C') \rightarrow A'B' + AB' \rightarrow B'(A+A') \rightarrow B'$$

$$\rightarrow D'$$

AB CD

	00	01	11	10
00	1			1
01	1			1
11	1			1
10	1			1

-----X-----  
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