

Paper 7, TDC Part-3
Chapter– 4, Combinational Logic Design
Lecture - 20

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* Diagonal and Offset Adjacencies of Groups of Ones

Now let us see diagonal and offset adjacencies of standard group of ~~the~~ two 1's and obtain their simplified terms.

For this we will take 3 ~~or~~ more variable K-Map. Diagonal and offset adjacencies of groups of ones is not possible for ~~the~~ 2 variable K-Map.

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

Diagonal 1

Group of 2 ones

$$F_1 = A\bar{B} + \bar{A}B$$
$$= \oplus A \oplus B$$

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The image shows two handwritten Karnaugh maps on lined paper. The top map is for a 2-variable function with variables A and B. The bottom map is for a 3-variable function with variables A, B, and C.

Top Karnaugh Map (2 variables):

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

Annotations for the top map: "Group of 2 Ones" with arrows pointing to the two 1s in the A=0 row; "Offset 1" with arrows pointing to the two 1s in the B=1 column.

Bottom Karnaugh Map (3 variables):

AB \ C	00	01	11	10
00	1	1	0	0
01	0	0	1	1
11	0	1	0	1
10	0	1	0	1

Annotations for the bottom map: "Diagonal 1 (F1)" with an arrow pointing to the two 1s in the C=0 row; "Offset 1 (F2)" with arrows pointing to the two 1s in the B=1 column.

Logic Derivation:

$$F_1 = \bar{B}\bar{C} + BC$$
$$= B \odot C$$

Textual Note: "In this K-map there are 4 groups of 2 Ones."

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Diagonal 1
where $F_1 = \bar{A}B\bar{C} + \bar{A}BC = \bar{A}(\bar{B}\bar{C} + BC)$
 $= \bar{A}(B \oplus C)$

Offset 1,
 $F_2 = A\bar{C}D + ACD = A(\bar{C}D + CD)$
 $= A(C \oplus D)$

From this, we observe or conclude that in K-map if grouping of 2 ones occurs in a diagonal or offset adjacent pattern that can be recognised as EX-OR, EX-NOR functions, ~~and~~ ^{so} the function can be simplified in terms of EX-OR, EX-NOR operations.

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Similarly groups of 4 ones in a K-map are in ~~diag.~~ diagonal or offset adjacencies. Their simplified terms are also given by EX-OR/EX-NOR functions.

K-map

below illustrate the diagonal and offset adjacencies of standard groups of four ones

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

Offset Adjacencies

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

Diagonal Adjacencies

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For 1st K-Map we have offset adjacencies of a group of 4 ones and its simplified expression can be given as

$$\begin{aligned}\text{Offset Adjacencies 1, } F_1 &= \bar{A}B + A\bar{B} \\ &= A \oplus B\end{aligned}$$

Whereas

~~Similarly~~ for 2nd K-Map we have diagonal adjacencies of group of 4 ones and its simplified expression can be given as

$$\begin{aligned}\text{Diagonal Adjacencies 1, } F_2 &= B\bar{C} + \bar{B}C \\ &= B \oplus C\end{aligned}$$

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Procedure for EX-OR and EX-NOR Simplification of K-Maps :-

- The K-Map should be simplified first using standard methods ~~and then the~~
- Then the diagonal / Offset adjacencies must be identified.
- The expression obtained ~~can~~ ^{can} be simplified partially by using boolean theorems and EX-OR / EX-NOR operations.

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Refer book- Modern Digital Electronics by RP Jain.

Thank You