IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 5, May 2023

DOI: 10.17148/IJARCCE.2023.125284

Combinational Logic Circuit (SOP & POS)

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Abstract: Combinational Logic Circuits are made up from basic logic gates like NAND gate, NOR gate or NOT gate that are connected together to generate complicated switching circuits. The building blocks of combinational logic circuits are all the logic gates. Decoder is an example of a combinational circuit is a, that converts the binary data in input into a number of different output lines in decimal code at its output user.

Keywords: AND, OR**,** NAND, NOR, NOT.

I. INTRODUCTION

The combinational logic circuit are specified in following ways:
1. Boolean Algebra
2. Truth Table
3. Logic Diagram

II. LITERATURE SERVEY

I. V. Anand and A. Kamara said in their paper that the circuits like Logic gates, Adders, Multipliers are the basic building block of the digital circuits. These combinational circuits can be designed by using the concepts of the reversible logic. The reversible logic is either a physically reversible or logically reversible. [1] As per the opinion of N. Divya, G. Ilakkiya, M. Dheeraj, R. Hinduja, M. G. Nathan and M. Harish Digital circuits are of combinational logic circuits and sequential circuits.[2]P. Y. J, J. S, M. J and A. E explained in their paper that Conventional methods to design combinational logic circuits (CLCs) is time consuming and needs expert knowledge[3].

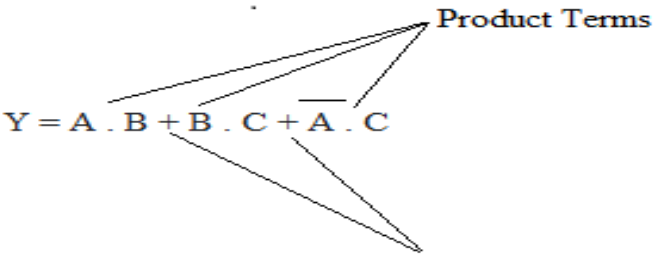
III. DESCRIPTION

A Standard Form of Combinational Circuit:
Combinational Logic circuits are represented in Standard Boolean formats. A Boolean variable can be expressed in either true form or complemented form that is in positive form or negative form. In standard form Boolean function will contain all the variables in either true form or in complemented form while in canonical number of variables depends on the output of SOP (Sum of Product) or POS (Product of Sum).

e. g

$$Y = A\,B\,C + A\,\overline{B}\,C$$

Sum of Products (SOP):
SOP (Sum of Products) form is a form of expression in Boolean algebra in which different **product** terms of inputs are being **sum**med together. This **product** is not arithmetical multiply but it is Boolean logical **AND** and the **Sum** is Boolean logical **OR.**
e. g



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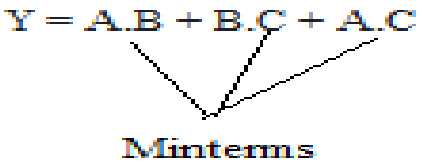
Sum of Products (SOP) Min Term

Min Term can be defined as, when the minimum combinations of inputs are high then the output will be high. The best example of this is AND gate, so we can say that min terms are combinations of AND gate inputs either in positive or in negative form.In short 0 = Negative ,1= Positive e.g.



SOP (Minterms):

A	B	C	Minterm
0	0	0	$m0=\overline{A}.\overline{B}.\overline{C}$
0	0	1	$m1=\overline{A}.\overline{B}.C$
0	1	0	$m2=\overline{A}.B.\overline{C}$
0	1	1	$m3=\overline{A}.B.C$
1	0	0	$m4=A.\overline{B}.\overline{C}$
1	0	1	$m5=A.\overline{B}.C$
1	1	0	$m6=A.B.\overline{C}$
1	1	1	$m7=A.B.C$

Representation of SOP:

$Y = A\,B\,C + \overline{A}.B.C + A.\overline{B}.C + A.B.\overline{C}$

$= m7 + m3 + m5 + m6$

$=\Sigma\,(3,5,6,7)$

Minterms will be denoted by m

Expression will be denoted by : Σ (SUMMATION)

Example:

SOP Y1= Σ(3,5,7)

Y1= m3,m5,m7

$Y1= \overline{A}.B.C + A.\overline{B}.C + A.B.C$

Product Of Sum (POS):

The product of Sum form is a form in which products of different sum terms of inputs are taken. These are not arithmetic product and sum but they are logical Boolean AND and OR respectively.

e.g.

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$$Y=(A+B+C)(\bar{A}+B+C)(\bar{A}+\bar{B}+C)(\bar{A}+\bar{B}+\bar{C})$$

SUM Terms

POS Maxterms :

A	B	C	Maxterm
0	0	0	$M0 = A + B + C$
0	0	1	$M1 = A + B + \bar{C}$
0	1	0	$M2 = A + \bar{B} + C$
0	1	1	$M3 = A + \bar{B} + \bar{C}$
1	0	0	$M4 = \bar{A} + B + C$
1	0	1	$M5 = \bar{A} + B + \bar{C}$
1	1	0	$M6 = \bar{A} + \bar{B} + C$
1	1	1	$M7 = \bar{A} + \bar{B} + \bar{C}$

REPRESENTATION POS (Max Terms)

$Y=(A+B+C)(\bar{A}+B+C)(\bar{A}+\bar{B}+C)(\bar{A}+\bar{B}+\bar{C})$
= M0 + M4 + M6 + M7
= Π (0,4,6,7)
Maxterms will be denoted by :M
Expression will be denoted by : Π (Pi)
In short 1=Negative ,0= Positive

Example

Write SOP and POS Expression for given Y
Y= Π (1,2,4,6,7)
= M1,M2,M4,M6,M7

$$=(A + B + \bar{C}).(A + \bar{B} + C).(\bar{A} + B + C).(\bar{A} + \bar{B} + C).(\bar{A} + \bar{B} + \bar{C})$$

This is POS Expression

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