

# Minimization of Boolean Functions using K-maps

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### Abstract

This manual explains how to minimize the boolean functions using K-maps.

## 1 COMPONENTS

component	value	quantity
Breadboard		1
Resistor	220ohm	1
Arduino	Uno	1
Sevensegment display	Common anode	1
Jumper wires		20

## 2 K-Maps

The Karnaugh map or K-map is used for minimization or simplification of Boolean function either in Sum of Product(SOP) form or in Product of Sum(POS) form. A Karnaugh map is similar to a truth table because it presents all of the possible values of input variables and the resulting output for each value. Instead of being organized into columns and rows like a truth table, the Karnaugh map is an array of cells in which each cell represents a binary value of the input variables. The cells are arranged in a way so that simplification of a given

expression is simply a matter of properly grouping the cells. Karnaugh maps can be used for expressions with two, three, four and five variables. Another method, called the Quine-McClusky method can be used for higher numbers of variables. The number of cells in a Karnaugh map is equal to the total number of possible input variable combinations as is the number of rows in a truth table. For three variables, the number of cells is  $2^3 = 8$ . For four variables, the number of cells is  $2^4 = 16$ .

### 3 Minimization

The boolean function given in (1) is minimized using 3-variable K-maps. Equation for F is

$$F = A'B'C' + A'BC' + A'BC + ABC' \quad (1)$$

the implicants 2,3 form a pair and results in the equation

$$A'B \quad (2)$$

the implicants 2,6 form a pair and results in the equation

$$B'C \quad (3)$$

the implicants 0,2 form a pair and results in the equation

$$A'C' \quad (4)$$

		$X_1X_0$			
		00	01	11	10
$X_2$	0	1	0	1	1
	1	0	0	0	1

Finally the minimized boolean function is represented by F' in (5)

## 4 Hardware



<b>Arduino</b>	2	3	4	5	6	7	8	com	dot
<b>Display</b>	a	b	c	d	e	f	g	5V	GRD

Make the connections as per Table and execute the following program.

<https://github.com/SyedTabassumNazeer/FWC/blob/main/main.cpp>