

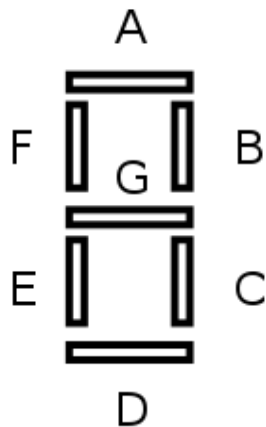
# Number of Segments Circuit PC/CP220 Project Phase I

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## Description

Seven segment displays are common in electronics. They consist of an arrangement of LEDs as shown below:



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Table 1 shows how numbers are typically displayed and how many segments are lit in each case:











number	display	segments lit	number of segments lit
0		a,b,c,d,e,f	6
1		b,c	2
2		a,b,d,e,g	5
3		a,b,c,d,g	5
4		b,c,f,g	4
5		a,c,d,f,g	5
6		a,c,d,e,f,g	6
7		a,b,c	3
8		a,b,c,d,e,f,g	7
9		a,b,c,d,f,g	6

Table 1: Digit display

The **Number of Segments Circuit** will indicate how many segments will be lit in a 7-segment display for a number from 0 to 9.

## Inputs

The **Number of Segments Circuit** will have four inputs,  $a_0$  to  $a_3$ , which give the binary representation of the *number to be displayed*. ( $a_0$  is the least significant bit.) (Four bits are required for numbers up to 9.)

## Outputs

The **Number of Segments Circuit** will have three outputs ,  $b_0$  to  $b_2$ , which give the binary representation of the *number of segments which will be lit*. ( $b_0$  is the least significant bit.) (Three bits are required for numbers up to 7.)

## Ambiguous cases

There are alternative possible displays for the numbers 6 and 9, which are shown in Table 2.

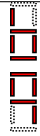
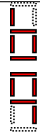
number	display	segments lit	number of segments
6		c,d,e,f,g	5
9		a,b,c,f,g	5

Table 2: Alternative possibilities

These are *not* going to be used, in favour of the versions shown in Table 1.

## Error conditions

Input binary numbers above 9 represent error conditions. Those would typically be indicated by a blank display, i.e. one with zero segments displayed. This is summarized in Table 3.

number	status	number of segments
10	error	0
11	error	0
12	error	0
13	error	0
14	error	0
15	error	0

Table 3: Error conditions

## Final Truth Table

Table 4 gives a summary of the circuit's behaviour.

















number	$a_3a_2a_1a_0$	display	number of segments	$b_2b_1b_0$
0	0000		6	110
1	0001		2	010
2	0010		5	101
3	0011		5	101
4	0100		4	100
5	0101		5	101
6	0110		6	110
7	0111		3	011
8	1000		7	111
9	1001		6	110
10	1010		error	000
11	1011		error	000
12	1100		error	000
13	1101		error	000
14	1110		error	000
15	1111		error	000

Table 4: Truth Table