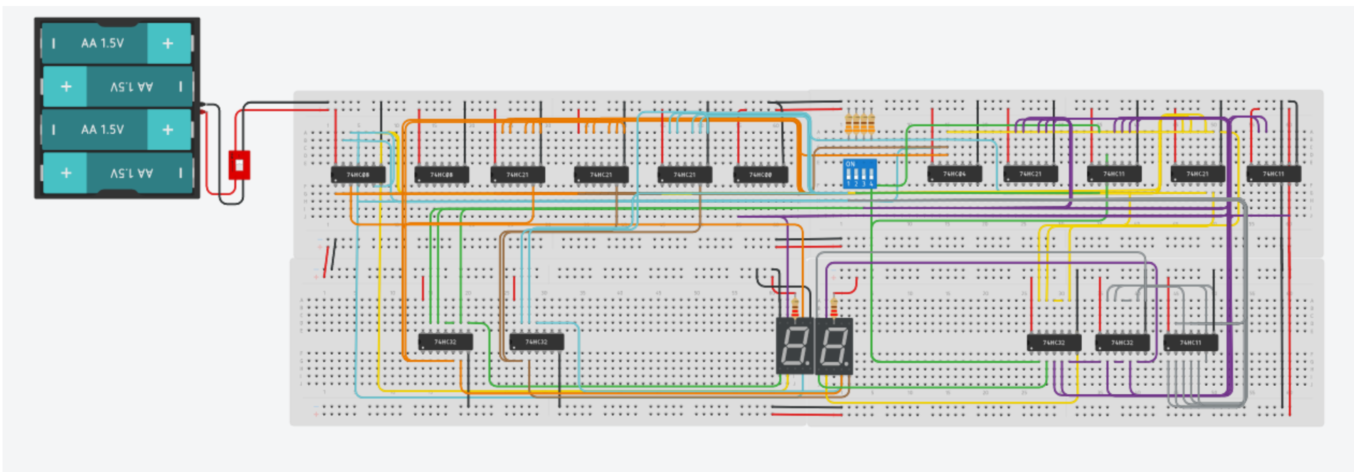
Boolean Algebra Summative Project



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Summary

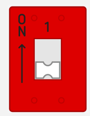
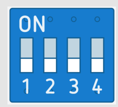
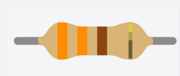
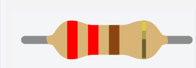
Purpose

The purpose of this circuit is to demonstrate a two-digit common anode display capable of showing numbers ranging from 28 to 43, which are all operated by the DIP switches. To begin with, the red DIP switch indicates the enable input, meaning that this entire circuit is controlled by the enable switch, which can consequently turn off and on the entire circuit at any given moment. Furthermore, the common anode 7 segment displays are both operated by four different DIP switches which are represented as binary inputs. These switches are listed alphabetically from A to D, with A being the most significant bit and D being the least significant bit. Pulldown resistors are also used for all the DIP switches as well as the 7-Segment Displays. The resistors are all mounted to 330 ohms, which is the ideal level of resistance to maintain the current flowing smoothly and protect the components from voltage spikes. Moreover, this circuit is organized such that the AND & NAND gates are all located on top of the circuit whereas the OR gates are located on the downside of the circuit, along with the two-digit anode displays being in the center. This entitles my circuit to be neat and well structured, allowing the user to trace and troubleshoot effortlessly. Overall, I am extremely content with the functionality and organization of my circuit and I am glad that I chose this option as I was able to learn and develop a lot of new skills and knowledge from this summative.

Testing

Although I have organized my circuit by labeling the components, color coding the wires, and leaving small notes, nevertheless, I will explicitly explain how someone can test my circuit. Keep in mind, the red enable bit controls the whole circuit. As a result, in order to test the circuit, turning on the enable bit is the first step, or else the circuit will never turn on. In addition, once you have turned on the enable bit, you can now test out the circuit through the blue quad-switch which controls the two-digit anode display. Be mindful of the fact that the switches are listed alphabetically from A to D, with A being the most significant bit and D being the least significant bit. Finally, once you follow all these procedures, you have a fully functional, intricate yet straightforward, anode display.

Part List

1.5 V Battery (4 Batteries)	
Dip Switch DPST	
DIP Switch SPST x4	
Resistors x6 • 220Ω x 2 • 330Ω x 4	 
AND Gates x10 • Quad AND Gate x7 • Triple 3 Input AND Gate x3	 
Quad NAND Gate x1	
Quad OR Gates x4	
Hex Inverter x1	
Common Anode 7 Segment Display x2	

Wire List

In order to make the circuit organized and easy to troubleshoot, I have colour coded all wires based on their segments for both common anode displays. I have also used the standard colour codes for the power and ground wires. Refer to the table below where I have listed all the colour codes for different wires.

Orange	**Segment a**
Brown	**Segment b**
Turquoise	**Segment c**
Yellow	**Segment d**
Green	**Segment e**
Purple	**Segment f**
Gray	**Segment g**
Red	**Power (VCC)**
Black	**Ground (GND)**

Process Work

Truth Table

A	B	C	D	Y	a	b	c	d	e	f	g	a	b	c	d	e	f	g
0	0	0	0	28	0	0	1	0	0	1	0	0	0	0	0	0	0	0
0	0	0	1	29	0	0	1	0	0	1	0	0	0	0	0	1	0	0
0	0	1	0	30	0	0	0	0	1	1	0	0	0	0	0	0	0	1
0	0	1	1	31	0	0	0	0	1	1	0	1	0	0	1	1	1	1
0	1	0	0	32	0	0	0	0	1	1	0	0	0	1	0	0	1	0
0	1	0	1	33	0	0	0	0	1	1	0	0	0	0	0	1	1	0
0	1	1	0	34	0	0	0	0	1	1	0	1	0	0	1	1	0	0
0	1	1	1	35	0	0	0	0	1	1	0	0	1	0	0	1	0	0
1	0	0	0	36	0	0	0	0	1	1	0	0	1	0	0	0	0	0
1	0	0	1	37	0	0	0	0	1	1	0	0	0	0	1	1	1	1
1	0	1	0	38	0	0	0	0	1	1	0	0	0	0	0	0	0	0
1	0	1	1	39	0	0	0	0	1	1	0	0	0	0	0	1	0	0
1	1	0	0	40	1	0	0	1	1	0	0	0	0	0	0	0	0	1
1	1	0	1	41	1	0	0	1	1	0	0	1	0	0	1	1	1	1
1	1	1	0	42	1	0	0	1	1	0	0	0	0	1	0	0	1	0
1	1	1	1	43	1	0	0	1	1	0	0	0	0	0	0	1	1	0

K-maps for 7-Segment Display #1

For a	C'D'	C'D	CD	CD'
A'B'	0	0	0	0
A'B	0	0	0	0
AB	1	1	1	1
AB'	0	0	0	0

Expression

$a = AB$

For b	C'D'	C'D	CD	CD'
A'B'	0	0	0	0
A'B	0	0	0	0
AB	0	0	0	0
AB'	0	0	0	0

Expression

$b = 0$

For c	C'D'	C'D	CD	CD'
A'B'	1	1	0	0
A'B	0	0	0	0
AB	0	0	0	0
AB'	0	0	0	0

Expression

$c = \overline{ABC}$

For d	C'D'	C'D	CD	CD'
A'B'	0	0	0	0
A'B	0	0	0	0
AB	1	1	1	1
AB'	0	0	0	0

Expression

$d = AB$

For e	C'D'	C'D	CD	CD'
A'B'	0	0	1	1
A'B	1	1	1	1
AB	1	1	1	1
AB'	1	1	1	1

Expression

$e = A + B + C$

For f	C'D'	C'D	CD	CD'
A'B'	1	1	1	1
A'B	1	1	1	1
AB	0	0	0	0
AB'	1	1	1	1

Expression

$f = \overline{A} + \overline{B}$

For g	C'D'	C'D	CD	CD'
A'B'	0	0	0	0
A'B	0	0	0	0
AB	0	0	0	0
AB'	0	0	0	0

Expression

$g = 0$

K-maps for 7-Segment Display #2

For a2	C'D'	C'D	CD	CD'
A'B'	0	0	1	0
A'B	0	0	0	0
AB	0	1	0	0
AB'	0	0	0	0

Expression

$a = \overline{A}\overline{B}CD + AB\overline{C}D + \overline{A}BC\overline{D}$

For b2	C'D'	C'D	CD	CD'
A'B'	0	0	0	0
A'B	0	0	1	0
AB	0	0	0	0
AB'	1	0	0	0

Expression

$b = \overline{A}BCD + A\overline{B}\overline{C}\,\overline{D}$

For c2	C'D'	C'D	CD	CD'
A'B'	0	0	0	0
A'B	1	0	0	0
AB	0	0	0	1
AB'	0	0	0	0

Expression

$c = \overline{A}B\overline{C}\widehat{D} + ABC\overline{D}$

For d2	C'D'	C'D	CD	CD'
A'B'	0	0	1	0
A'B	0	0	0	1
AB	0	1	0	0
AB'	0	1	0	0

Expression

$d = A\overline{C}D + \overline{AB}CD + \overline{A}BC\overline{D}$

For e2	C'D'	C'D	CD	CD'
A'B'	0	1	1	0
A'B	0	1	1	1
AB	0	1	1	0
AB'	0	1	1	0

Expression

$e = D + \overline{A}BC$

For f2	C'D'	C'D	CD	CD'
A'B'	0	0	1	0
A'B	1	1	0	0
AB	0	1	1	1
AB'	0	1	0	0

Expression

$f = \bar{A}B\bar{C} + A\bar{C}D + \overline{AB}CD + ABC$

For g2	C'D'	C'D	CD	CD'
A'B'	0	0	1	1
A'B	0	0	0	0
AB	1	1	0	0
AB'	0	1	0	0

Expression

$g = \overline{AB}C + AB\bar{C} + A\bar{C}D$

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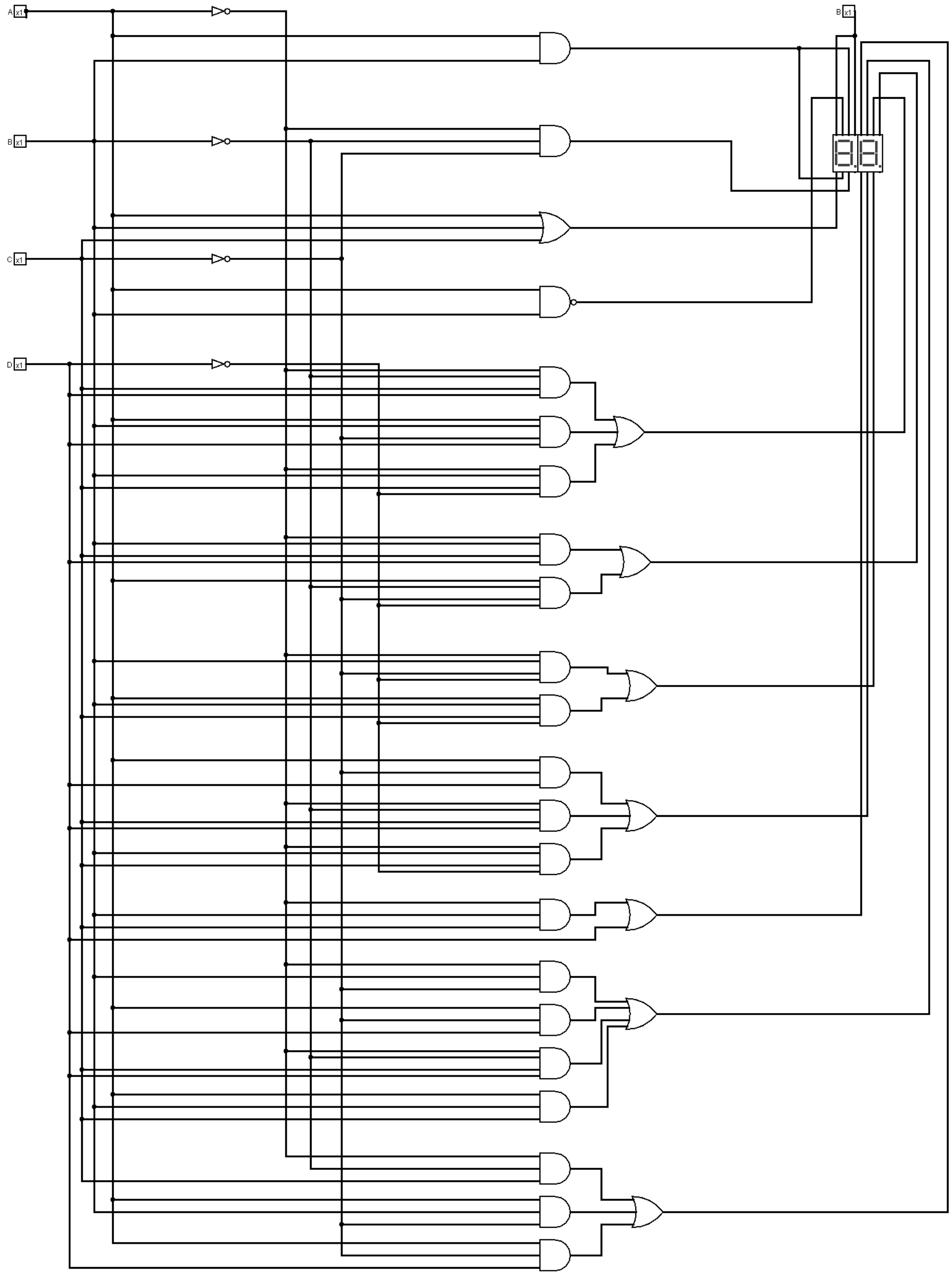
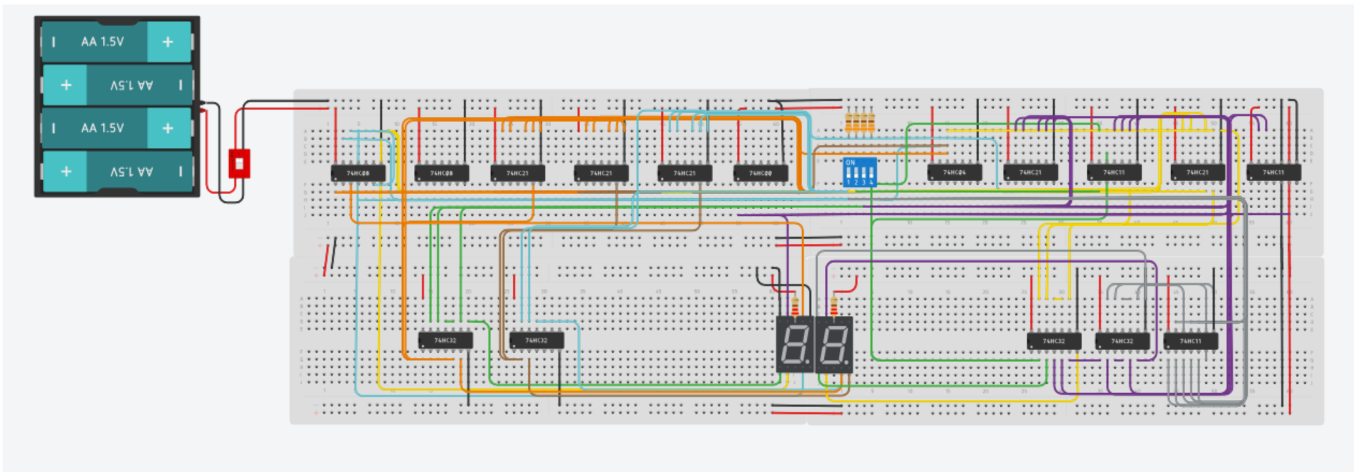


Tinkercad Link



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