Dela Rosa. Pamella Jei S.
2020-06676

CS 20 Laboratory 5: Combinational Circuit Design

1. (7pts, 1pt each) Show a single truth table which includes all the 7 outputs for all the possible values of DCBA.

	D	C	B	A	a	b	c	d	e	f	g
0	0	0	0	0	1	1	1	1	1	1	0
1	0	0	0	1	0	1	1	0	0	0	0
2	0	0	1	0	1	1	0	1	1	0	1
3	0	0	1	1	1	1	1	1	0	0	1
4	0	1	0	0	0	1	1	0	0	1	1
5	0	1	0	1	1	0	1	1	0	1	1
6	0	1	1	0	1	0	1	1	1	1	1
7	0	1	1	1	1	1	1	0	0	0	0
8	1	0	0	0	1	1	1	1	1	1	1
9	1	0	0	1	1	1	1	1	0	1	1
A	1	0	1	0	1	1	1	0	1	1	1
b	1	0	1	1	0	0	1	1	1	1	1
C	1	1	0	0	1	0	0	1	1	1	0
d	1	1	0	1	0	1	1	1	1	0	1
E	1	1	1	0	1	0	0	1	1	1	1
F	1	1	1	1	1	0	0	0	1	1	1

2. (7pts, 1pt each) Solve for the minimized product-of-sums expressions of a, b, c, d, e, f, g. Show the groupings made using an annotated K-map.

   k-map of expression a:

DC \ BA	00	01	11	10
00	1	0	1	1
01	0	1	1	1
11	1	0	1	1
10	1	1	0	1

POS of expression a: **a = (D+C'+B+A) (D+C+B+A') (D'+C'+B+A') (D'+C+B'+A')**

k-map of expression b:

DC \ BA	00	01	11	10
00	1	1	1	1
01	1	0	1	0
11	0	1	0	0
10	1	1	0	1

POS of expression b: **b = (D+C'+B+A') (D'+C'+A) (D'+B'+A') (C'+B'+A)**

k-map of expression c:

DC \ BA	00	01	11	10
00	1	1	1	0
01	1	1	1	1
11	0	1	0	0
10	1	1	1	1

POS of expression c: **c = (D+C+B'+A) (D'+C'+B') (D'+C'+A)**

k-map of expression d:

DC \ BA	00	01	11	10
00	1	0	1	1
01	0	1	0	1
11	1	1	0	1
10	1	1	1	0

POS of expression d: **d = (D+C'+B+A) (D+C+B+A') (C'+B'+A') (D'+C+B'+A)**

k-map of expression e:

DC \ BA	00	01	11	10
00	1	0	0	1
01	0	0	0	1
11	1	1	1	1
10	1	0	1	1

POS of expression e: **e = (C+B+A') (D+C'+B) (D+A')**

k-map of expression f:

DC \ BA	00	01	11	10
00	1	0	0	0
01	1	1	0	1
11	1	0	1	1
10	1	1	1	1

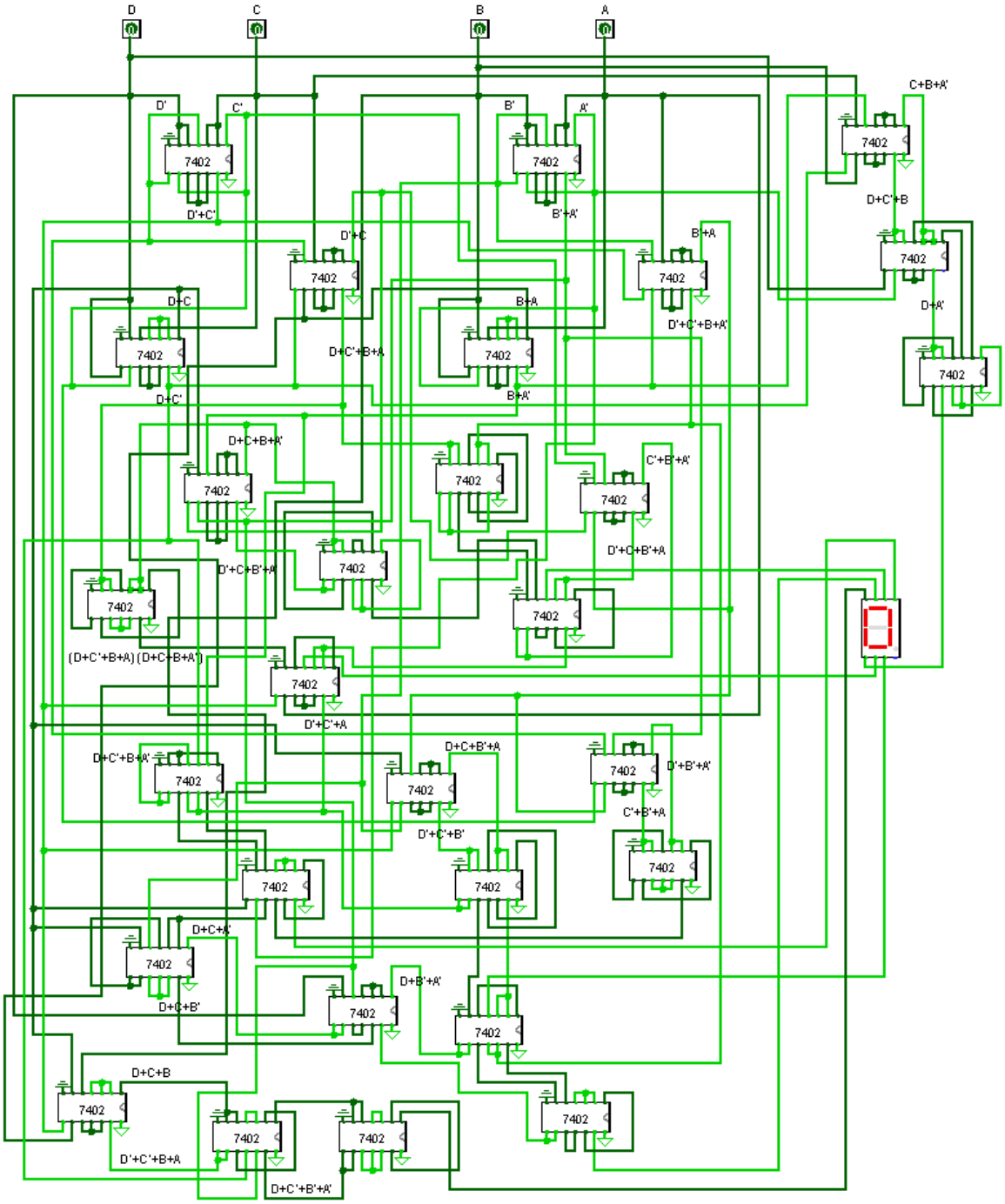
POS of expression f: **f = (D+C+A') (D+C+B') (D+B'+A') (D'+C'+B+A')**

k-map of expression g:

DC \ BA	00	01	11	10
00	0	0	1	1
01	1	1	0	1
11	0	1	1	1
10	1	1	1	1

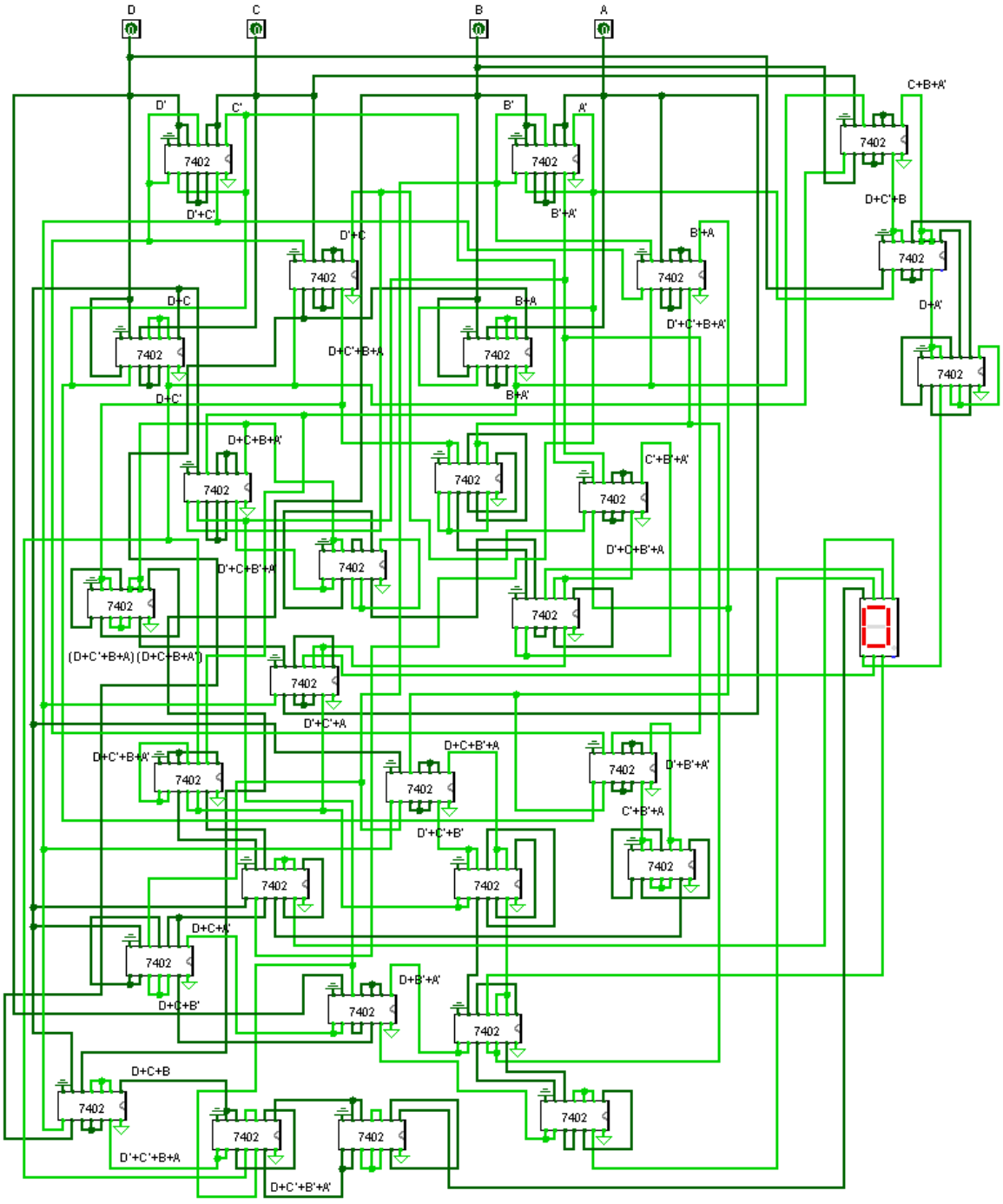
POS of expression g: **g = (D+C+B) (D'+C'+B+A) (D+C'+B'+A')**

3. Modify/simplify the logic circuit design by using only 74LS02 ICs. Show the circuit diagram of the new design.



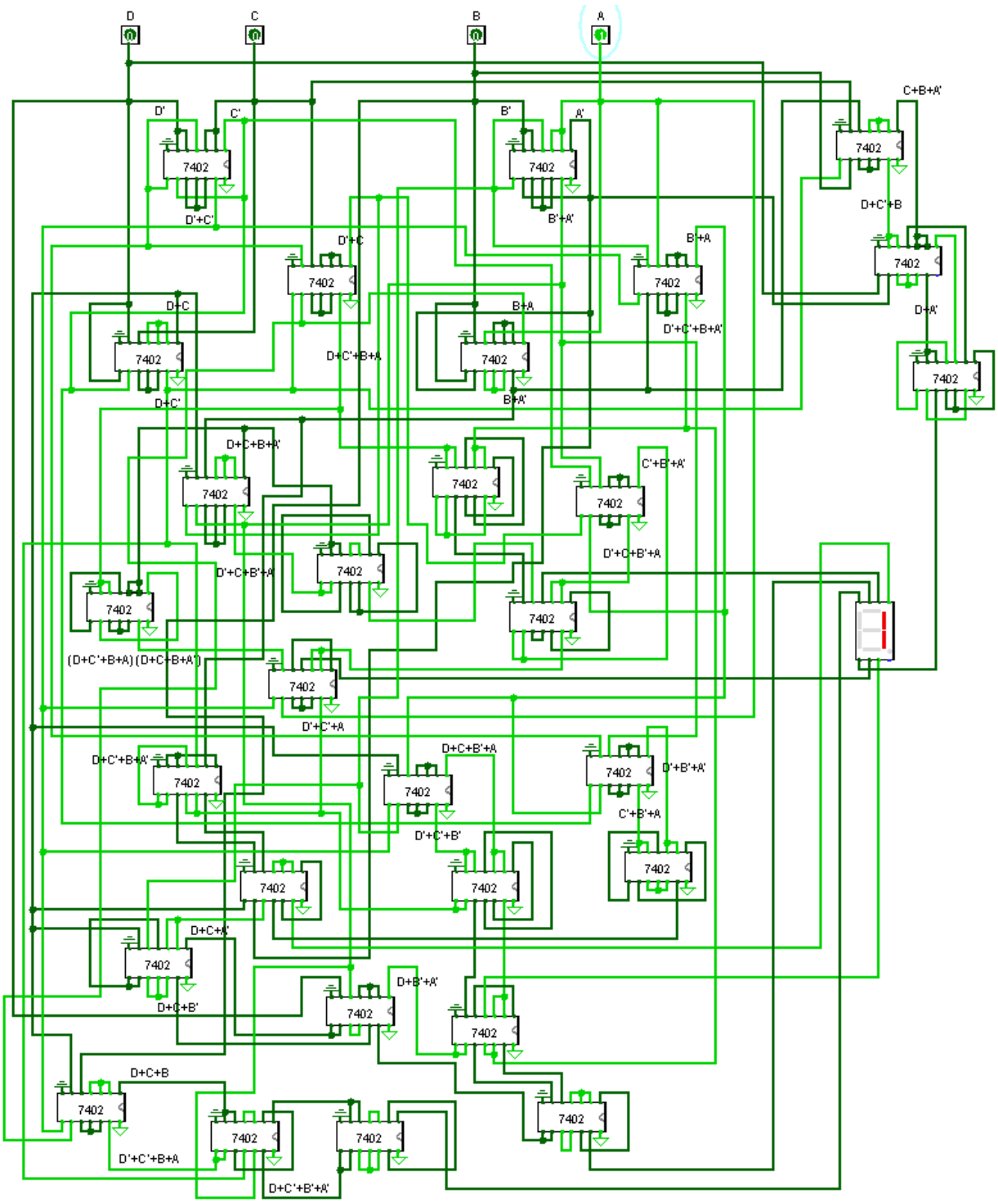
4. (6pts) Show through pictures that the implementation works correctly for all possible values of DCBA.

   DCBA = 0000



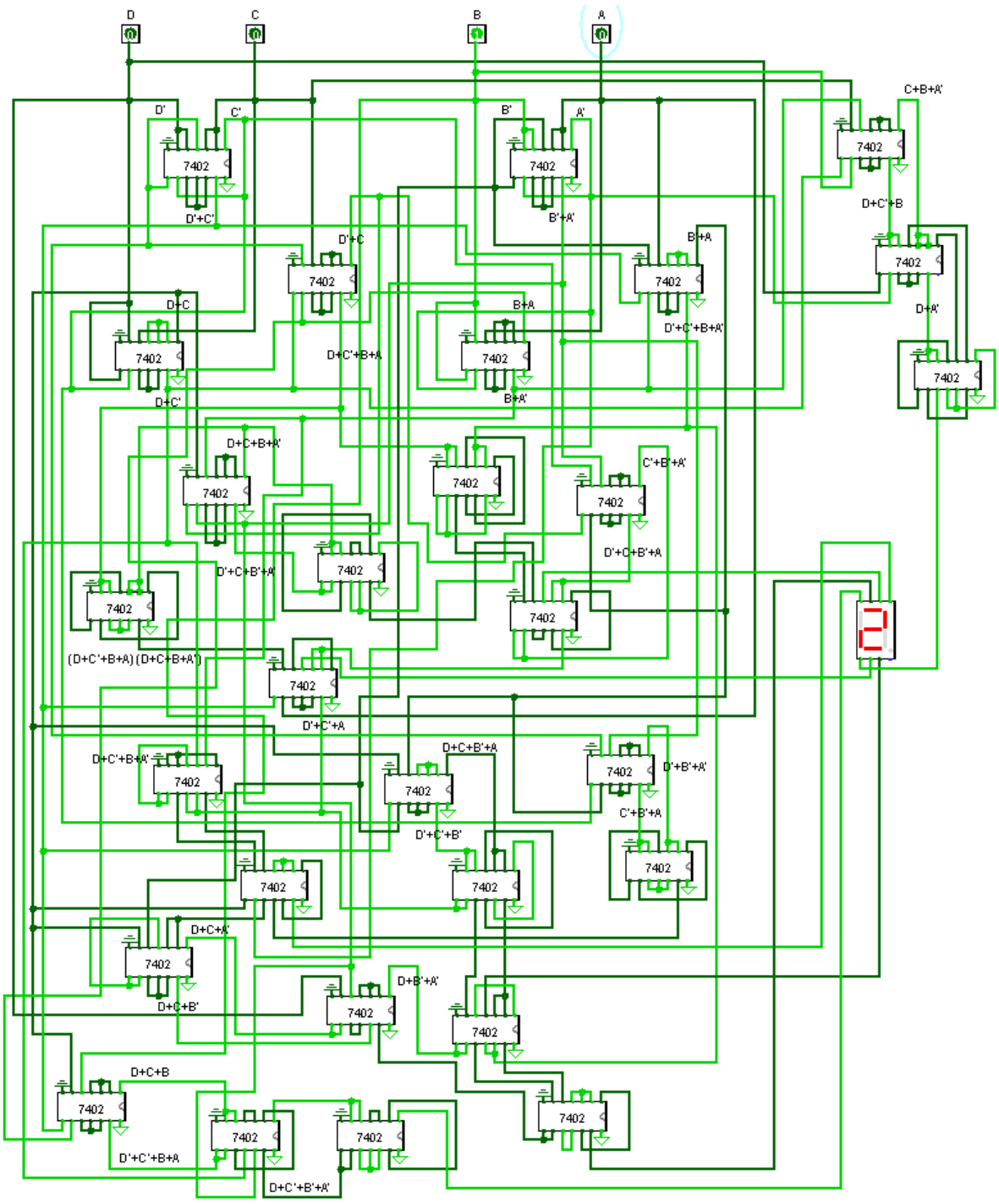
Dela Rosa. Pamella Jei S.
2020-06676

DCBA = 0001

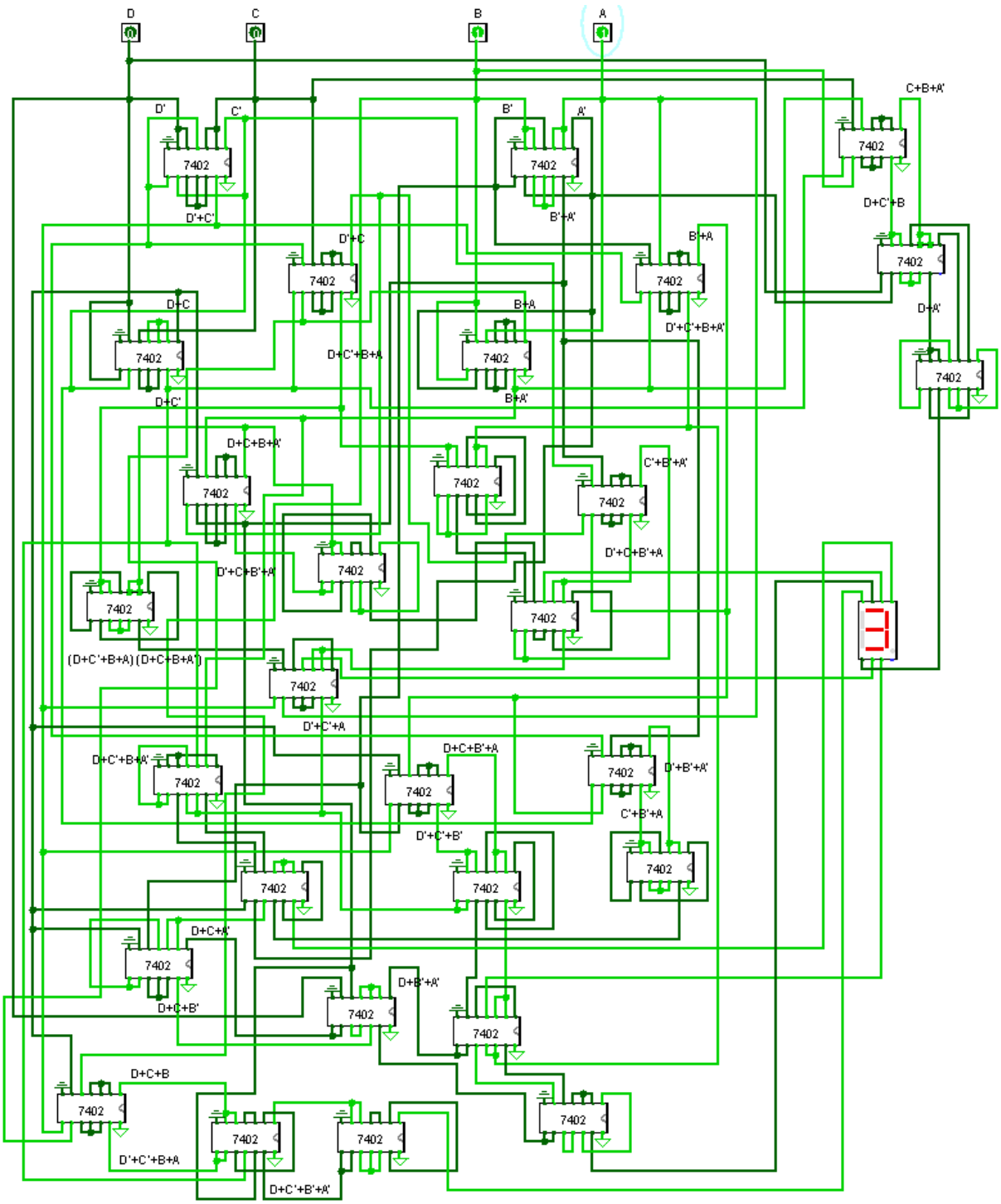


Dela Rosa. Pamella Jei S.
2020-06676

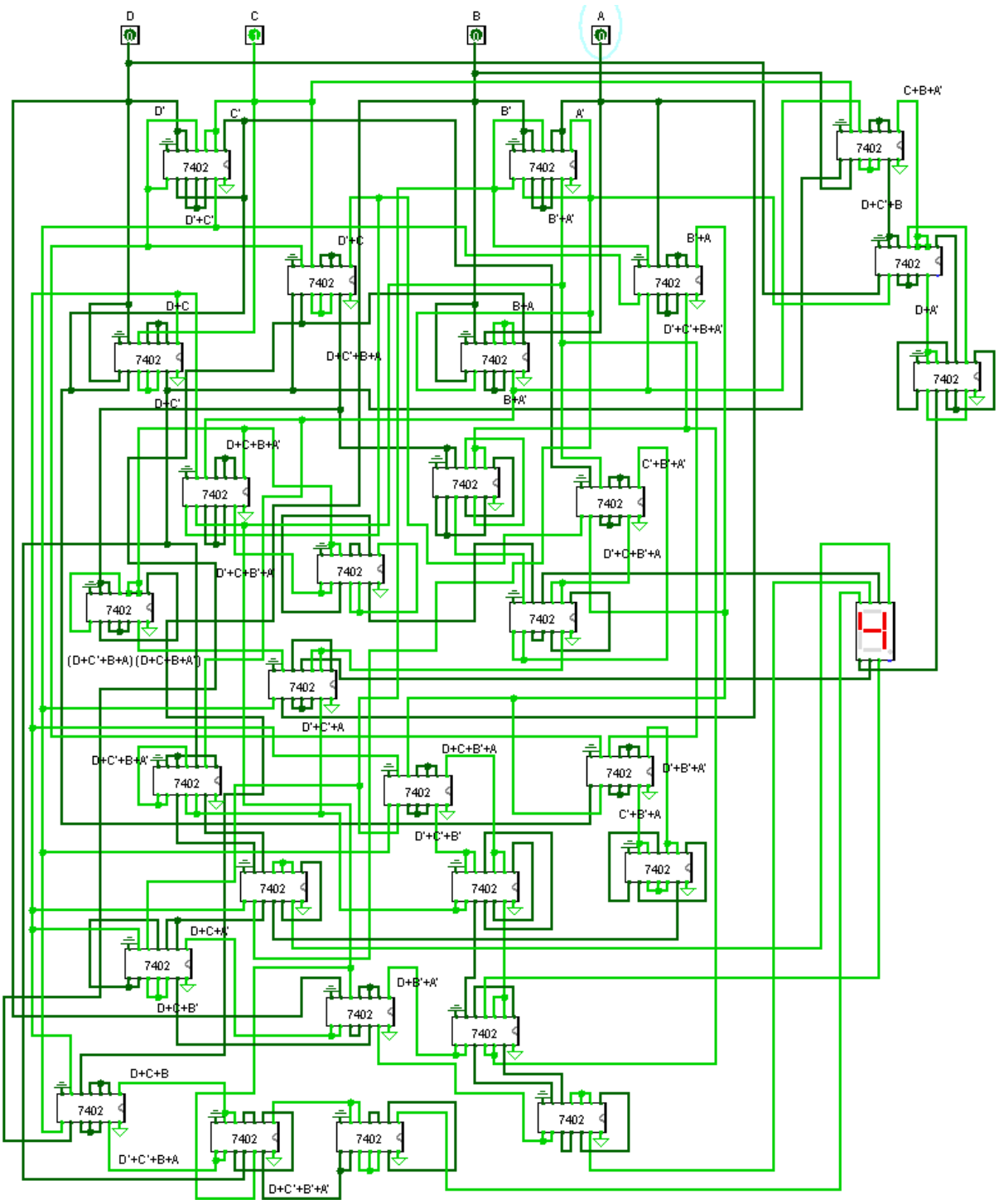
DCBA = 0010



DCBA = 0011

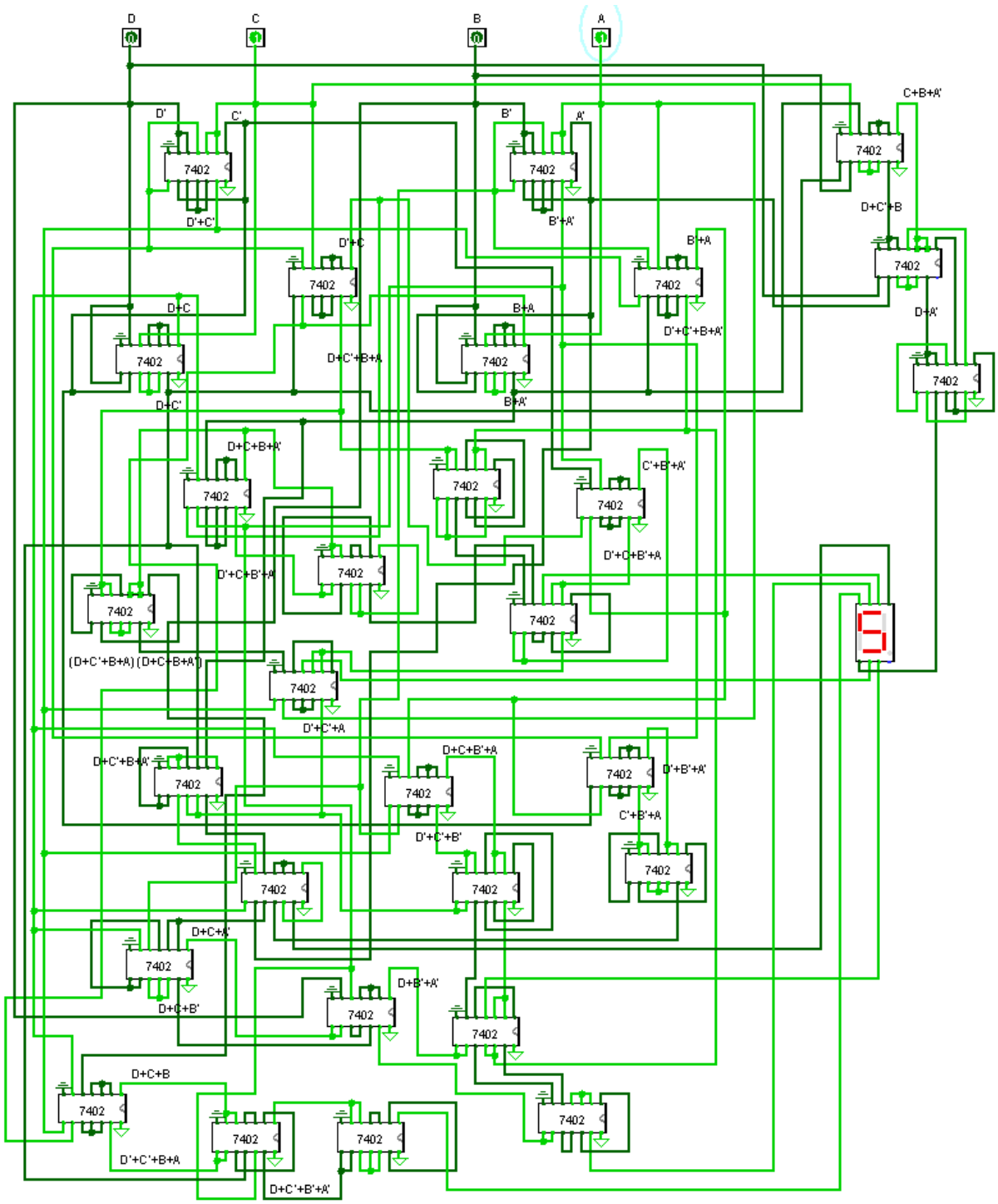

D
C
B
A
7402
D'
C'
B'
A'
D'+C'
D'+C
B'+A'
B+A
D+C
D+C'+B+A
D+C'
D+C+B+A'
C'+B'+A'
D'+C+B'+A'
D'+C+B'+A
(D+C'+B+A)(D+C+B+A')
D'+C'+A
D+C'+B+A'
D+C'+B'+A
D'+B'+A'
C'+B'+A
D'+C'+B'
D+C+A'
D+C+B'
D+B'+A'
D+C+B
D'+C'+B+A
D+C'+B'+A'
C+B+A'
D+C'+B
D+A'

DCBA = 0100


D
C
B
A
7402
D'+C'
B'+A'
C+B+A'
D+C'+B
D+A'
D'+C
B+A
D+C
D+C'+B+A
D'+C'+B+A'
D+C'
D+C+B+A'
C'+B'+A'
D'+C+B'+A'
D'+C+B'+A
(D+C'+B+A)(D+C+B+A')
D'+C'+A
D+C'+B+A'
D+C+B'+A
D'+B'+A'
C'+B'+A
D'+C'+B
D+C+A'
D+C+B'
D+B'+A'
D+C+B
D'+C'+B+A
D+C'+B'+A'

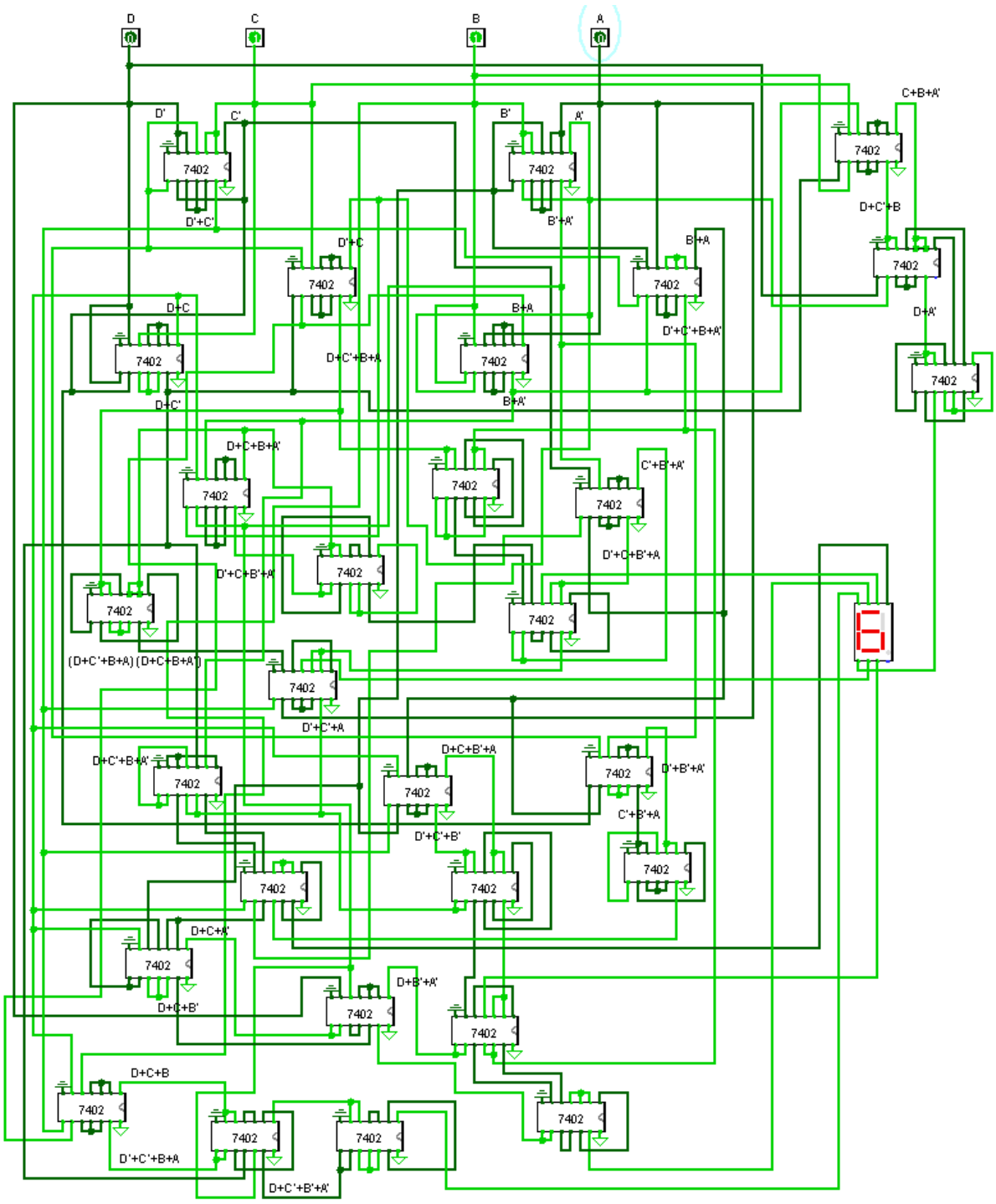
Dela Rosa. Pamella Jei S.
2020-06676

DCBA = 0101



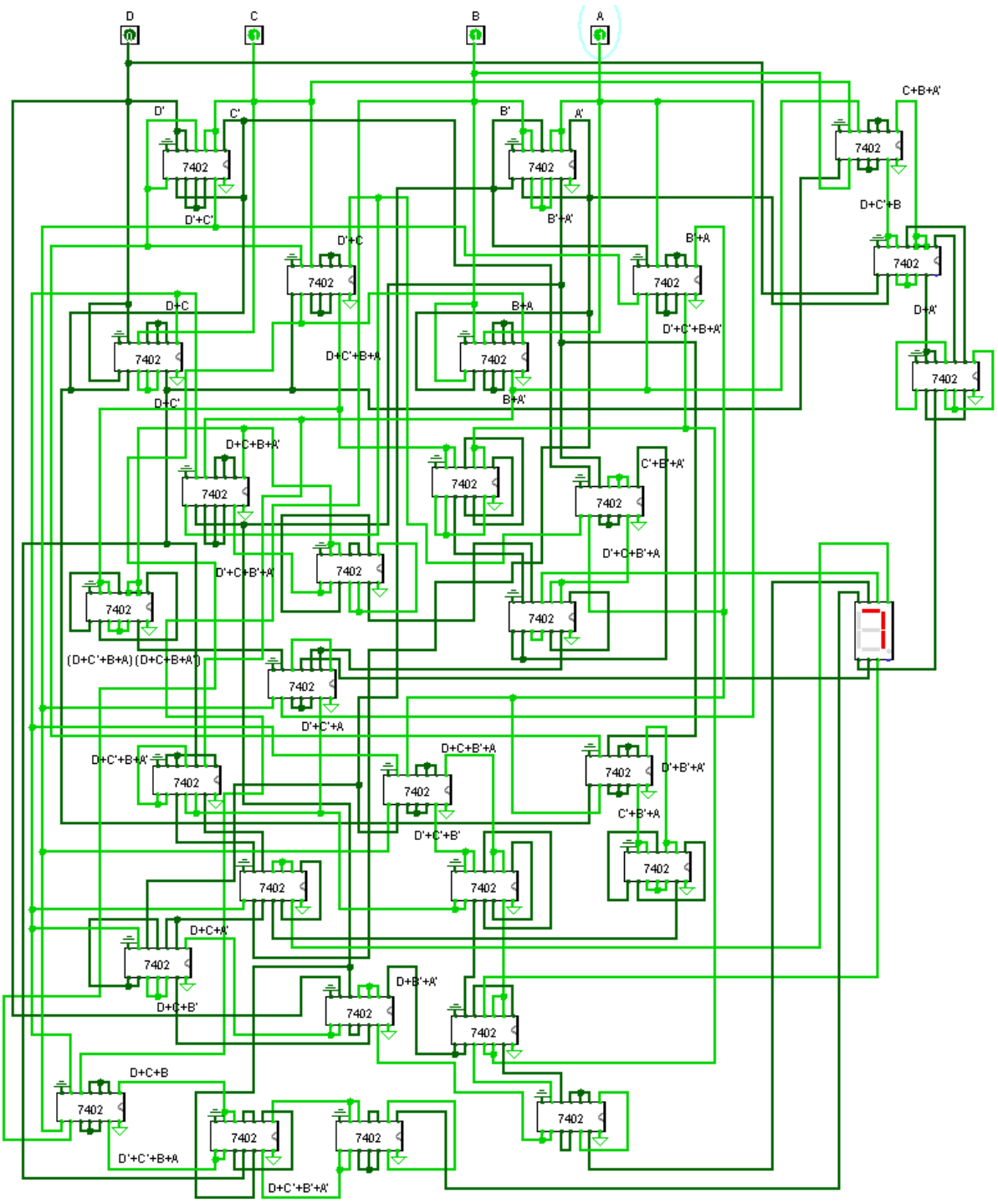
Dela Rosa. Pamella Jei S.
2020-06676

DCBA = 0110

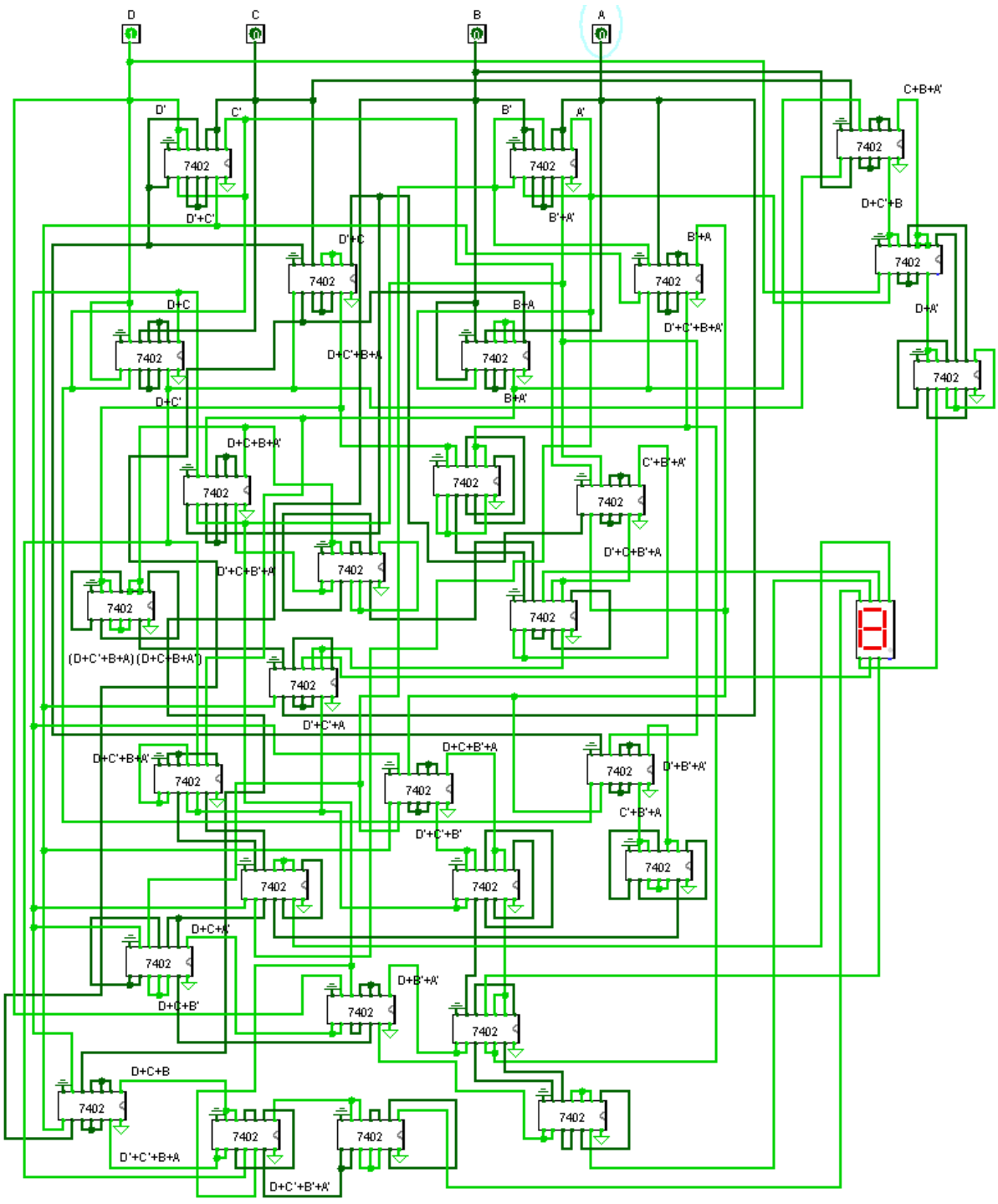


Dela Rosa. Pamella Jei S.
2020-06676

DCBA = 0111

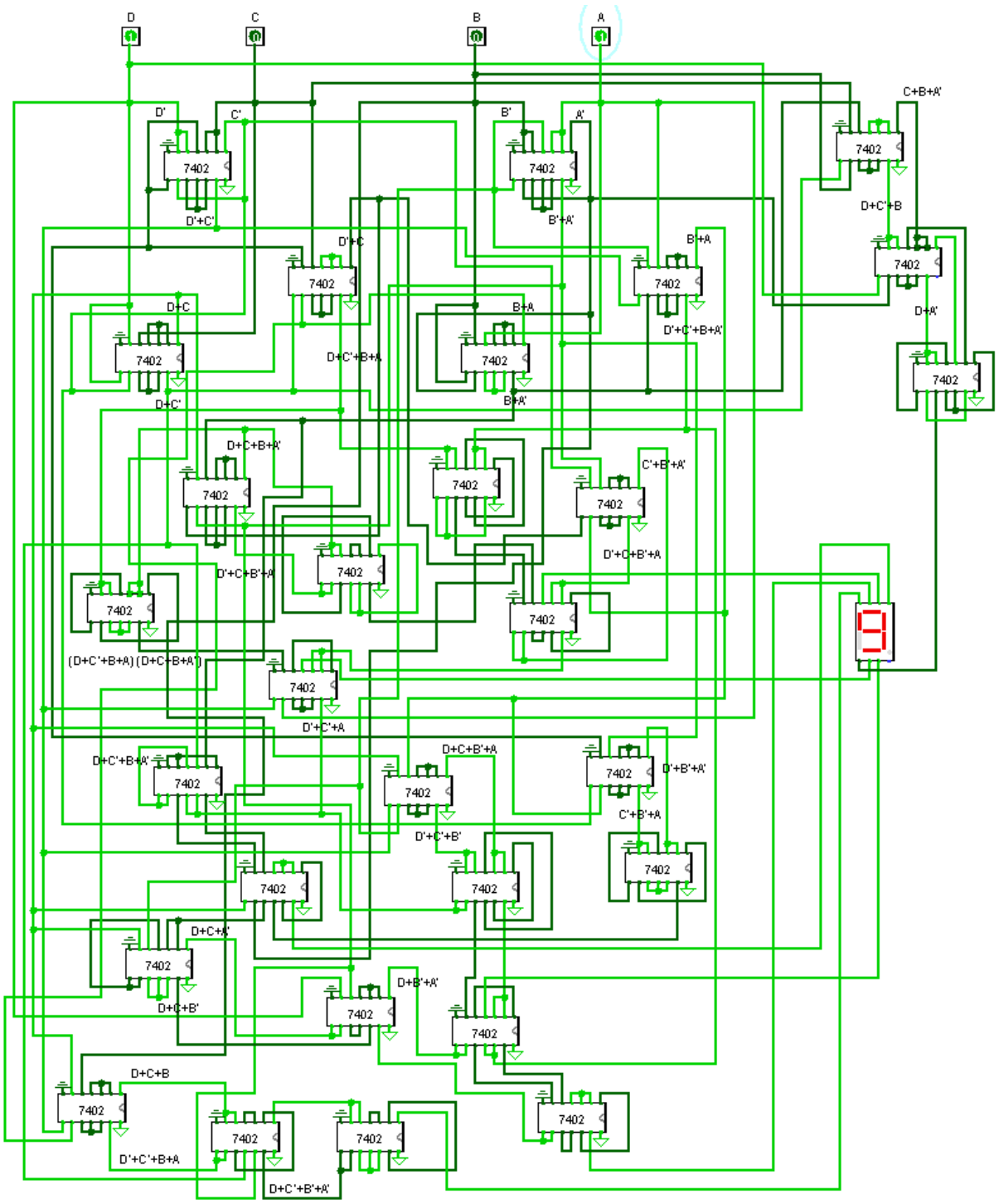


DCBA = 1000


D
C
B
A
7402
D'
C'
B'
A'
D'+C'
B'+A'
C+B+A'
D+C'+B
D+A'
D'+C
B+A
D'+C'+B+A'
D+C
D+C'+B+A
D+C'
D+C+B+A'
C'+B'+A'
D'+C+B'+A
(D+C'+B+A)'(D+C+B+A')
D'+C'+A
D+C+B'+A
D'+B'+A'
D+C'+B'
D+C+A'
D+B'+A'
D+C+B
D'+C'+B+A
D+C'+B'+A'

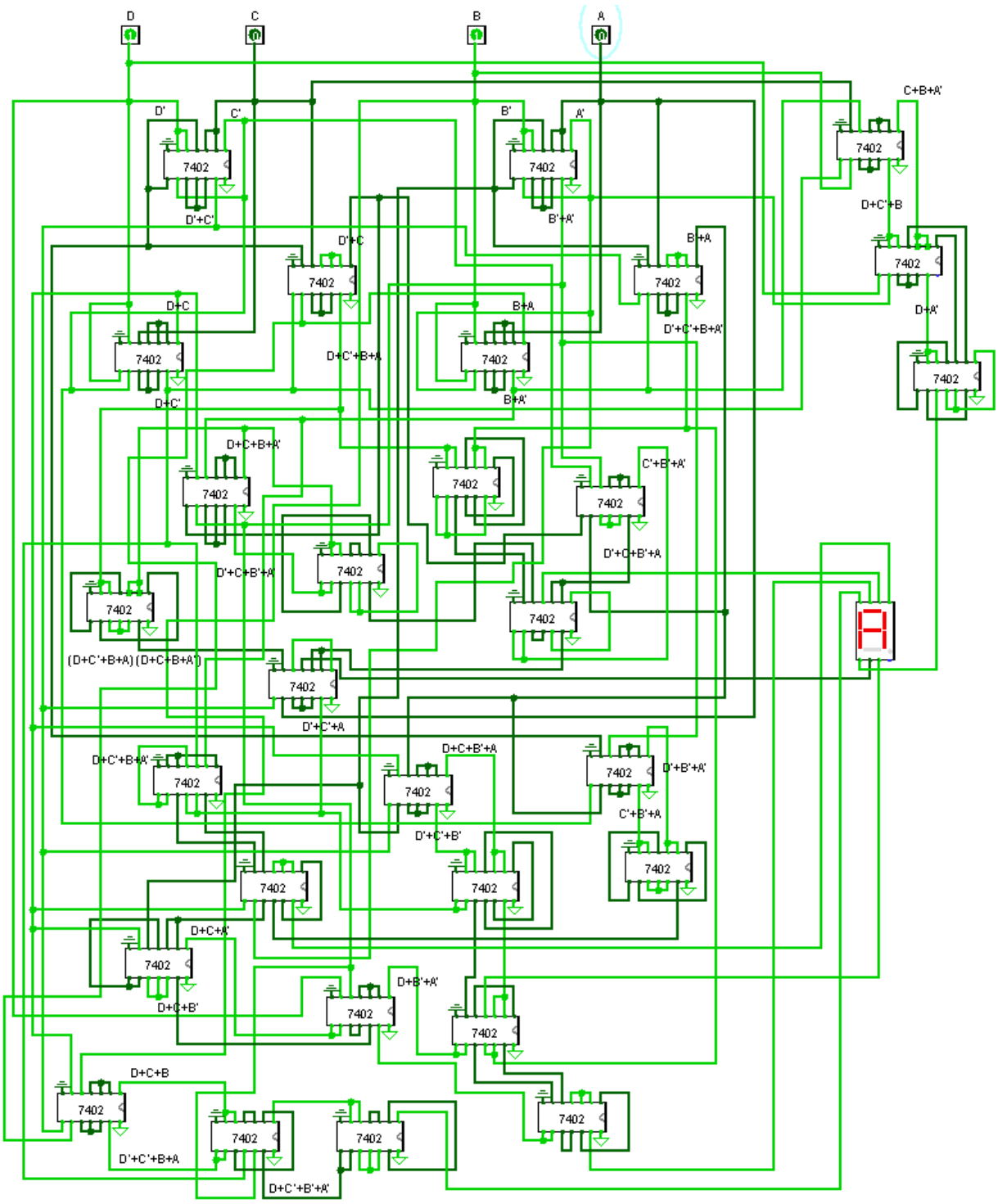
Dela Rosa. Pamella Jei S.
2020-06676

DCBA = 1001



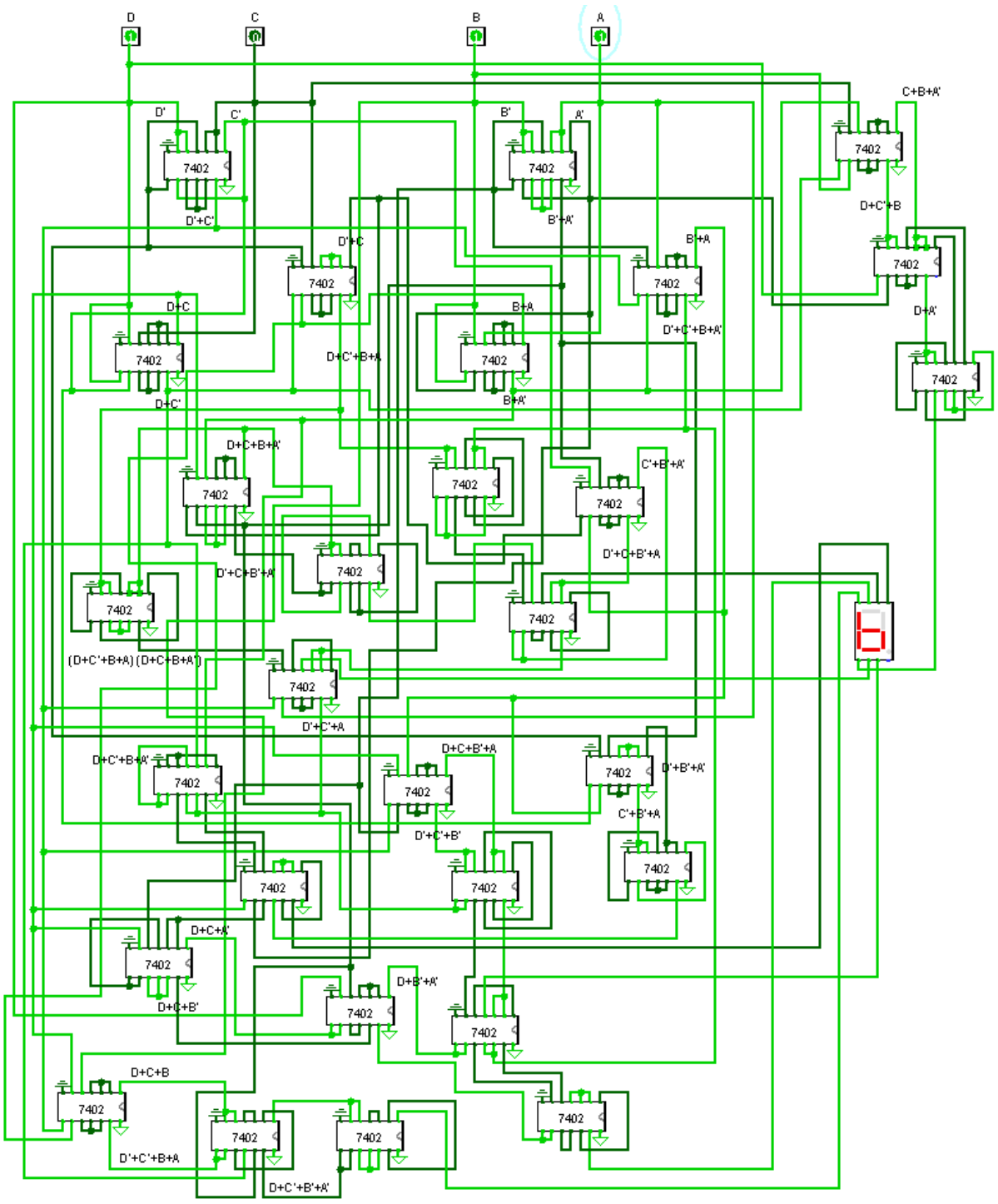
Dela Rosa. Pamella Jei S.
2020-06676

DCBA = 1010

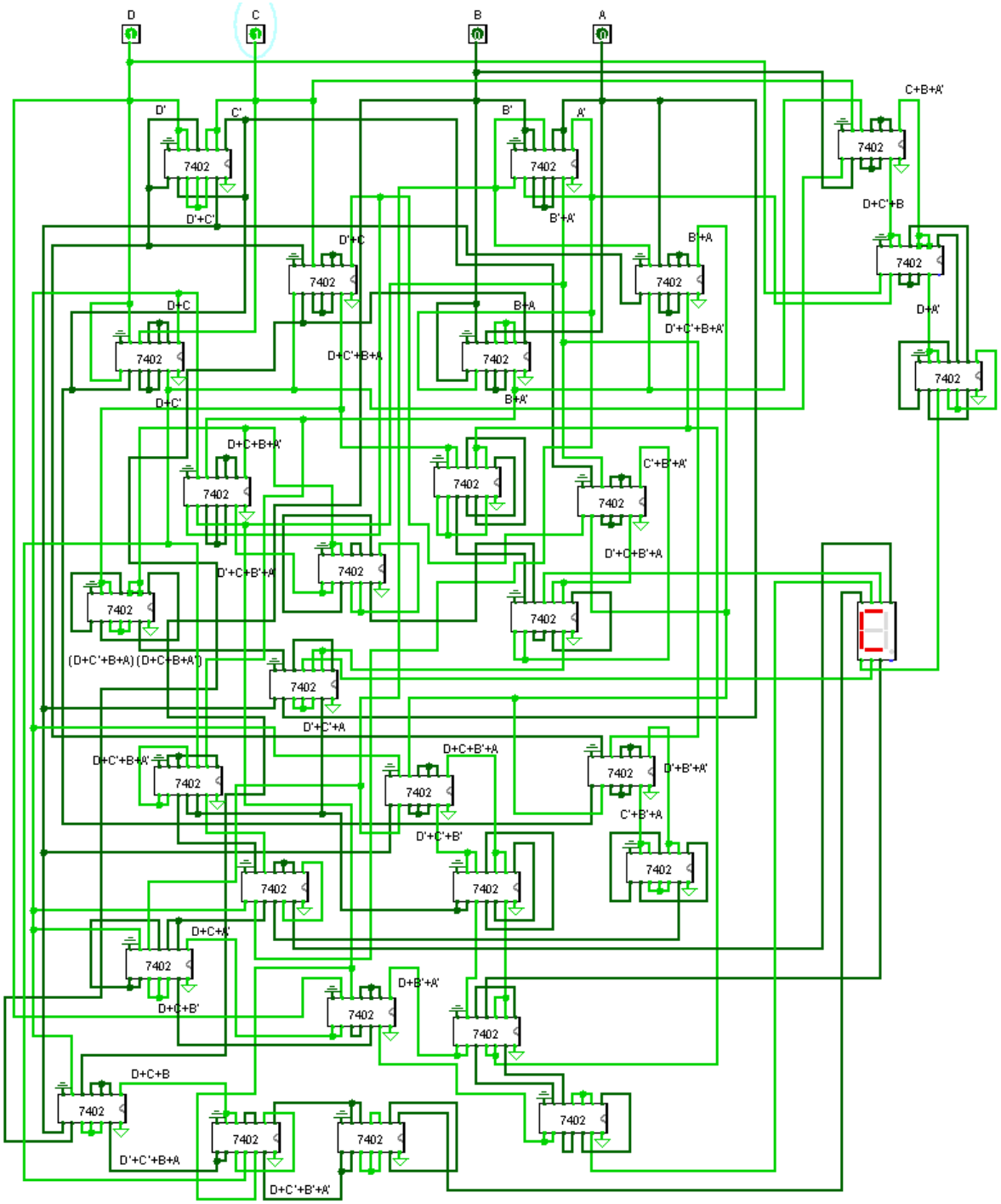


Dela Rosa. Pamella Jei S.
2020-06676

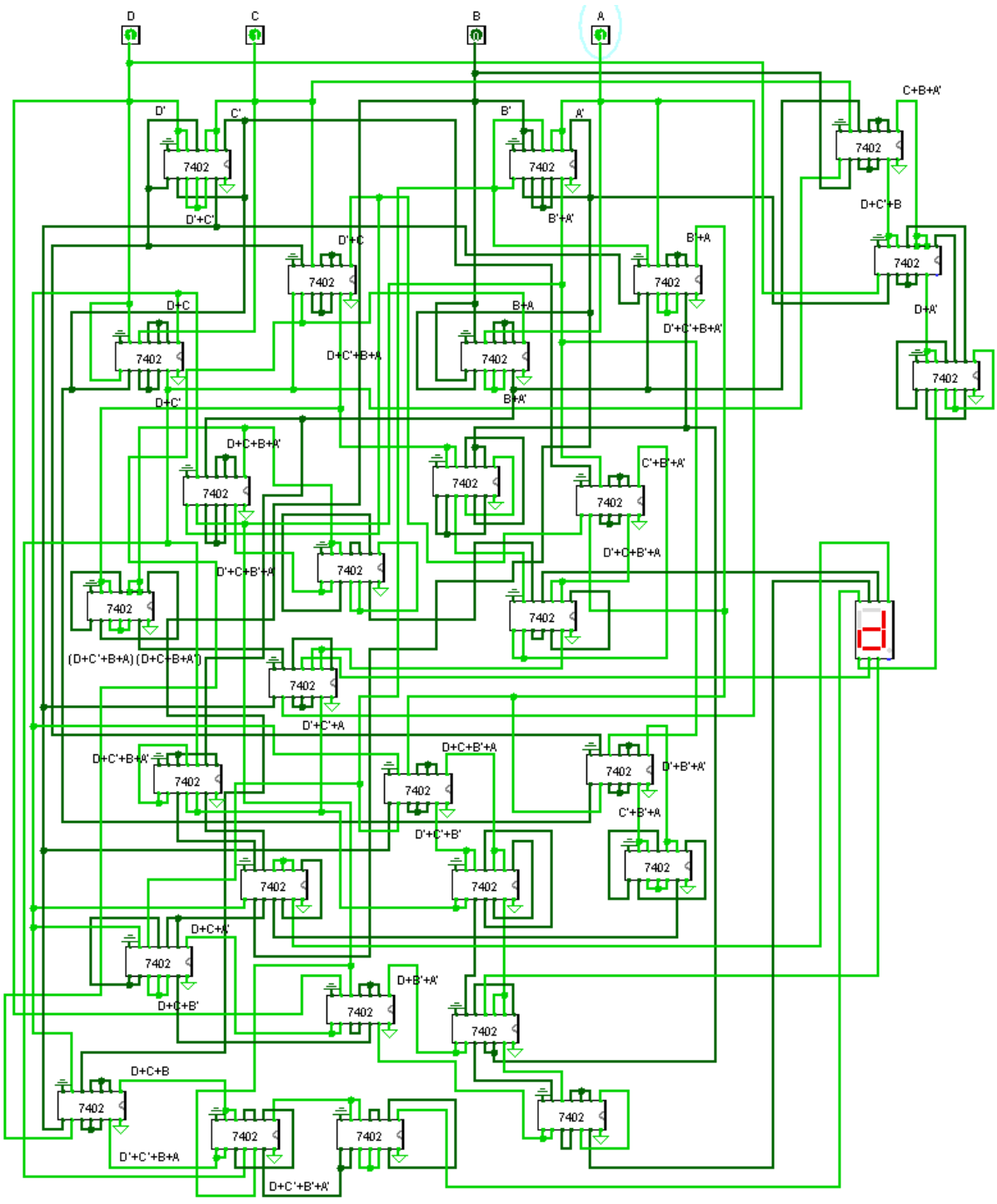
DCBA = 1011



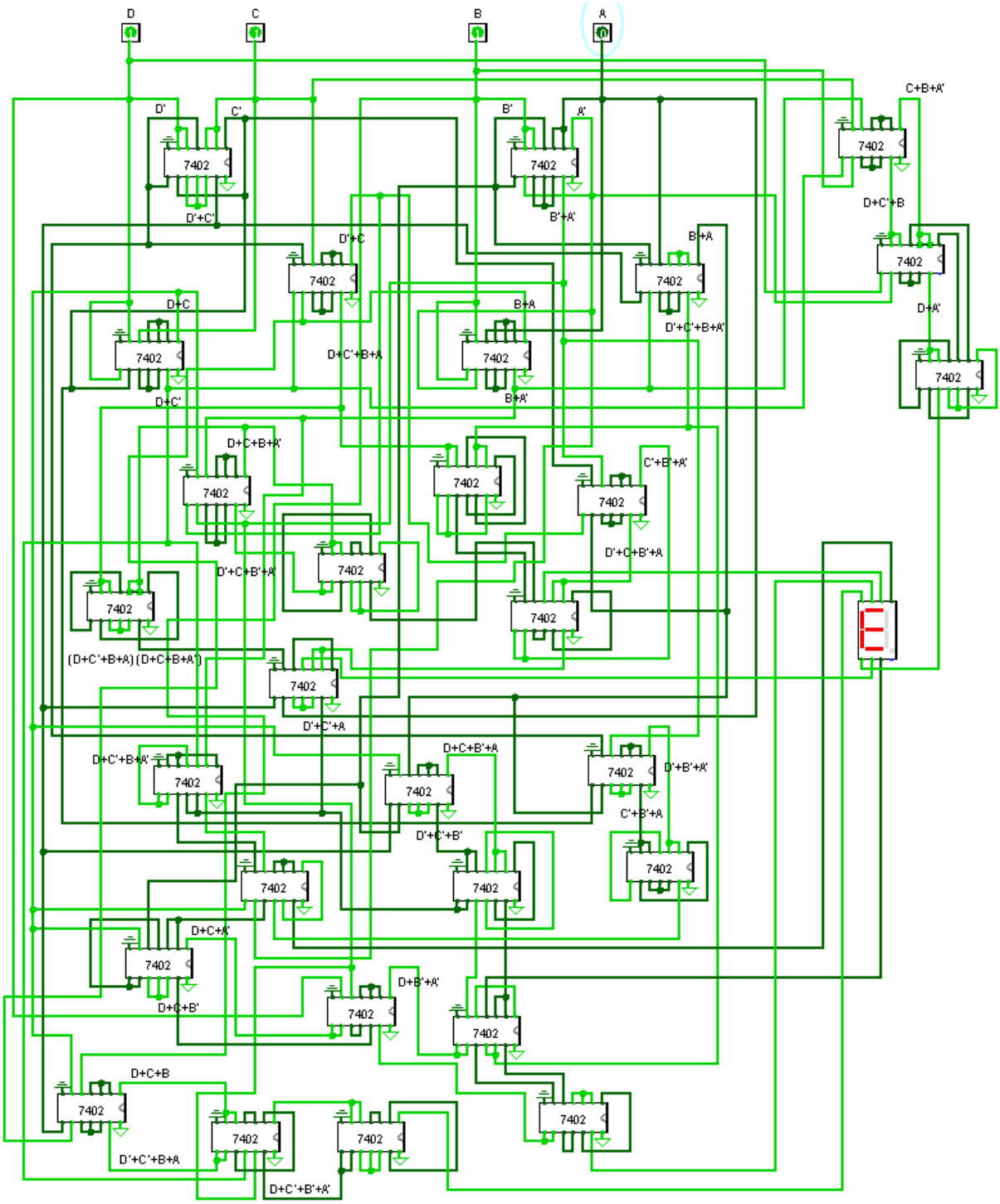
DCBA = 1100


D
C
B
A
7402
D'
C'
B'
A'
D'+C'
D'+C
B'+A'
B+A
C+B+A'
D+C'+B
D+A'
D+C
D+C'+B+A'
D+C'
D+C+B+A'
C'+B'+A'
D'+C+B'+A'
(D+C'+B+A)'(D+C+B+A')
D'+C'+A'
D+C'+B+A'
D+C+B'+A'
D'+B'+A'
C'+B'+A'
D'+C'+B'
D+C+A'
D+C+B'
D+B'+A'
D+C+B
D'+C'+B+A'
D+C'+B'+A'

DCBA = 1101


D
C
B
A
7402
D'
C'
B'
A'
D'+C'
D'+C
D+C
D+C'+B+A
B+A
D'+C'+B+A'
C+B+A'
D+C'+B
D+A'
D+C+B+A'
C'+B'+A'
D'+C+B'+A'
(D+C'+B+A) (D+C+B+A')
D'+C'+A
D+C+B'+A
D'+B'+A'
D+C'+B+A'
D'+C'+B
C'+B'+A
D+C+A'
D+C+B'
D+B'+A'
D+C+B
D'+C'+B+A
D+C'+B'+A'

DCBA = 1110


D
C
B
A
7402
D'
C'
B'
A'
D'+C'
B'+A'
C+B+A'
D+C'+B
D+A'
D'+C
B+A
D'+C'+B+A'
D+C
D+C'+B+A
D+C'
D+C+B+A'
C'+B'+A'
D'+C+B'+A'
D'+C+B'+A
(D+C'+B+A)(D+C+B+A')
D'+C'+A
D+C'+B+A'
D+C+B'+A
D'+B'+A'
C'+B'+A
D'+C'+B'
D+C+A'
D+C+B'
D+B'+A'
D+C+B
D'+C'+B+A
D+C'+B'+A'

Dela Rosa. Pamella Jei S.
2020-06676

DCBA = 1111