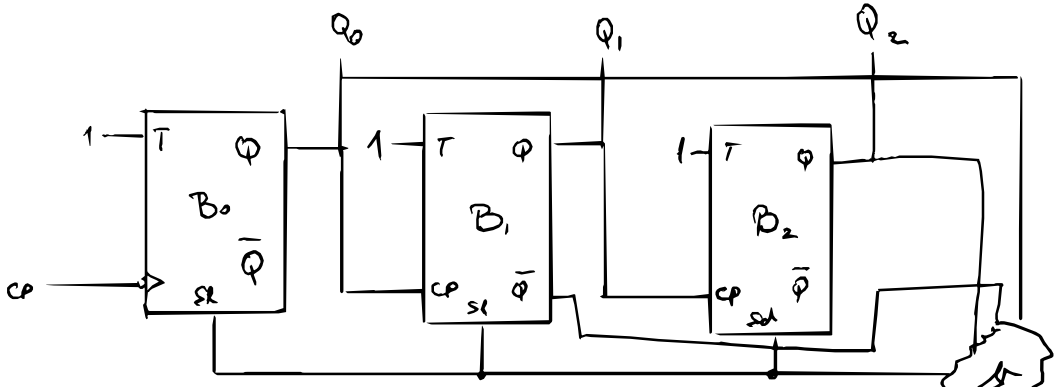
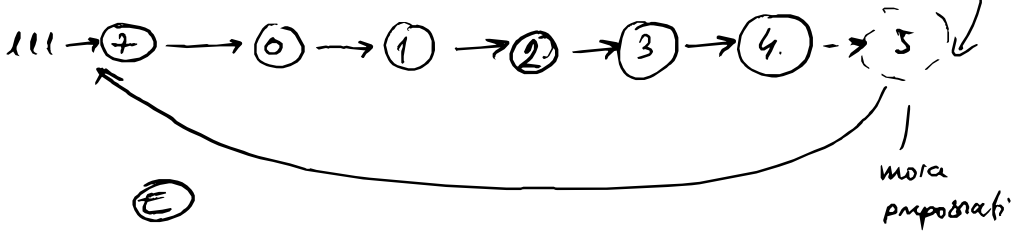
Z1 2021 (A)

(1.) 3-bitno asinkrono binarno brojilo

- 6 stanja
- $Q_2\ Q_1\ Q_0$

→ što dovesti na Sd koji se aktiviraju sa 1
↳ spojeni zajedno

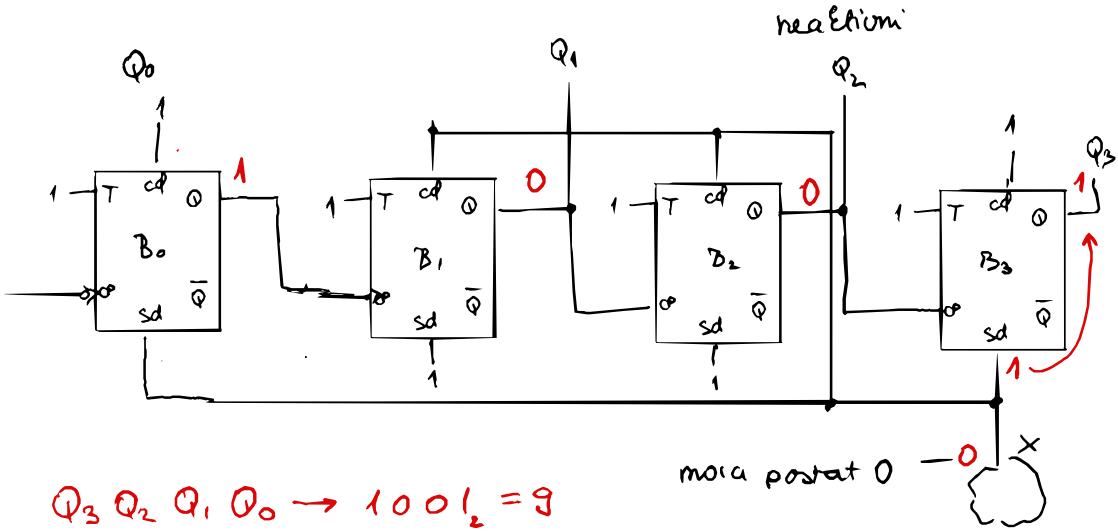




101 → $Q_2 \bar{Q}_1 Q_0$

(2) Asinkrono binarno brojilo

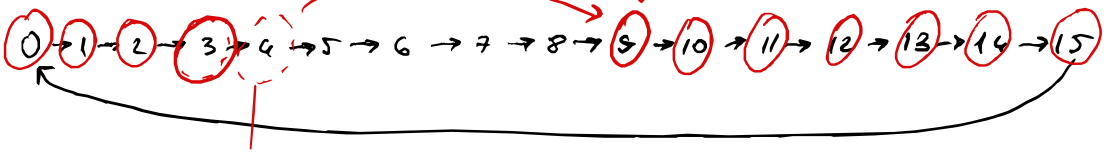
4 T bistabila s asinkronim Sd i Cd → aktiviraju s 0



$Q_3 Q_2 Q_1 Q_0 \rightarrow 1001_2 = 9$

↓

kada generiran signal za prekid
aktivan odlazim u 9



tranzicijsko stanje

- {} sklop ga mora prepoznati i reagirati sa log 0

$4 = 0100_2 \Rightarrow 0 \rightarrow \bar{Q}_3 Q_2 \bar{Q}_1 \bar{Q}_0$ → prepoznaje 1

↳ komplementiramo

$$\overline{\bar{Q}_3 Q_2 \bar{Q}_1 \bar{Q}_0} = \boxed{Q + \bar{Q}_2 + Q_1 + Q_0}$$

(E)

* Sinkrono

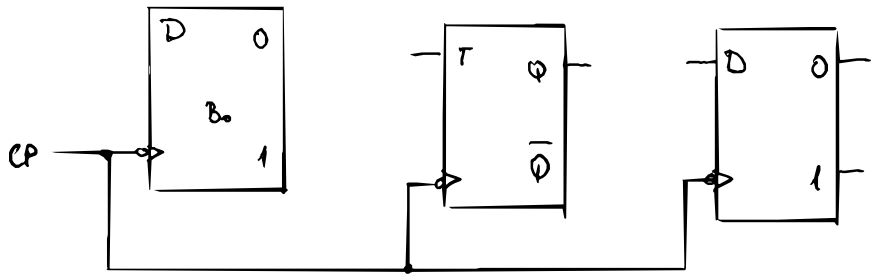
(3.) 3 bistabila

B_2 i $B_0 \rightarrow D$

$B_1 \rightarrow T$

što dovesti na B_2 i B_1

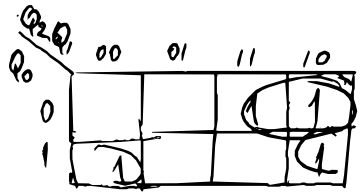
Želimo 0, 3, 2, 1, 4, 5, 6, 7



T.S. S.S. Potrebna pobuda

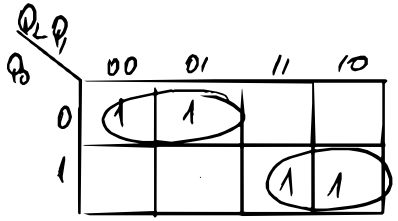
Q_2 Q_1 Q_0	Q_2 Q_1 Q_0	D_2	T_1	D_0	
0 0 0	0 1 1	0	1	1	0
0 0 1	1 0 0	1	0	0	1
0 1 0	0 0 1	0	1	1	2
0 1 1	0 1 0	0	0	0	3
1 0 0	1 0 1	1	0	1	4
1 0 1	1 1 0	1	1	0	5
1 1 0	1 1 1	1	0	1	6
1 1 1	0 0 0	0	1	0	7

D_2



$D_2 = Q_2 \bar{Q}_0 + \bar{Q}_1 Q_0$

T_1



$T_2 = \bar{Q}_2 \cdot \bar{Q}_0 + Q_2 Q_0$

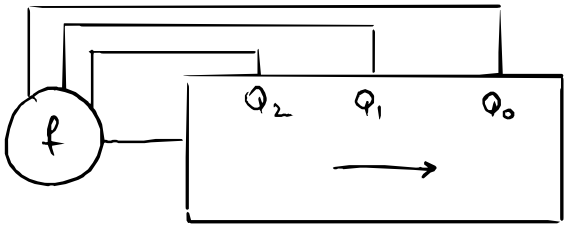
(A)

(4.) Mooreov stroj s kodiranim br. stanja

B_2, B_1 i B_0 (Q_2, Q_1, Q_0)

Ulazi x i y (C) → jer Mooreov stroj ne ovisi o ulazu

(5.) pomačni registar 0, 4, 2, 5, 6, 3, 1 – mora imati sigurni start



TS			SS		
Q_2	Q_1	Q_0	Q_2	Q_1	Q_0
0	0	0	1	0	0
0	0	1	0	0	0
0	1	0	1	0	1
0	1	1	0	0	1
1	0	0	0	1	0
1	0	1	1	1	0
1	1	0	0	1	1
1	1	1	0	1	1

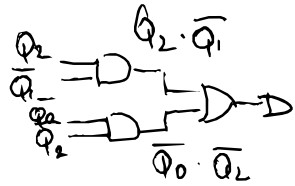
→ f

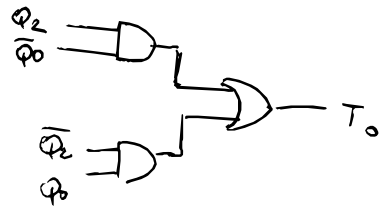
111 < 011 →
< 111 ~~111~~

Q_0 \ Q_2Q_1	00	01	11	10
0	1	1		
1				1

$f = \bar{Q}_2 \bar{Q}_0 + Q_1 \bar{Q}_1 Q_0$ (1)

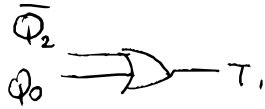
6.



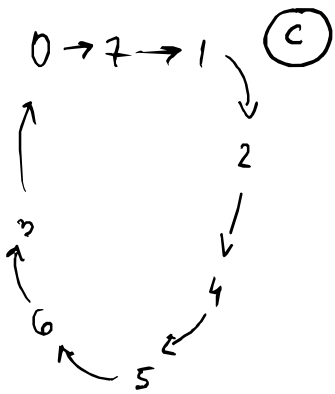


$D_2 \rightarrow \; Q_2 \cdot \bar{Q}_1 + \bar{Q}_0 \, \bar{Q}_2$

$T_0 = Q_2 \bar{Q}_0 + \bar{Q}_2 Q_0 + \bar{Q}_1$



$T_1 \rightarrow \; \bar{Q}_2 + Q_0$



T.S.						S.S.		
Q_2	Q_1	Q_0	D_2	T_1	T_0	Q_2	Q_1	Q_0
0	0	0	1	1	1	1	1	1
0	0	1	0	1	1	0	1	0
0	1	0	1	1	0	1	0	0
0	1	1	0	1	1	0	0	0
1	0	0	1	0	1	1	0	1
1	0	1	1	1	1	1	1	0
1	1	0	0	0	1	0	1	1
1	1	1	0	1	0	0	0	1

7. $t_{dds} = 10\,ns$ $t_{hold} = 10ns$ $t_{setup} = 20ns$ $t_{db} = 20\,ns$

f_{max}?

↓ nekritično za f_{max}

- sinkroni sklop

$$f_{max} = \frac{1}{t_{cp}}$$

mux ↓

B_2 – načeloma t_{db} još $2 \times t_{dds}$ (2 nivoja logike) + t_{setup}

$B_1 = t_{db} + 1 \times t_{dds} + t_{setup}$

$B_0 = t_{db} + 2 \times t_{dds} + t_{setup}$

najgori slučaj!

$T_{B_2} \rightarrow 20ns + 2 \times 10ns + 20ns = 60ns$

$T_{B_1} \rightarrow 20ns + 10ns + 20 = 50ns$

$T_{B_0} \rightarrow 20ns + 20ns + 20$ ← 60ns

$$f_{max} = \frac{1}{T} = \frac{1}{60}$$

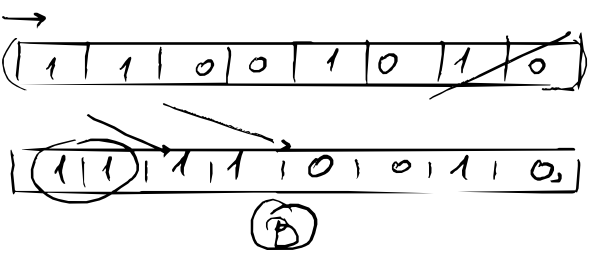
$f_{max} = 16.64\,MHz$

B

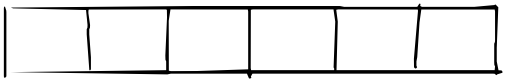
8. 11001010_2

aritmetički pomak udesno za 2 vijesta

A_{C_2}



9.



B-komplement

$R_1\ 362077_8$

$R_2\ 47153_8$

$R_3 = R_1 - R_2$

$R_3 = ?$

$R_3 = R_1 + \overline{R_2}^{8} = R_1 + \overline{R_2}^{7} + 1$

$R_2 = 047153$

$\overline{R_2}^{7} = 730624$

$\overline{R_2}^{8} = 730625$

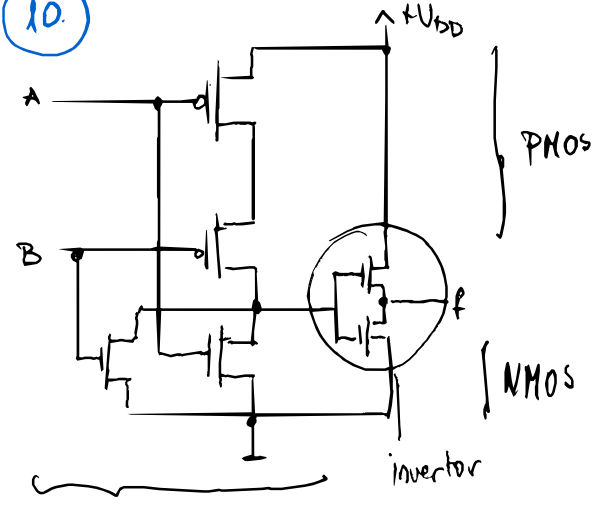
$= R_1 + \overline{R_2}^{(8)}$

$=$

```
  1   1  1
  362077
+ 730625
1|312724
```

C

10.



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

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

$g = \overline{B+A} = \overline{A} \cdot \overline{B}$

koji ostvaruje $\overline{f}$ → $\overline{f} = \overline{A+B}$ NILI ali zbog invertora ILI

B

11.

$U = 3{,}6\,V$

$f_{max} = 100\,MHz$

$P_d = 48\,mW$

$f_2 = 200\,MHz$

$U_2 = U_1$

$P_{d2} = ?$

$P_{d1} = C \cdot U_1^2 \cdot f_1 \rightarrow C = \frac{P_{d1}}{U_1^2 \cdot f_1}$

$P_{d2} = C \cdot U_2^2 \cdot f_2 \rightarrow P_{d2} = \frac{P_{d1}}{U_1^2 \cdot f_1} U_1^2 \cdot f_2$

$P_{d2} = \frac{P_{d1} \cdot f_2}{f_1} = \frac{48\,mW \cdot 200}{100}$

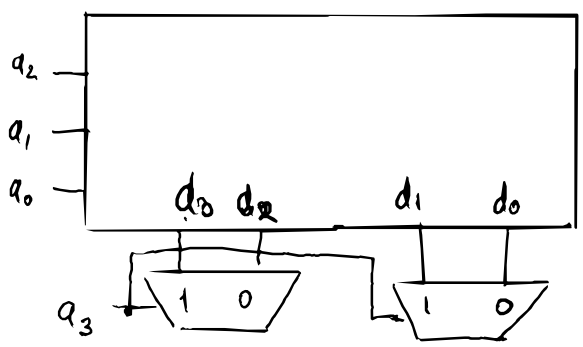
$P_{d2} = 96\,mW$ (D)

12.

ROM 8×4

MUX 2/1 → ROM 16×2

{3, 1, 2, 0, 1, 0, 2, 3, 2, 0, 3, 1, 0, 3, 1, 2}



a_3	a_2	a_1	a_0	D_3	D_2	D_1	D_0
0	0	0	0	1		1	
0	0	0	1	0		1	
0	0	1	0	0		0	
0	0	1	1	0		0	
0	1	0	0	0		1	
0	1	0	1	0		0	
0	1	1	0	1		0	
0	1	1	1	1		1	
1	0	0	0	1		0	
1	0	0	1	0		0	
1	0	1	0	1		1	
1	0	1	1	0		1	
1	1	0	0	0		0	
1	1	0	1	1		1	
1	1	1	0	0		1	
1	1	1	1	1		0	

ROM 16×2:

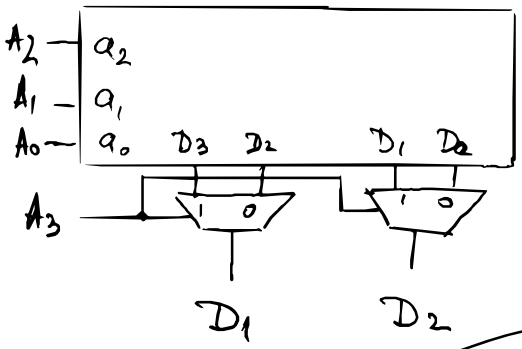
13	1	1	0	1	D
1	0	0	0	1	1
11	1	0	1	1	B
2	0	0	1	0	2
1	0	0	0	1	1
10	1	0	1	0	A
6	0	1	1	0	6
13	1	1	0	1	D

1	1	1	0	E
0	0	1	0	2
0	1	1	1	7
0	0	0	1	1
0	0	1	0	2
0	1	0	1	5
1	0	0	1	1
1	1	1	0	E

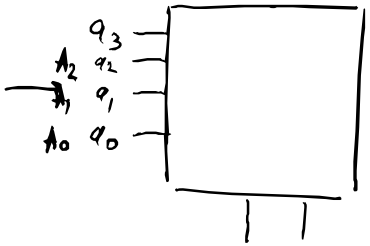
negdje sam fulala – gledaj čupeju

12-

PROM 8×4



16 × 2

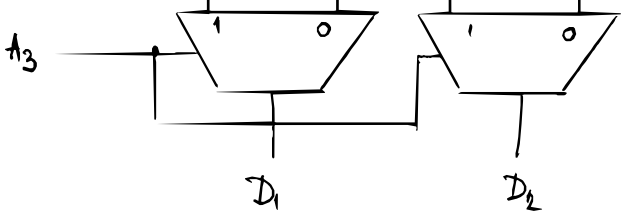


E

1	1	0	1	D	
0	0	0	1	1	
1	1	1	0	E	
0	0	1	0	2	
0	0	0	1	1	
1	0	1	0	A	
0	1	1	0	6	
1	1	0	1	D	

A3 A2 A1

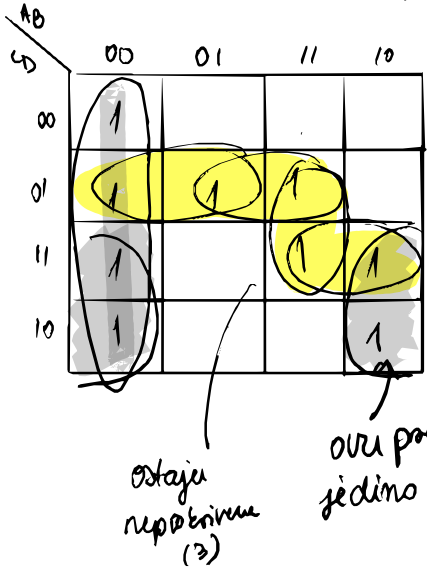
D3 D2 D1 D0



	A3	A2	A1	A0	D3	D2	D1	D0
3	0	0	0	0		1		1
1	0	0	0	1		0		1
2	0	0	1	0		1		0
0	0	0	1	1		0		0
1	0	1	0	0		0		1
0	0	1	0	1		0		0
2	0	1	1	0		1		0
3	0	1	1	1		1		1
2	1	0	0	0	1		0	
0	1	0	0	1	0		0	
3	1	0	1	0	1		1	
1	1	0	1	1	0		1	
0	1	1	0	0	0		0	
3	1	1	0	1	1		1	
1	1	1	1	0	0		1	
2	1	1	1	0	1		0	

13. Koliko ekvivalentnih min. oblika u zapisu sume produkata ima funkcija

$f(A,B,C,D) = \sum m(0,1,2,3,5,10,11,13,15)$?



primarni

Bitni primarni implikanti = maksimalno veliki pravokutnici koji jedini pokrivaju neke jedinice

$f = \bar{A}\bar{B} + \bar{B}C +$

3 moguća načina

↳ 3 ekvivalentna minimalna oblika

14. blah

15.

A	B	f
-1	-1	1
-1	1	-1
1	-1	-1
1	1	-1

negativna logika

-1 = 1

1 = 0

→

A	B	f
1	1	0
1	0	1
0	1	1
0	0	1

NI

c

16.

$(\overline{x_2} + x_1)(\overline{x_1} + \overline{x_0}) \rightarrow g \qquad \rightarrow \overline{g} = \overline{(\overline{x_2} + x_1)(\overline{x_1} + \overline{x_0})}$

$f = (x_2 + \overline{g})(x_1 + \overline{x_1})$ ($x_1 + \overline{x_1} = 1$)

$\overline{g} = x \cdot \overline{x_1} + x_1 \cdot \overline{x_0}$

$f = x_2 + x_2 \overline{x_1} + x_1 \cdot \overline{x_0}$ (x_2)

$f = x_2 + x_1 \cdot \overline{x_0}$ (D)

17. $f = A \cdot B + A \cdot C$

$g = \overline{A} \cdot B + \overline{B} \cdot C$

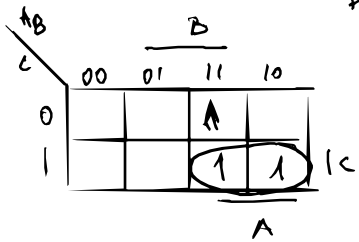
→ PAL NI-NI

PAL

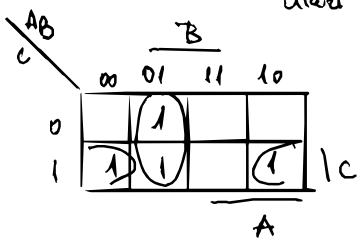
ulazi × NI sklopovi × izlazi

$m \times n \times k$

f



g



$f = AC + AB$

$g = \overline{A}B + \overline{B}C$

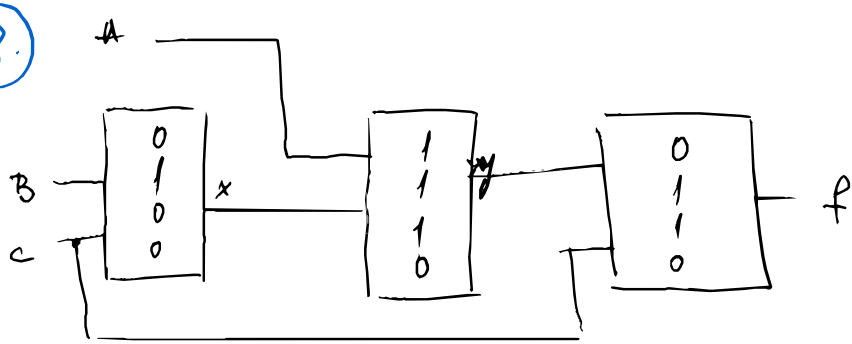
$M = 2$

$n = 3$ (A, B, C)

$k = 4$

$3 \times 4 \times 2$ (C)

18.



B C	X
0 0	0
0 1	1
1 0	0
1 1	0

$X = \bar{B} \cdot C$

A X	Y
0 0	1
0 1	1
1 0	1
1 1	0

$Y = \bar{A} + \bar{X} =$

y C	f
0 0	0
0 1	1
1 0	1
1 1	0

$f = \bar{y}C + y\bar{C} = y \oplus C$

$Y = \bar{A} + \overline{\bar{B} \cdot C} = \bar{A} + B + \bar{C}$

$f = \overbrace{(\bar{A} + B + \bar{C})}^{\bar{Y}} \cdot C + (\bar{A} + B + \bar{C})\bar{C}$

$= A \cdot \bar{B} \cdot C \cdot C + \bar{A}\bar{C} + B\bar{C} + \bar{C}\bar{C}$

$= A \cdot \bar{B} \cdot C + \bar{A}\bar{C} + B\bar{C} + \bar{C}$

$= A\bar{B}C + \bar{C}\underbrace{(\bar{A} + 1)}_{1} + B\bar{C}$

$= A\bar{B}C + \bar{C}(1 + B) = A\bar{B}C + \bar{C}$

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

Boole

$* (X + YZ)$

$(X + Y)(X + Z)$

$X = \bar{C} \quad YZ = A\bar{B}C$

Y

19. 8421

$U_{izl} = -4{,}5V$

$R_8 = 1k\Omega$ → najmniejszy

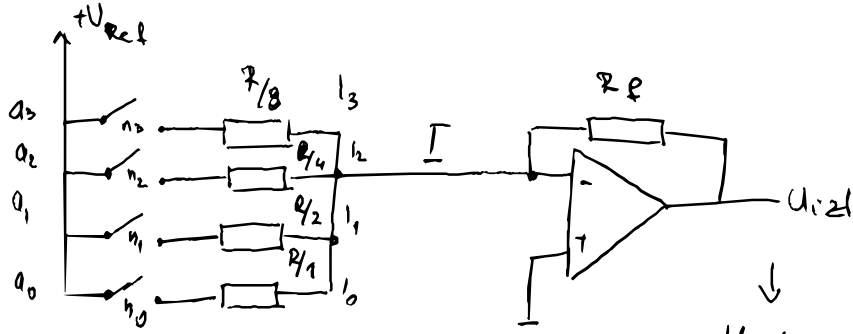
$R_f = 400\Omega$

$U_r = 10V$

$n = ?$

$\frac{R}{8} = 1k\Omega$

$R = 8k\Omega$



$R_3 = \frac{1k\Omega}{8}$

$R_2 = \frac{1k\Omega}{4}$

$R_1 = \frac{1k\Omega}{2}$

$R_0 = \frac{1k\Omega}{1}$

$I = \sum_{i=0}^{n-1} I_i$

$I_i = \frac{U_{REF}}{R_i}$

$U_{izl} = -I \cdot R_{ef}$

$I = \frac{U_{REF}}{R}(8n_3 + 4n_2 + 2n_1 + n_0)$

$k \cdot n$

$I = \frac{U_{REF}}{R} \cdot n$ (const)

$U_{izl} = -\frac{U_{REF}}{R} \cdot n \cdot R_f$

$\frac{-R \cdot U_{izl}}{U_{REF} \cdot R_f} = n$

$n = \frac{+8000 \cdot 4{,}5}{10 \cdot 400} = 9$

B

20. 8-bitni ADC sa sukcesivnom aproks.

Ulazni → 240ns

U_{max} → t_{max}?

$f_{max} = f_{max}$