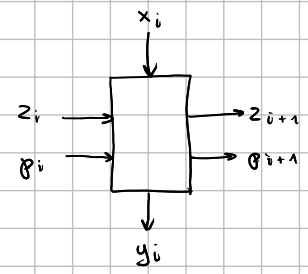
A1

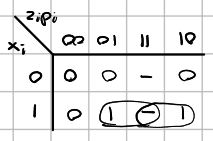


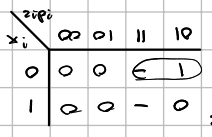

$z_i$ - same zera do tej pory

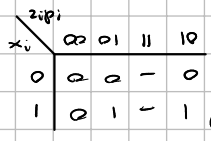
$p_i$ - kolejny z grupy 1

nie może być jednocześnie $z_i \cdot p_i$

| $x_i$ | $z_i$ | $p_i$ | $y_i$ | $z_{i+1}$ | $p_{i+1}$ |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 | 1 | 0 |
| 0 | 1 | 1 | — | — | — |
| 1 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 1 | 1 | 0 | 1 |
| 1 | 1 | 0 | 1 | 0 | 1 |
| 1 | 1 | 1 | — | — | — |



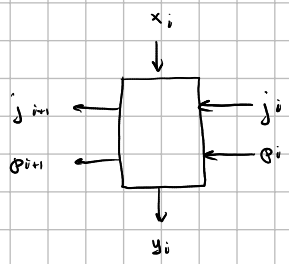




$y_i = x_i p_i + x_i z_i = x_i(z_i + p_i)$

$z_{i+1} = \overline{x}_i z_i$

$p_{i+1} = x_i p_i + x_i z_i = y_i$

A3



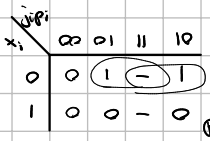

$j_i$ - do tej pory same jedynki

$p_i$ - kolejne '0' z pierwszej grupy

| $x_i$ | $j_i$ | $p_i$ | $y_i$ | $j_{i+1}$ | $p_{i+1}$ |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 0 | 0 |
| 0 | 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 0 | 0 | 0 | 1 |
| 0 | 1 | 1 | — | — | — |
| 1 | 0 | 0 | 1 | 0 | 0 |
| 1 | 0 | 1 | 1 | 0 | 0 |
| 1 | 1 | 0 | 1 | 1 | 0 |
| 1 | 1 | 1 | — | — | — |

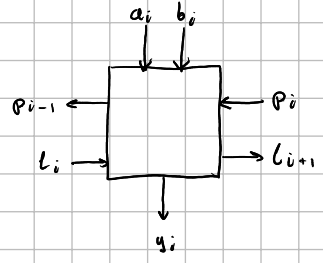

$y_i = \overline{j}_i \overline{p}_i + x_i$


$j_{i+1} = x_i j_i$




$p_{i+1} = \overline{x}_i p_i + \overline{x}_i j_i = \overline{x}_i (p_i + j_i)$

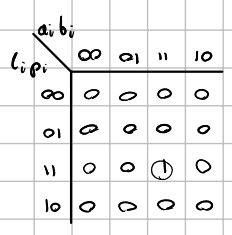
A2




$p_i$ - już była przerwa z prawej jedynki w A

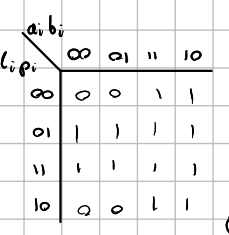
$l_i$ - już była przerwa z lewej jedynki w B

$y_i$ - iloczyn bitów A i B między skrajnymi jedynkami




$y_i = l_i p_i a_i b_i$


$l_{i+1} = l_i + b_i$



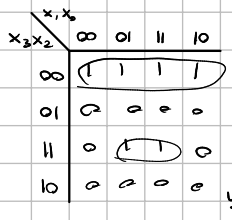

$p_{i-1} = p_i + a_i$

B 1

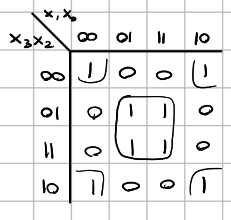
$y_1 = \sum (0, 1, 2, 3, 13, 15)$
$y_2 = \sum (0, 2, 5, 7, 8, 10, 13, 15)$
$y_3 = \sum (0, 2, 4, 5, 6, 7, 11, 13, 15)$

$y_1 y_2 = \sum (0, 2, 13, 15)$
$y_2 y_3 = \sum (0, 2, 5, 7, 13, 15)$
$y_1 y_3 = \sum (0, 2, 13, 15)$

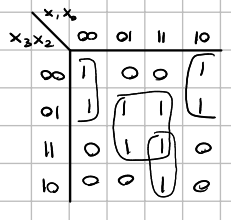
$y_1 y_2 y_3 = \sum (0, 2, 13, 15)$



$y_1$



$y_2$



$y_3$

$y_1 = \overline{x_3}\,\overline{x_2} + x_3 x_2 x_0$

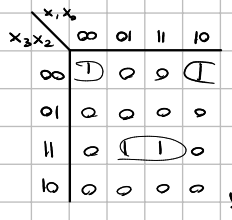
$y_2 = \overline{x_2}\,\overline{x_0} + x_2 x_0$

$y_3 = x_3 x_1 x_0 + \overline{x_3}\,\overline{x_0} + x_2 x_0$

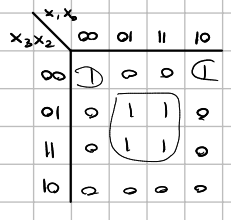
$y_1 = \sum (0, 1, 2, 3)(13, 15)$

$y_2 = \sum (0, 2, 8, 10)(5, 7, 13, 15)$

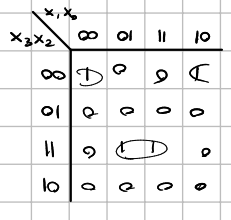
$y_3 = \sum (11, 15)(0, 2, 4, 6)(5, 7, 13, 15)$



$y_1 y_2$



$y_2 y_3$



$y_1 y_3$

$y_1 y_2 = \overline{x_3}\,\overline{x_2}\,\overline{x_0} + x_3 x_2 x_0$

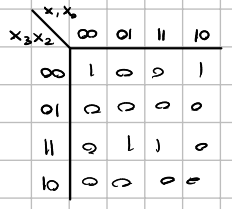
$y_2 y_3 = \overline{x_3}\,\overline{x_2}\,\overline{x_0} + x_2 x_0$

$y_1 y_3 = \overline{x_3}\,\overline{x_2}\,\overline{x_0} + x_3 x_2 x_0$

$y_1 y_2 = \sum (0, 2)(13, 15)$

$y_2 y_3 = \sum (0, 2)(5, 7, 13, 15)$

$y_1 y_3 = \sum (0, 2)(13, 15)$




$y_1 y_2 y_3 = \overline{x_3}\,\overline{x_2}\,\overline{x_0} + x_3 x_2 x_0 = \sum (0, 2)(13, 15)$

$y_1 = \sum (0, 1, 2, 3)(13, 15)$
$y_2 = \sum (0, 2, 8, 10)(5, 7, 13, 15)$
$y_3 = \sum (11, 15)(0, 2, 4, 6)(5, 7, 13, 15)$

$y_1 y_2 = \sum (0, 2)(13, 15)$
$y_2 y_3 = \sum (0, 2)(5, 7, 13, 15)$
$y_1 y_3 = \sum (0, 2)(13, 15)$

$y_1 y_2 y_3 = \sum (0, 2)(13, 15)$

| | | 0 | 1 | 2 | 3 | 13 | 15 | 0 | 2 | 5 | 7 | 8 | 10 | 13 | 15 | 0 | 2 | 4 | 5 | 6 | 7 | 11 | 13 | 15 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0,1,2,3 | $y_1$ | × | X | × | X | | | | | | | | | | | | | | | | | | | | ✓ |
| 13,15 | $y_1$ | | | | | × | × | | | | | | | | | | | | | | | | | | |
| 0,2,8,10 | $y_2$ | | | | | | | × | × | | | X | X | | | | | | | | | | | | ✓ |
| 5,7,13,15 | $y_2$ | | | | | | | | | × | × | | | × | × | | | | | | | | | | |
| 11,15 | $y_3$ | | | | | | | | | | | | | | | | | | | | | × | | × | ✓ |
| 0,2,4,6 | $y_3$ | | | | | | | | | | | | | | | × | × | X | | X | | | | | ✓ |
| 5,7,13,15 | $y_3$ | | | | | | | | | | | | | | | | | | × | | × | | × | × | |
| 0,2 | $y_1 y_2$ | × | | × | | | | × | × | | | | | | | | | | | | | | | | |
| 13,15 | $y_1 y_2$ | | | | | × | × | | | | | | | × | × | | | | | | | | | | |
| 0,2 | $y_2 y_3$ | | | | | | | × | × | | | | | | | × | × | | | | | | | | |
| 5,7,13,15 | $y_2 y_3$ | | | | | | | | | × | × | | | × | × | | | | × | | × | | × | × | ✓ |
| 0,2 | $y_1 y_3$ | × | | × | | | | | | | | | | | | × | × | | | | | | | | |
| 13,15 | $y_1 y_3$ | | | | | × | × | | | | | | | | | | | | | | | | × | × | |
| 0,2 | $y_{123}$ | × | | × | | | | × | × | | | | | | | × | × | | | | | | | | |
| 13,15 | $y_{123}$ | | | | | X | X | | | | | | | × | × | | | | | | | | × | × | ✓ |

$y_1 = \sum (0, 1, 2, 3)(13, 15)$

$y_2 = \sum (0, 2, 8, 10)(5, 7, 13, 15)$

$y_3 = \sum (11, 15)(0, 2, 4, 6)(5, 7, 13, 15)$

B 3

$y_1 = \sum(5,7,8,9,10,11)$

$y_2 = \sum(1,3,5,7,8,10,12,14)$

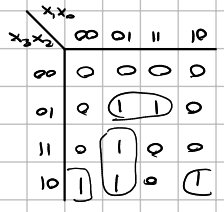
$y_3 = \sum(0,1,2,3,5,7,8,10,15)$

$y_1 y_2 = \sum(5,7,8,10)$

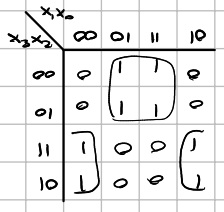
$y_2 y_3 = \sum(1,3,5,7,8,10)$

$y_1 y_3 = \sum(5,7,8,10)$

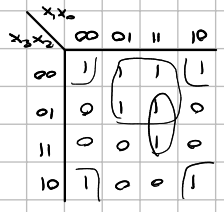
$y_1 y_2 y_3 = \sum(5,7,8,10)$




$y_1$




$y_2$




$y_3$

$y_1 = x_3\bar{x}_2\bar{x}_0 + x_3\bar{x}_2x_0 + \bar{x}_3x_2x_0$

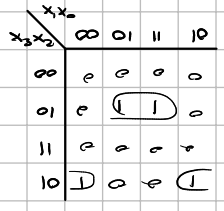
$(8,10) + (9,11) + (5,7)$

$y_2 = \bar{x}_3x_0 + x_3\bar{x}_0$

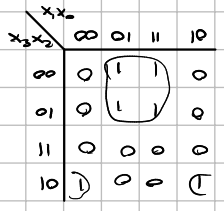
$(1,3,5,7) + (8,10,12,14)$

$y_3 = \bar{x}_2\bar{x}_0 + \bar{x}_3x_0 + x_2x_1x_0$

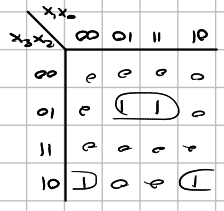
$(0,2,8,10) + (1,3,5,7) + (7,15)$




$y_1 y_2$




$y_2 y_3$




$y_1 y_3$

$y_1 y_2 = x_3\bar{x}_2\bar{x}_0 + \bar{x}_3x_2x_0$

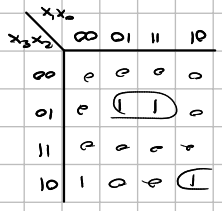
$(8,10) + (5,7)$

$y_2 y_3 = \bar{x}_3x_0 + x_3\bar{x}_2\bar{x}_0$

$(1,3,5,7) + (8,10)$

$y_1 y_3 = x_3\bar{x}_2\bar{x}_0 + \bar{x}_3x_2x_0$

$(8,10) + (5,7)$




$y_1 y_2 y_3 = x_3\bar{x}_2\bar{x}_0 + \bar{x}_3x_2x_0$

$(8,10) + (5,7)$

| | y | 5 | 7 | 8 | 9 | 10 | 11 | 1 | 3 | 5 | 7 | 8 | 10 | 12 | 14 | 0 | 1 | 2 | 3 | 5 | 7 | 8 | 10 | 15 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8, 10 | 1 | | | X | | X | | | | | | | | | | | | | | | | | | | |
| 9, 11 | 1 | | | | X | | X | | | | | | | | | | | | | | | | | | ✓ |
| 5, 7 | 1 | X | X | | | | | | | | | | | | | | | | | | | | | | |
| 1, 3, 5, 7 | 2 | | | | | | | X | X | X | X | | | | | | | | | | | | | | |
| 8, 10, 12, 14 | 2 | | | | | | | | | | | X | X | X | X | | | | | | | | | | ✓ |
| 0, 2, 8, 10 | 3 | | | | | | | | | | | | | | | X | | X | | | | X | X | | ✓ |
| 1, 3, 5, 7 | 3 | | | | | | | | | | | | | | | | X | | X | X | X | | | | |
| 7, 15 | 3 | | | | | | | | | | | | | | | | | | | | X | | | X | ✓ |
| 8, 10 | 12 | | | X | | X | | | | | | X | X | | | | | | | | | | | | |
| 5, 7 | 12 | X | X | | | | | | | X | X | | | | | | | | | | | | | | |
| 1, 3, 5, 7 | 23 | | | | | | | X | X | X | X | | | | | | X | | X | X | X | | | | ✓ |
| 8, 10 | 23 | | | | | | | | | | | X | X | | | | | | | | | X | X | | |
| 8, 10 | 13 | | | X | | X | | | | | | | | | | | | | | | | X | X | | |
| 5, 7 | 13 | X | X | | | | | | | | | | | | | | | | | X | X | | | | |
| 8, 10 | 123 | | | X | | X | | | | | | X | X | | | | | | | | | X | X | | ✓ |
| 5, 7 | 123 | X | X | | | | | | | X | X | | | | | | | | | X | X | | | | ✓ |

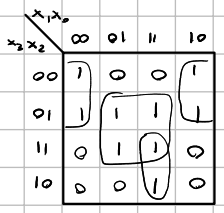
$y_1 = x_3\bar{x}_2\bar{x}_0 + x_3\bar{x}_2x_0 + \bar{x}_3x_2x_0$

$y_2 = \bar{x}_3x_0 + x_3\bar{x}_0$ 7 zamiast 8

$y_3 = \bar{x}_2\bar{x}_0 + \bar{x}_3x_0 + x_2x_1x_0$

C 1

$y = \sum(0, 2, 4, 5, 6, 7, 11, 13, 15)$




$y = \overline{x}_3 \overline{x}_0 + x_2 x_0 + x_3 x_1 x_0$

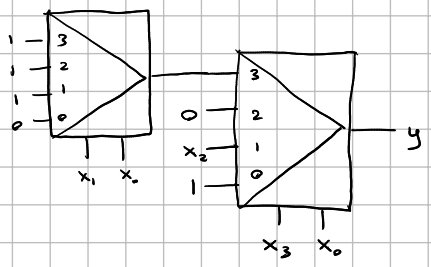
$x_3 \rightarrow$ 2 razy — $x_3$ i $x_0$ na wejścia sterujące

$x_2 \rightarrow$ 1 raz

$x_1 \rightarrow$ 1 raz

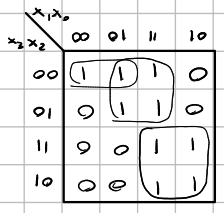
$x_0 \rightarrow$ 3 razy

| $x_3$ | $x_0$ | y |
|---|---|---|
| 0 | 0 | $1 \cdot 1 + x_2 \cdot 0 + x_1 \cdot 0 = 1 + 0 = 1$ |
| 0 | 1 | $1 \cdot 0 + x_2 \cdot 1 + 0 \cdot x_1 \cdot 1 = 0 + x_2 + 0 = x_2$ |
| 1 | 0 | $0 \cdot 1 + x_2 \cdot 0 + 1 \cdot x_1 \cdot 0 = 0 + 0 + 0 = 0$ |
| 1 | 1 | $0 \cdot 0 + x_2 \cdot 1 + 1 \cdot x_1 \cdot 1 = x_2 + x_1$ |




C 2

$y = \sum(0, 1, 3, 5, 7, 10, 11, 14, 15)$




$y = x_3 x_1 + \overline{x}_3 x_0 + \overline{x}_3 \overline{x}_2 \overline{x}_1$

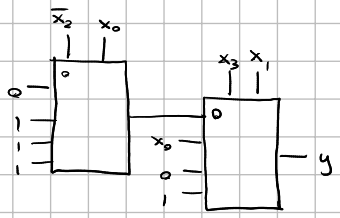
$x_3 \rightarrow$ 3 — $x_3 x_1$ na wejście sterujące

$x_2 \rightarrow$ 1

$x_1 \rightarrow$ 2

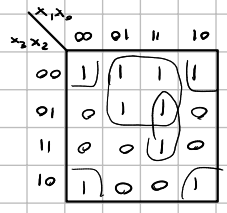
$x_0 \rightarrow$ 1

| $x_3$ | $x_1$ | y |
|---|---|---|
| 0 | 0 | $0 \cdot 0 + 1 \cdot x_0 + 1 \cdot \overline{x}_2 \cdot 1 = x_0 + \overline{x}_2$ |
| 0 | 1 | $0 \cdot 1 + 1 \cdot x_0 + 1 \cdot \overline{x}_2 \cdot 0 = x_0$ |
| 1 | 0 | $1 \cdot 0 + 0 \cdot x_0 + 0 \cdot \overline{x}_2 \cdot 1 = 0$ |
| 1 | 1 | $1 \cdot 1 + 0 \cdot x_0 + 0 \cdot \overline{x}_2 \cdot 0 = 1$ |




C 3

$y = \sum(0, 1, 2, 3, 5, 7, 8, 10, 15)$



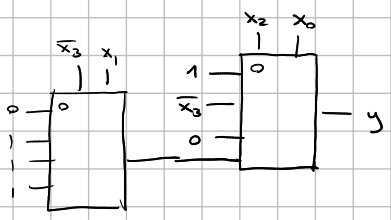

$y = \overline{x}_2 \overline{x}_0 + \overline{x}_3 x_0 + x_2 x_1 x_0$

$x_3 \rightarrow$ 1

$x_2 \rightarrow$ 2

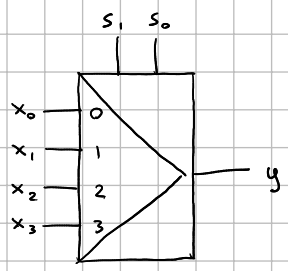
$x_1 \rightarrow$ 1

$x_0 \rightarrow$ 3




| $x_2$ | $x_0$ | y |
|---|---|---|
| 0 | 0 | $1 + 0 + 0 = 1$ |
| 0 | 1 | $0 + \overline{x}_3 + 0 = \overline{x}_3$ |
| 1 | 0 | $0 + 0 + 0 = 0$ |
| 1 | 1 | $0 + \overline{x}_3 + x_1 = \overline{x}_3 + x_1$ |

Multiplexer 4 – 1




| $s_1$ | $s_0$ | y |
|---|---|---|
| 0 | 0 | $x_0$ |
| 0 | 1 | $x_1$ |
| 1 | 0 | $x_2$ |
| 1 | 1 | $x_3$ |

$$y = \bar{s}_1 \bar{s}_0 x_0 + \bar{s}_1 s_0 x_1 + s_1 \bar{s}_0 x_2 + s_1 s_0 x_3$$