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| ***KOLEGIUM KARKONOSKIE***  ***INSTYTUT TECHNIKI*** | | | | |
| **LABORATORIUM TECHNIKI CYFROWEJ** | | | | |
| *Numer grupy: 8/3* | *Numer ćwiczenia: 9* | | *Prowadzący: mgr. Aleksander Dziuda* | |
| *Skład podgrupy:* | *Temat ćwiczenia:* T9. Projektowanie elementów kombinacyjnych wykorzystując struktury SPLD. | | | |
|
| *Data wykonania:*  *12.05.2008 r.* | *Ocena:* | | *Podpis:* |

1. **Cel ćwiczenia**

Celem ćwiczenia jest wykorzystanie języka CUPL do programowania pojedynczych kombinacyjnych elementów logicznych w strukturach SPLD: GAL 16V8 i GAL 22V10.

Synteza i symulacja elementów logicznych opisanych tabelą prawdy lub równaniami logicznymi w języku CUPL.

1. **Zadania**

Wszystkie ćwiczenia (1-4) wykonaliśmy na jednym układzie GAL 22V10.



Tabela prawdy do zadań 1-4

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| a | b | c | d | Zad1 | Zad2 | Zad3 | | | | | | Zad4  (a,b,c,d) |
| OR  (a,b) | NAND  (a,b,c,d) | AND  (a,b) | NAND  (a,b) | OR  (a,b) | NOR  (a,b) | ExOR  (a,b) | ExNOR  (a,b) |
| 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 |
| 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 |
| 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 |
| 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 |
| 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 |
| 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 |
| 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 |

1. **Plik BRAMKI.PLD**

Name Bramki ;

PartNo 00 ;

Date 2008-05-12 ;

Revision 01 ;

Designer grupa 8/3 ;

Company KK IT ;

Assembly None ;

Location ;

Device g22v10 ;

/\* \*\*\*\*\*\*\*\*\*\*\*\*\*\*\* INPUT PINS \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

PIN 2 = a ;

PIN 3 = b ;

PIN 4 = c ;

PIN 5 = d ;

/\* \*\*\*\*\*\*\*\*\*\*\*\*\*\*\* OUTPUT PINS \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

PIN 14 = zad1;

PIN 15 = zad2;

PIN 16 = and;

PIN 17 = nand;

PIN 18 = or;

PIN 19 = nor;

PIN 20 = exor;

PIN 21 = exnor;

PIN 22 = zad4;

zad1 = a#b;

zad2 = !(a&b&c&d);

and = a&b;

nand = !(a&b);

or = a#b;

nor = !(a#b);

exor = a$b;

exnor = !(a$b);

zad4 = a&b#c&d;

1. **Plik BRAMKI.DOC**

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Bramki

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

CUPL(WM) 5.0a Serial# 60008009

Device g22v10 Library DLIB-h-40-1

Created Thu Feb 22 14:41:20 2001

Name Bramki

Partno 00

Revision 01

Date 2008-05-12

Designer grupa 8/3

Company KK IT

Assembly None

Location

===============================================================================

Expanded Product Terms

===============================================================================

and =>

a & b

exnor =>

a & !b

# !a & b

exor =>

a & !b

# !a & b

nand =>

a & b

nor =>

a

# b

or =>

a

# b

zad1 =>

a

# b

zad2 =>

a

& b

& c

& d

zad4 =>

a & b

# c & d

and.oe =>

1

exnor.oe =>

1

exor.oe =>

1

nand.oe =>

1

nor.oe =>

1

or.oe =>

1

zad1.oe =>

1

zad2.oe =>

1

zad4.oe =>

1

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Symbol Table

=======================================================================

Pin Variable Pterms Max Min

Pol Name Ext Pin Type Used Pterms Level

--- -------- --- --- ---- ------ ------ -----

a 2 V - - -

and 16 V 1 12 1

b 3 V - - -

c 4 V - - -

d 5 V - - -

exnor 21 V 2 12 1

exor 20 V 2 14 1

nand 17 V 1 14 1

nor 19 V 2 16 1

or 18 V 2 16 1

zad1 14 V 2 8 1

zad2 15 V 4 10 1

zad4 22 V 2 10 1

and oe 16 D 1 1 0

exnor oe 21 D 1 1 0

exor oe 20 D 1 1 0

nand oe 17 D 1 1 0

nor oe 19 D 1 1 0

or oe 18 D 1 1 0

zad1 oe 14 D 1 1 0

zad2 oe 15 D 1 1 0

zad4 oe 22 D 1 1 0

LEGEND D : default variable F : field G : group

I : intermediate variable N : node M : extended node

U : undefined V : variable X : extended variable

T : function

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Fuse Plot

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SP

05764 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

AR

00000 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

Pin #23 05808 Mode xx

00044 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

00088 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

00132 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

00176 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

00220 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

00264 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

00308 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

00352 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

00396 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

Pin #22 05810 Mode --

00440 --------------------------------------------

00484 ----x---x-----------------------------------

00528 ------------x---x---------------------------

00572 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

00616 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

00660 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

00704 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

00748 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

00792 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

00836 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

00880 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

Pin #21 05812 Mode x-

00924 --------------------------------------------

00968 ----x----x----------------------------------

01012 -----x--x-----------------------------------

01056 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

01100 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

01144 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

01188 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

01232 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

01276 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

01320 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

01364 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

01408 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

01452 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

Pin #20 05814 Mode --

01496 --------------------------------------------

01540 ----x----x----------------------------------

01584 -----x--x-----------------------------------

01628 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

01672 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

01716 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

01760 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

01804 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

01848 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

01892 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

01936 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

01980 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

02024 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

02068 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

02112 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

Pin #19 05816 Mode x-

02156 --------------------------------------------

02200 ----x---------------------------------------

02244 --------x-----------------------------------

02288 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

02332 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

02376 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

02420 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

02464 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

02508 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

02552 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

02596 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

02640 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

02684 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

02728 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

02772 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

02816 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

02860 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

Pin #18 05818 Mode --

02904 --------------------------------------------

02948 ----x---------------------------------------

02992 --------x-----------------------------------

03036 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

03080 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

03124 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

03168 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

03212 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

03256 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

03300 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

03344 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

03388 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

03432 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

03476 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

03520 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

03564 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

03608 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

Pin #17 05820 Mode x-

03652 --------------------------------------------

03696 ----x---x-----------------------------------

03740 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

03784 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

03828 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

03872 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

03916 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

03960 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

04004 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

04048 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

04092 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

04136 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

04180 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

04224 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

04268 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

Pin #16 05822 Mode --

04312 --------------------------------------------

04356 ----x---x-----------------------------------

04400 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

04444 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

04488 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

04532 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

04576 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

04620 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

04664 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

04708 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

04752 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

04796 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

04840 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

Pin #15 05824 Mode x-

04884 --------------------------------------------

04928 ----x---------------------------------------

04972 --------x-----------------------------------

05016 ------------x-------------------------------

05060 ----------------x---------------------------

05104 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

05148 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

05192 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

05236 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

05280 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

05324 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

Pin #14 05826 Mode --

05368 --------------------------------------------

05412 ----x---------------------------------------

05456 --------x-----------------------------------

05500 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

05544 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

05588 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

05632 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

05676 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

05720 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

LEGEND X : fuse not blown

- : fuse blown

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Chip Diagram

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\_\_\_\_\_\_\_\_\_\_\_\_\_\_

| Bramki |

x---|1 24|---x Vcc

a x---|2 23|---x

b x---|3 22|---x zad4

c x---|4 21|---x exnor

d x---|5 20|---x exor

x---|6 19|---x nor

x---|7 18|---x or

x---|8 17|---x nand

x---|9 16|---x and

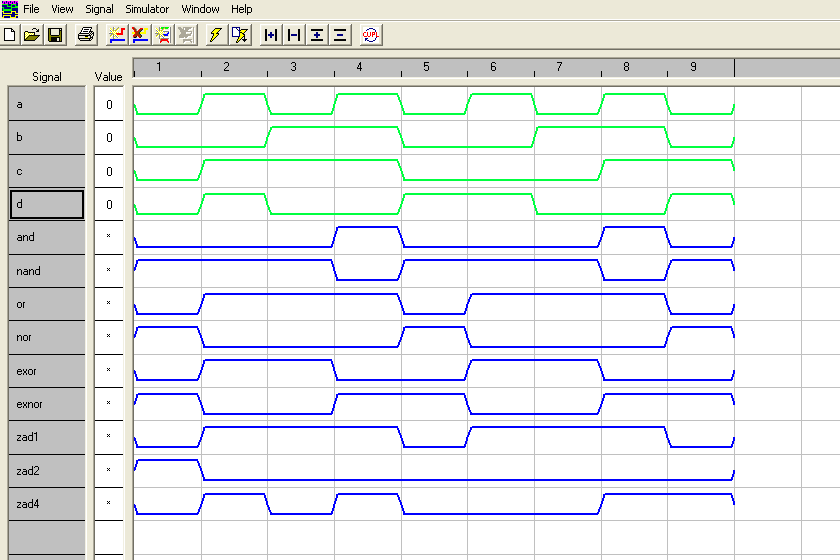
x---|10 15|---x zad2

x---|11 14|---x zad1

GND x---|12 13|---x

|\_\_\_\_\_\_\_\_\_\_\_\_\_\_|

1. **Przebiegi czasowe**



1. **Wnioski**

W czasie zajęć laboratoryjnych wykonaliśmy cztery zadania. Sprawdziliśmy działanie bramek AND, NAND, OR, NOR, ExOR, ExNOR i 4-wejściwej bramki NAND oraz zaprojektowaliśmy funkcję AND – OR – NOT. Wszystkie ćwiczenia wykonaliśmy programując jeden układ, GAL 22V10.

W sprawozdaniu zostały zamieszczone pliki .PLD, .DOC oraz przebiegi czasowe. Z przeprowadzonych doświadczeń wynika, że teoretyczne założenia zostały poparte praktycznymi faktami. Wszystkie układy działały zgodnie z założeniami. Ich tabele prawdy pokrywały się z naszymi wynikami.