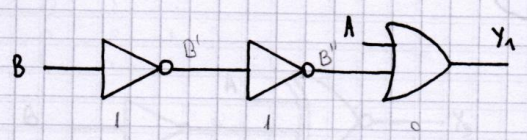
HOJA N°

FECHA

ROSATELLI, MARÍA FLORENCIA

①



A	B	Y_1
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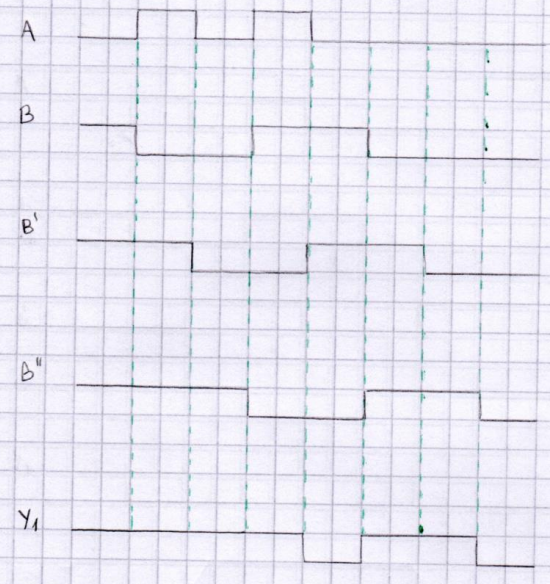
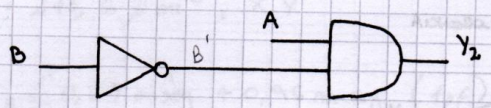
1	1	1



NOTA

ROSATELLI, MARIA FLORENZIA



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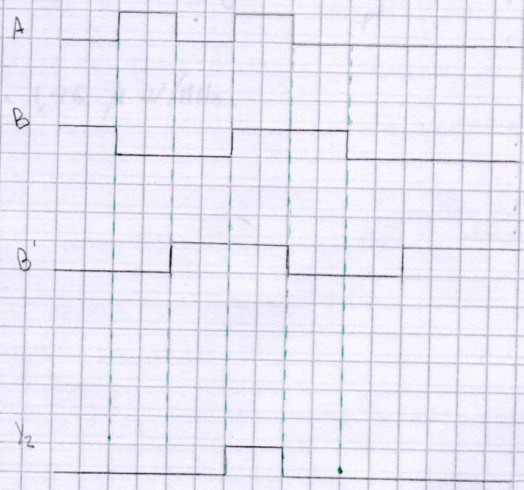
1	1	1

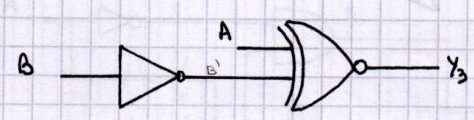


NOTA

HOJA Nº

FECHA

ROSATELLI, MARÍA FLORENCIA



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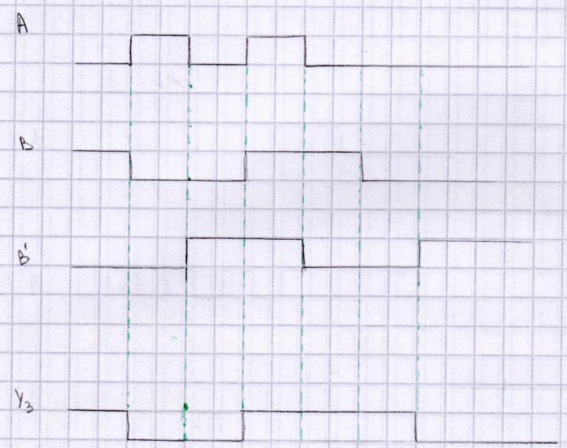
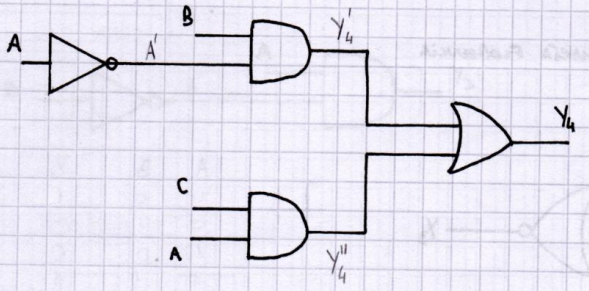
1	1	1



NOTA

ROSATELLI, MARÍA FLORENCIA



A'	A	B	Y_4'
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1	0	1	1
0	1	0	0
0	1	1	0

A	C	Y_4'
0	0	0
0	1	0
1	0	0
1	1	1

Y_4'	Y_4''	Y_4
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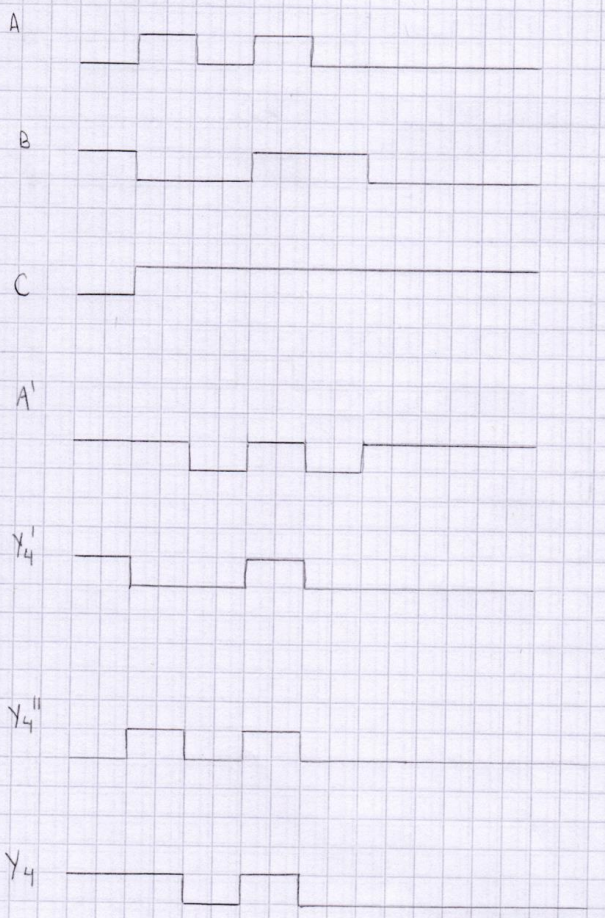
0	1	1
1	0	1
1	1	1



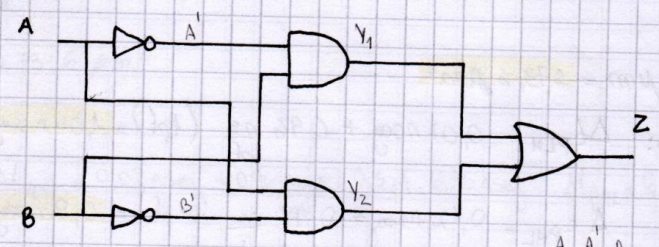
NOTA

HOJA N°

FECHA

ROSATELLI, MARÍA FLORENCIA

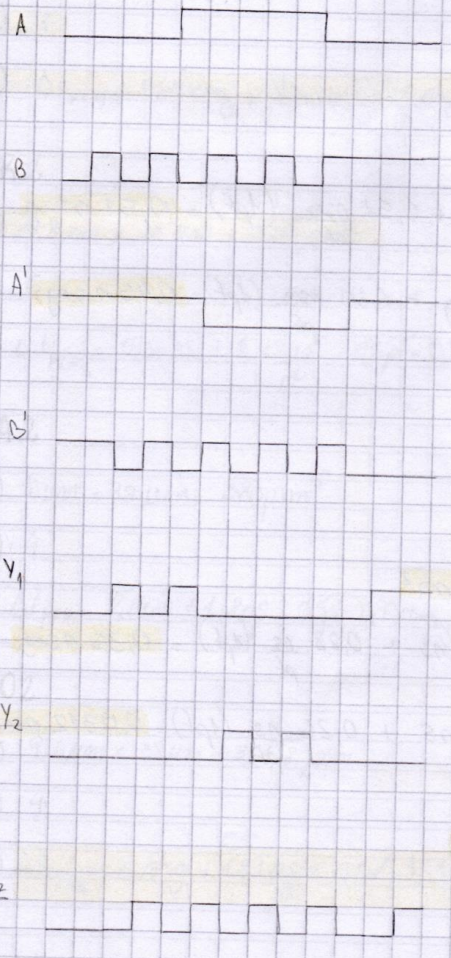
②



A	A'	B	Y_1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0

A	B'	B	Y_2
0	1	0	0
0	0	1	0
1	1	0	1
1	0	1	0

Y_1	Y_2	Z
0	0	0
0	1	1
1	0	1
1	1	1



NOTA

ROSATELLI, MARÍA FLORENCIA

③

CARGA = 1 pf

INV

Area: $7,2\,\mu m \times 38,0\,\mu m = 273,6\,\mu m^2$

Tiempo de propagación: $\Delta t_{PLH} = 0,07\,nseg + 0,96\,\frac{ns}{pf}\,(1pf) = 1,03\,nseg$

$\Delta t_{PHL} = 0,12\,nseg + 0,78\,\frac{ns}{pf}\,(1pf) = 0,9\,nseg$

Consumo de potencia: $1,46\,\mu W/MHz$

INV 2

Área: $7,2\,\mu m \times 38\,\mu m = 273,6\,\mu m^2$

Tiempo de propagación: $\Delta t_{PLH} = 0,06\,nseg + 0,51\,\frac{nseg}{pf}\,(1pf) = 0,57\,nseg.$

$\Delta t_{PHL} = 0,10\,nseg + 0,35\,\frac{nseg}{pf}\,(1pf) = 0,45\,nseg.$

Consumo de potencia: $2,31\,\mu W/MHz$

INV 3

Área: $13,4\,\mu m \times 38\,\mu m = 509,2\,\mu m^2$

Tiempo de propagación: $\Delta t_{PLH} = 0,07\,ns + 0,28\,\frac{ns}{pf}\,(1pf) = 0,35\,nseg$

$\Delta t_{PHL} = 0,12\,ns + 0,26\,\frac{ns}{pf}\,(1pf) = 0,0312\,nseg$

Consumo de potencia: $4,54\,\mu W/MHz$

NOTA

HOJA N° 3

FECHA

ROSATELLI, MARÍA FLORENCIA

④

INV

a) 273,6 μm^2

b) 4

c) $\Delta t_{PLH} = 0,07 nseg + 0,96 \frac{nseg}{pf} \cdot 0,5 pf = 0,55 nseg$ $\Delta t_{PHL} = 0,12 nseg + 0,78 \frac{nseg}{pf} 0,5pf = 0,51 nseg$

AN2

a) 509,2 μm^2

b) 7

c) $\Delta t_{PLHA} = 0,69 nseg$, $\Delta t_{PLHB} = 0,75 nseg$ $\Delta t_{PHLA} = 0,81 nseg$ $\Delta t_{PHLB} = 0,79 nseg$

OR2

a) 13,8 $\mu m \times 38 \mu m = 524 \mu m^2$

b) 6

c) $\Delta t_{PLH_A} = 0,33 ns + 0,95 \frac{ns}{pf} \cdot 0,5pf = 0,805 nseg$ $\Delta t_{PHL_A} = 0,35 ns + 0,78 \frac{ns}{pf} \cdot 0,5pf = 0,74 nseg$

NA2

a) 10 $\mu m \times 38 \mu m = 380 \mu m^2$

b) 4

c) $\Delta t_{PLH} = 0,14 ns + 1,18 \frac{ns}{pf} \cdot 0,5pf = 0,73 nseg$ $\Delta t_{PHL_B} = 0,14 nseg + 0,97 \frac{nseg}{pf} \cdot 0,5pf = 0,625 nseg$

NO2

a) 9,6 $\mu m \times 38 \mu m = 364,8 \mu m^2$

b) 4

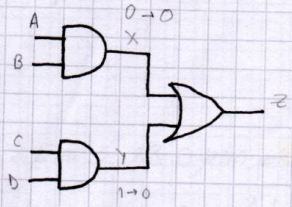
c) $\Delta t_{PLH_A} = 0,13 nseg + 1,83 \frac{nseg}{pf} \cdot 0,5pf = 1,04 nseg$ $\Delta t_{PHL_A} = 0,18 nseg + 1,02 \frac{ns}{pf} 0,5pf = 0,69 nseg$

$\Delta t_{PLH_B} = 0,12 nseg + 1,83 \frac{nseg}{pf} \cdot 0,5pf = 1,03 nseg$

NOTA

ROSATELLI, MARÍA FLORENCIA

(5)



A	B	C	D	Z
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0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1

A	B	C	D	Z
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

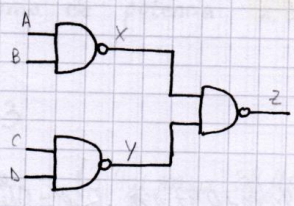
Área = $(X_{AND} * Y_{AND}) + (X_{AND} * Y_{AND}) + (X_{OR} * Y_{OR}) = (13,8\mu m * 38\mu m) * 2 + (13,4\mu m * 38\mu m)$

$\Rightarrow$ 1,55 nm^2

$T = \Delta t_{PHL(AND)} + \Delta t_{PHL(OR)} = 0,81\ nseg + 0,69\ nseg = 1,5\ nseg = \Delta t_{HL}$

$\Delta t_{PLH(AND)} + \Delta t_{PLH(OR)} = 0,75\ nseg + 0,805\ nseg = 1,555\ nseg = \Delta t_{LH}$

Potencia = $2 * P_{AND} + P_{OR} = 2 * (4,26\mu W/MHz) + 4,16\mu W/MHz =$ 12,68 $\mu W/MHz$



A	B	C	D	Z
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1

A	B	C	D	Z
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

Área = $(X_{NAND} * Y_{NAND}) * 3 = (380pm^2) * 3 =$ 1,14 nm^2

$T = 2 * \Delta t_{PLH\,NAND} = 2 * 0,73nseg =$ 1,46 nseg $= \Delta t_{LH}$

$2 * \Delta t_{PHL\,NAND} = 0,625nseg * 2 =$ 1,25 nseg $= \Delta t_{HL}$

Potencia = $3 * P_{NAND} = 2,21\mu W/MHz * 3 =$ 6,63 $\mu W/MHz$

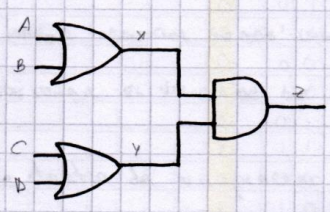
NOTA

HOJA N°

FECHA

ROSATELLI, MARÍA FLORENCIA

⑥



A	B	C	D	Z
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

$Area = 2 * (X_{OR} * Y_{OR}) + (X_{AND} * Y_{AND}) = 2 * (13,8\,\mu m * 38\,\mu m) + (13,4\,\mu m * 38\,\mu m) =$

$\Rightarrow 1,55\,nm^2$

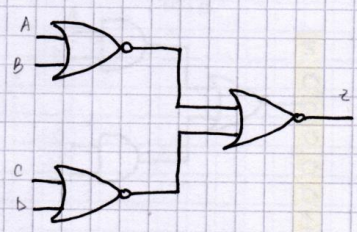
$T = \Delta t_{PLH\,(OR)} + \Delta t_{PLH\,(AND)} = 0,805\,nseg + 0,75\,nseg = 1,555\,nseg$

$\Delta t_{PHL\,(OR)} + \Delta t_{PHL\,(AND)} = 0,71\,nseg + 0,81\,nseg = 1,52\,nseg$

$Potencia = 4,26\,\frac{\mu W}{MHz} + 2 * \left(4,16\,\frac{\mu W}{MHz}\right) = 12,58\,\frac{\mu W}{MHz}$

NOTA

ROSATELLI, MARÍA FLORENCIA



A	B	C	D	Z
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0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

Área = 3 * NAND = 3 * (9,6 µm * 3,8 µm) = 0,36 n m^2

T = $2 * \Delta t_{PLH} = 2 * 1,04$ nseg = 2,08 nseg

$2 * \Delta t_{PHL} = 2 * 0,69$ nseg = 1,38 nseg

Potencia = $3 * P_{NOR} = 3 * 2,21 \frac{\mu W}{MHz} = 6,63 \frac{\mu W}{MHz}$

Dependiendo lo que se busca en optimización conviene uno o el otro circuito.

Por menos área, potencia, costo y Δt_{PHL} → 2do circuito (NOR)

Por menor Δt_{PLH} → 1° circuito (OR - AND)

NOTA

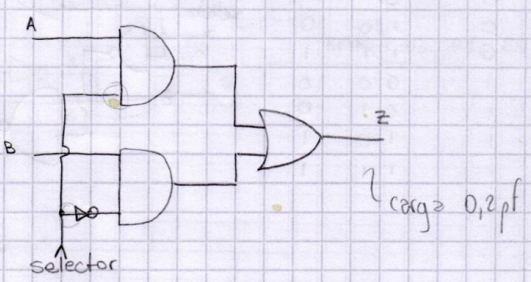
HOJA N°

FECHA

ROSATELLI, MARÍA FLORENCIA

(7)

selector	A	B	Z
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1



$Área = 2*(X_{AND} * Y_{AND}) + (X_{(NOT)} * Y_{(NOT)}) + (X_{(OR)} * Y_{OR}) = 2*(509,2\,pm^2) + (273,6\,pm^2) + (524\,pm^2)$

$\Rightarrow$ 1,81 nm^2

N° transistores = $2*7 + 4 + 6 = 24$

$\Delta T \rightarrow$

$10\%\ C_{(AND)} = 0,1 \cdot (0,033pf) = 0,0033\,pf$

$10\%\ C_{(NOT)} = 0,1 \cdot (0,058pf) = 0,0058\,pf$

$10\%\ C_{(OR)} = 0,1\ (0,036pf) = 0,0036\,pf$

$\rightarrow \Delta t_{Pxx} = t_{pt} + \Delta t_{pt}\ (C_{Fanin} \cdot 0,1 + C_{Fanin\,(COMPUERTA\ SIGUIENTE)})\Big|_{NOT+AND+OR} =$

$\rightarrow 0,12\,ns + 0,96\,\frac{ns}{pF}\,(0,0058pf + 0,033pf) + 0,4\,ns + 0,82\,\frac{ns}{pf}\,(0,0033pf + 0,036pf) +$

$+ 0,35\,ns + 0,95\,\frac{ns}{pf}\,(0,0036pf + 0,2pf) = 0,157\,nseg + 0,432\,nseg + 0,543\,nseg =$

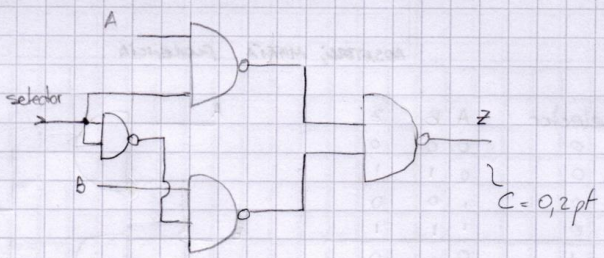
$\rightarrow$ 1,133 nseg

NOTA

ROSATELLI, MARÍA FLORENCIA

b)

selector	A	B	Z
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1



$$\text{Área} = 4\,(X_{(NAND)} * Y_{(NAND)}) = 4\,(380\,\mu m^2) = 1{,}52\,nm^2$$

$$N^\circ \text{ de transistores} = 4 * 4 = 16$$

$\Delta T \rightarrow$

$$C_{(NAND)} = 0{,}1 \cdot (0{,}050\,pf) = 0{,}0050\,pf$$

$$\Delta t_{pxx} = 2\left[0{,}14\,nseg + 1{,}18\,\frac{ns}{pf}\,(0{,}0050\,pf + 0{,}05\,pf)\right] + 0{,}14\,nseg + 1{,}18\,\frac{ns}{pf}\,(0{,}005\,pf + 0{,}2\,pf)$$

$$\Rightarrow 0{,}41\,nseg + 0{,}382\,nseg \approx 0{,}792\,nseg$$

PARA LOS CÁLCULOS DE t_r CONSIDERO LOS PEORES CASOS DE RETARDO ENTRE A Y B Y ENTRE EL LOW-HIGH, HIGH-LOW.

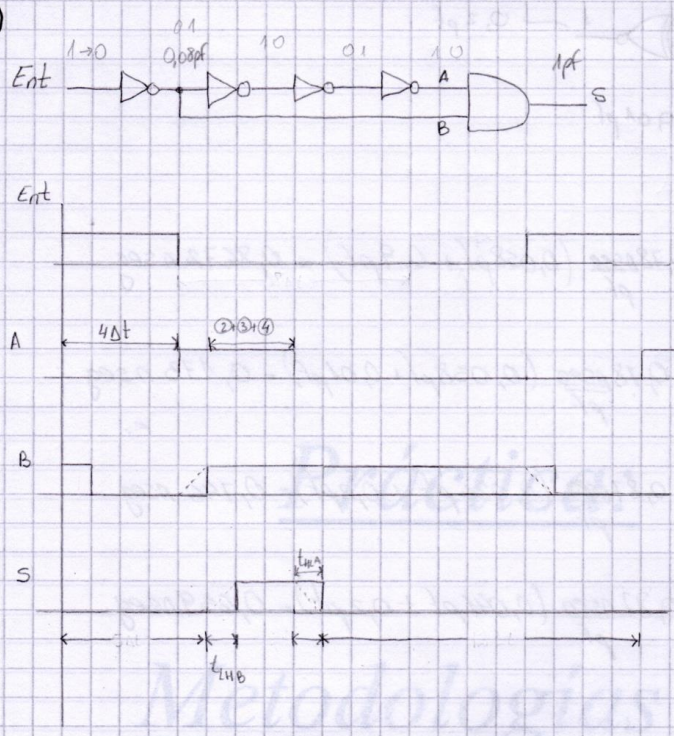
NOTA

HOJA Nº

FECHA

ROSATELLI, MARÍA FLORENCIA

⑧



1) $\Delta t_{PLH} = 0,07 nseg + 0,96 \frac{nseg}{pf} (0,08pf + 0,058pf + 0,033pf) = 0,234 nseg$

2) $\Delta t_{PHL} = 0,12 nseg + 0,78 \frac{nseg}{pF} (0,08pf + 0,058pf) = 0,227 nseg$

3) $\Delta t_{PLH} = 0,07 nseg + 0,96 \frac{nseg}{pf} (0,08pf + 0,058pf) = 0,202 nseg$

4) $\Delta t_{PHL} = 0,12 nseg + 0,78 \frac{nseg}{pf} (0,08pf + 0,029pf) = 0,205 nseg$

$\Delta t_{PHLA} = 0,40 nseg + 0,82 \frac{nseg}{pf} \cdot (0,08pf + 1pf) = 1,2856 nseg$

$\Delta t_{PLHB} = 0,36 nseg + 0,78 \frac{nseg}{pf} (0,08pf + 1pf) = 1,2024 nseg$

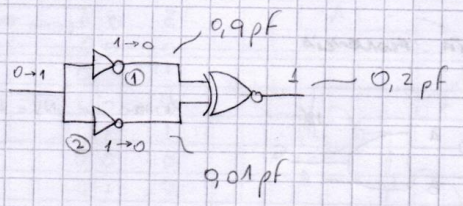
$\Delta T = t_{LHB} - ② - ③ - ④ = 1,2024 ns - 0,227 nseg - 0,202 nseg - 0,205 nseg = 0,5684 nseg$

$\Rightarrow \Delta T + \Delta t_{PHLA} = 1,854 nseg$

NOTA

ROSATELLI, MARIA FLORENCIA

⑨

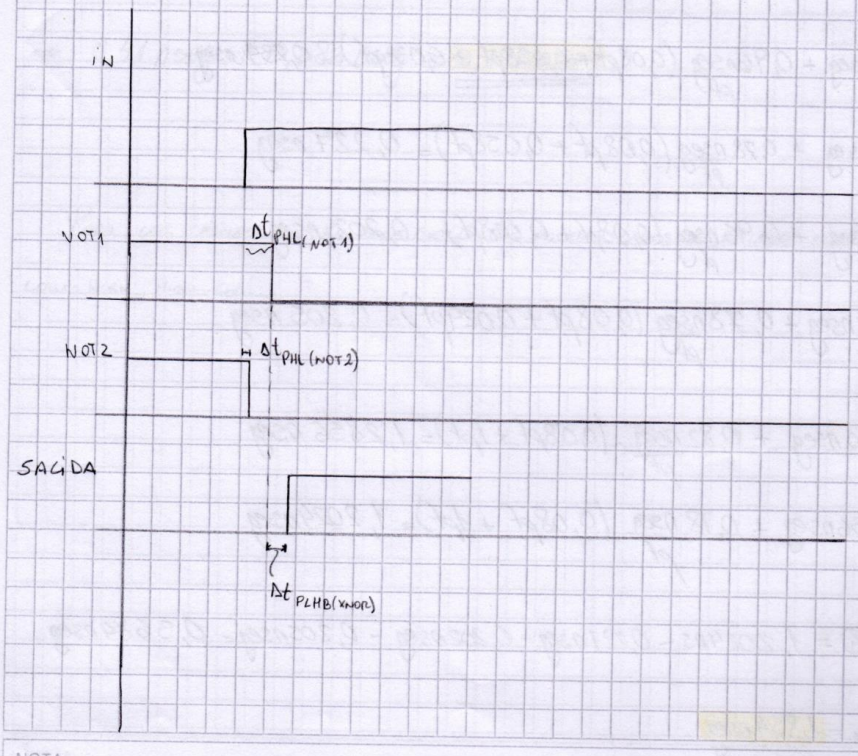


$$\Delta t_{P_{HL}\,(NOT\,1)} = 0,12\,nseg + \frac{0,78\,nseg}{pf}\,(0,058pf + 0,9pf) = 0,8672\,nseg$$

$$\Delta t_{P_{HL}\,(NOT\,2)} = 0,12\,nseg + \frac{0,78\,nseg}{pf}\,(0,058pf + 0,01pf) = 0,173\,nseg$$

$$\Delta t_{P_{(XNOR)}\,LH_B} = 0,55\,nseg + \frac{0,87\,nseg}{pf}\,(0,026pf + 0,2pf) = 0,746\,nseg$$

$$\Delta t_{P_{LHA\,(XNOR)}} = 0,45\,nseg + \frac{0,87\,nseg}{pf}\,(0,011pf + 0,2pf) = 0,659\,nseg$$



NOTA

NOTA