Aula 06 - Projetos de Circuitos Combinacionais

Circuitos Digitais - CRT 0384
Prof. Rennan Dantas
Ciência da Computação

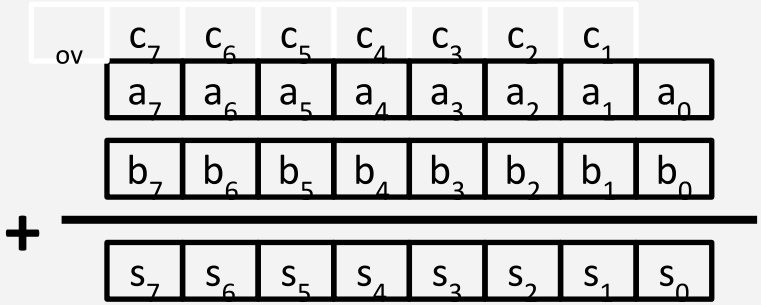
2020.1

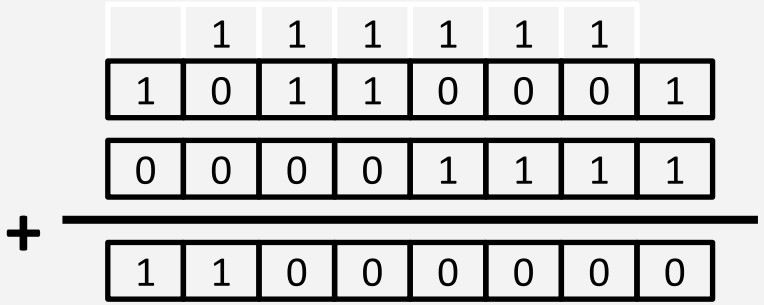
Sumário

- Circuitos Somadores e Subtratores
- Multiplexadores e demultiplexadores

Problema

- Construir um circuito digital capaz de somar dois números 8 bits.

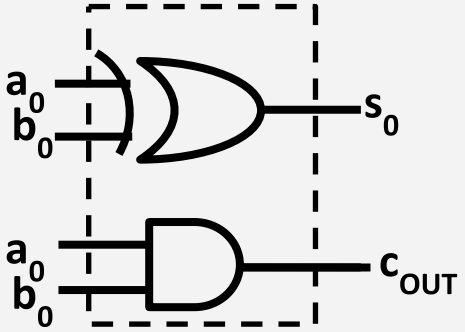




Meio Somador

a_0	b_0	s_0	c_{OUT}
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

$$s_0 = a_0 \oplus b_0$$
$$c_{OUT} = a_0 \cdot b_0$$



Somador Completo

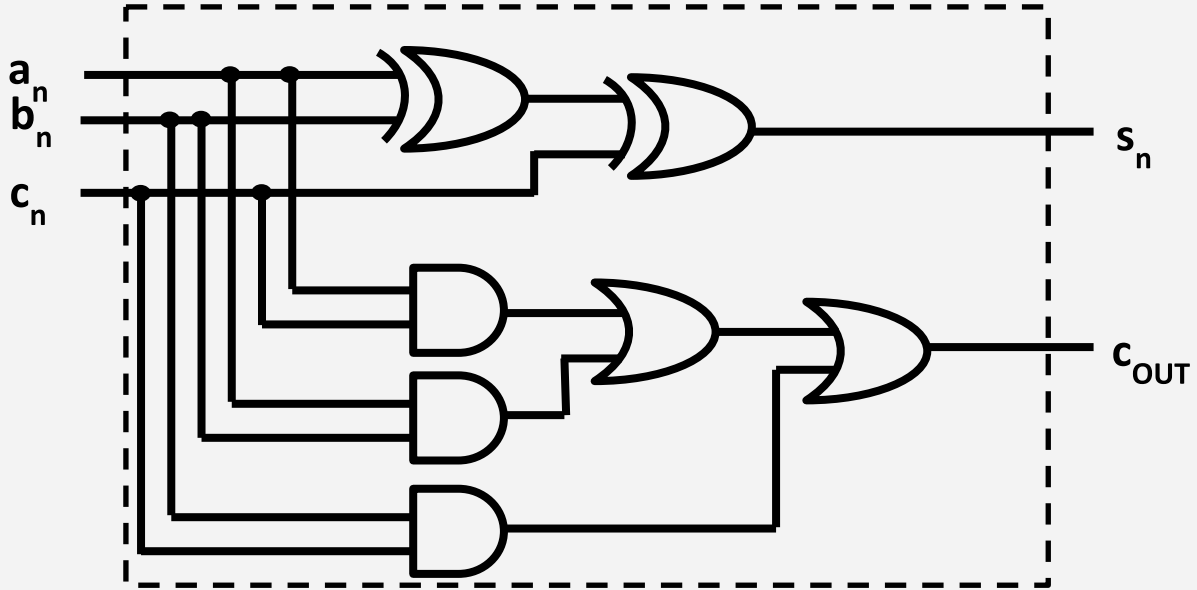
- Somador para os demais bits

a_n	b_n	c_n	s_n	c_{OUT}
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

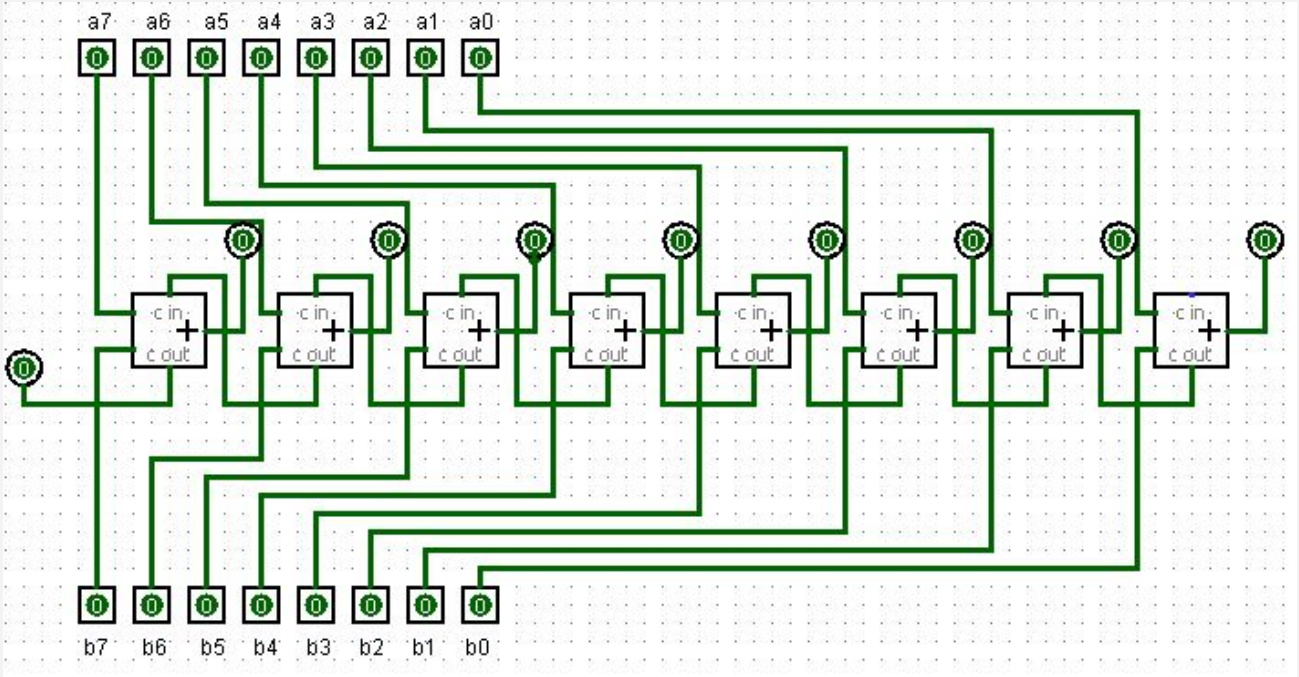
a_n	b_n	c_n	s_n	c_{OUT}
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

Somador Completo

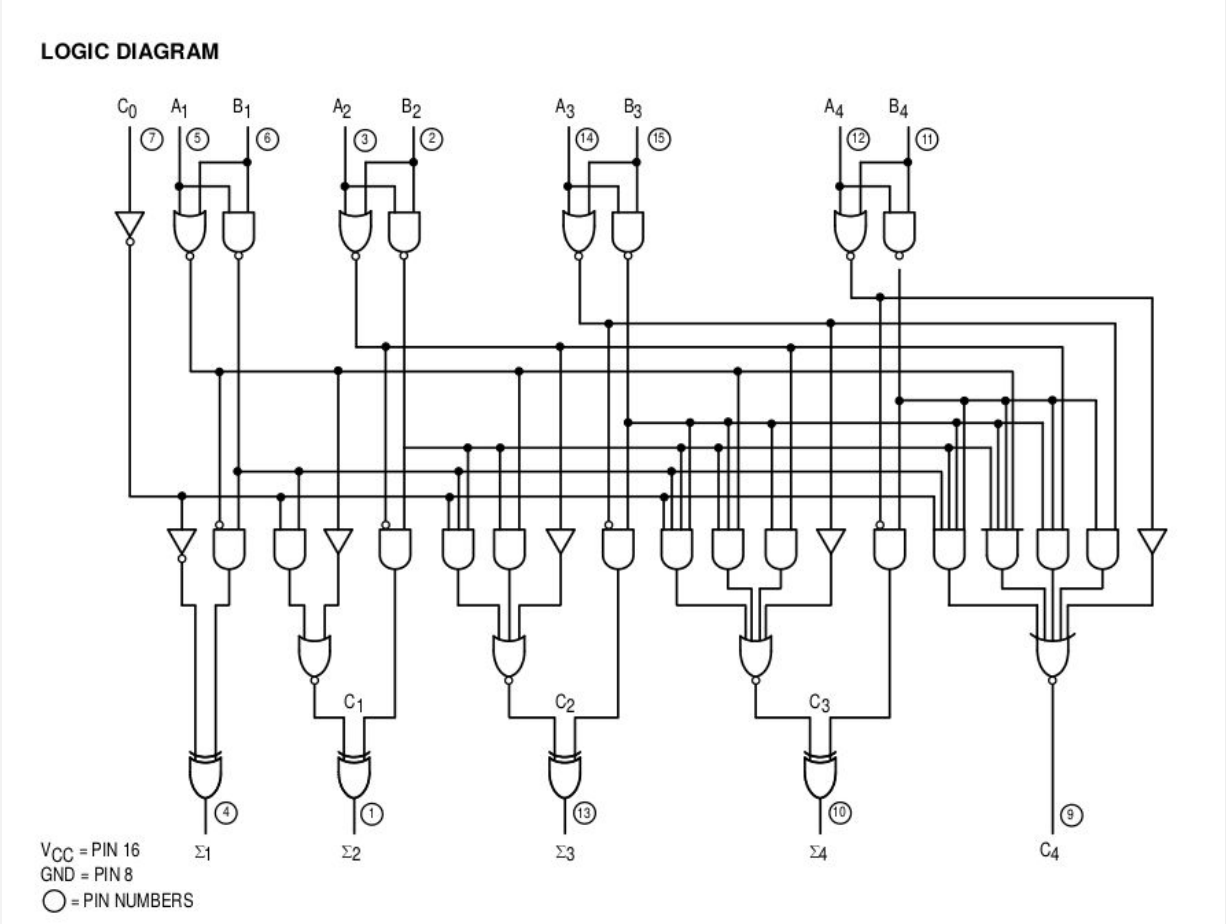
Circuito Somador



Somador de 8 bits



Somador comercial - 74LS283

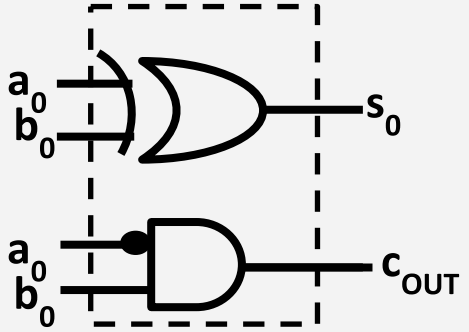


Meio Subtrator

Meio Subtrator

a_0	b_0	s_0	c_{OUT}
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

$$s_0 = a_0 \oplus b_0$$
$$c_{OUT} = \bar{a}_0 \cdot b_0$$



Subtrator Completo

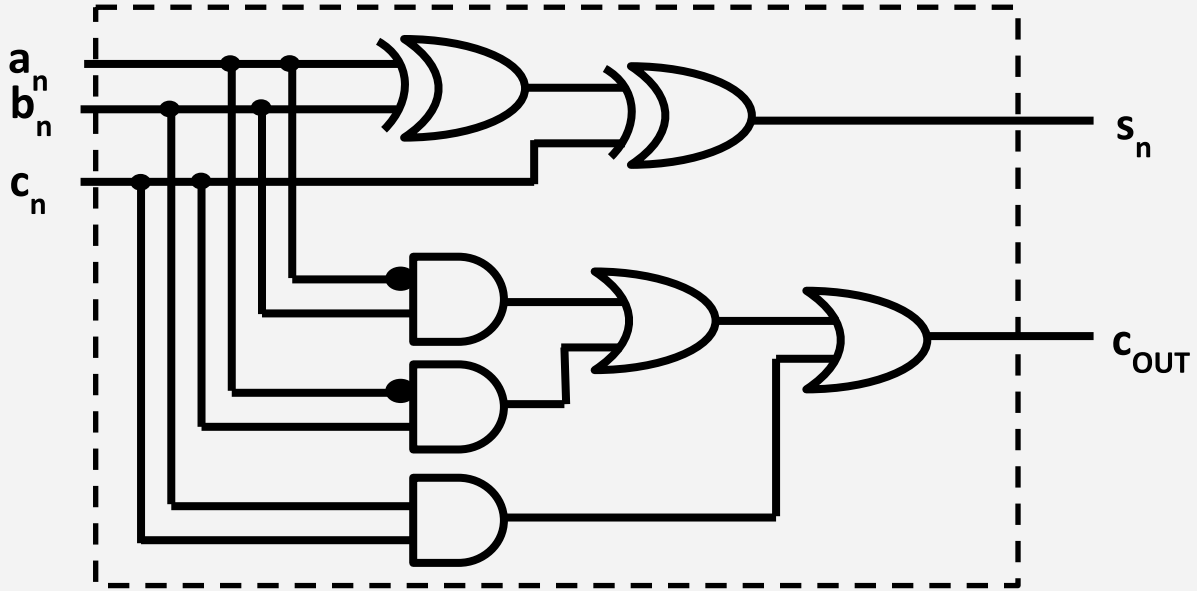
- Subtrator para os demais bits

a_n	b_n	c_n	c_{OUT}	s_n
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

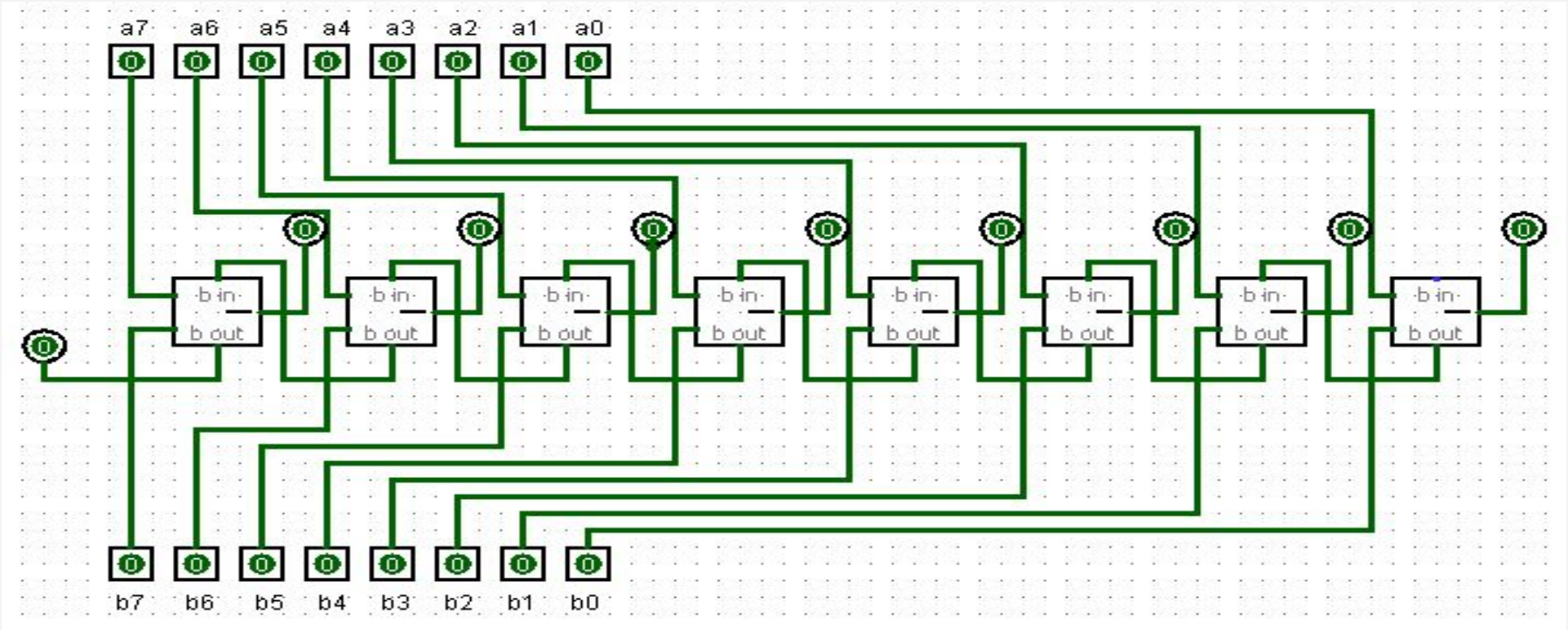
a_n	b_n	c_n	c_{OUT}	s_n
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

Subtrator Completo

Circuito Subtrator

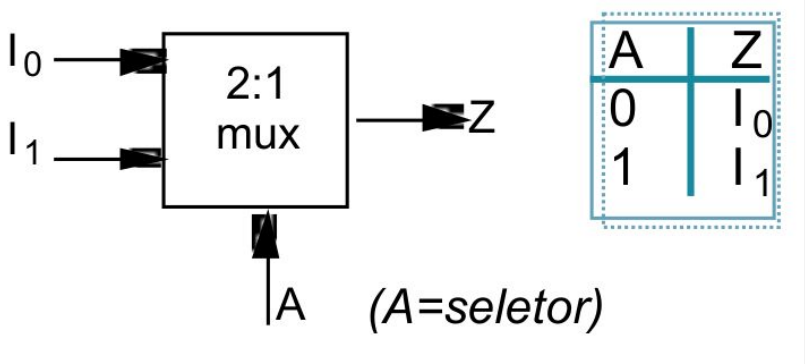


Subtrator de 8 bits

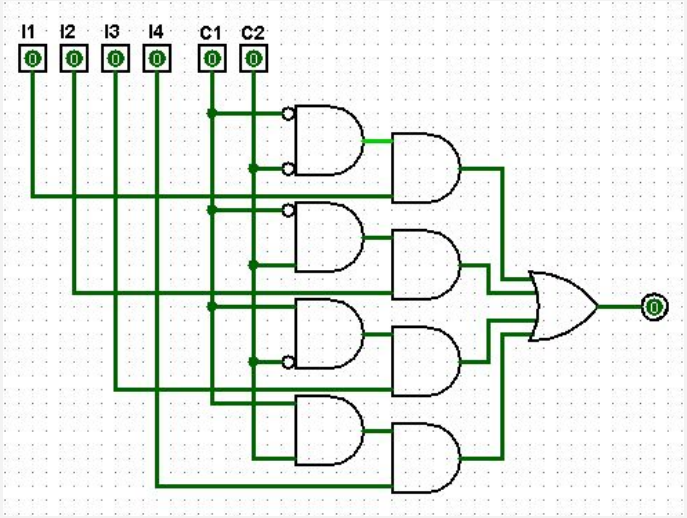


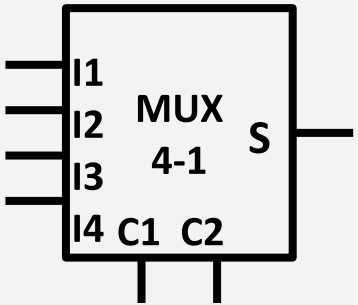
Multiplexadores

- A seleção de 2^n entradas é feitas através de n linhas de controle que endereçam cada uma destas entradas para a saída.
- Cada entrada possui um endereço determinado, o qual é, em geral, associado a um mintermo.
- A saída recebe o valor da entrada correspondente ao endereço escolhido.
- **Exemplo de um multiplexador/seletor de duas entradas e uma saída (mux 2->1)**

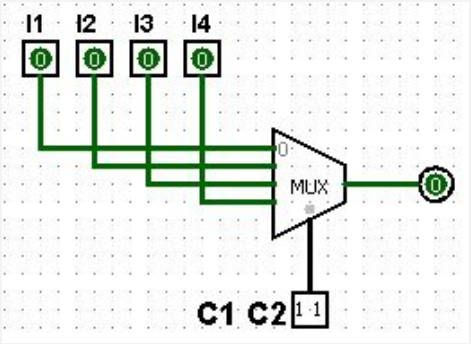


MUX 4-1





I1	I2	I3	I4	C1	C2	S
--	--	--	--	0	0	I1
--	--	--	--	0	1	I2
--	--	--	--	1	0	I3
--	--	--	--	1	1	I4

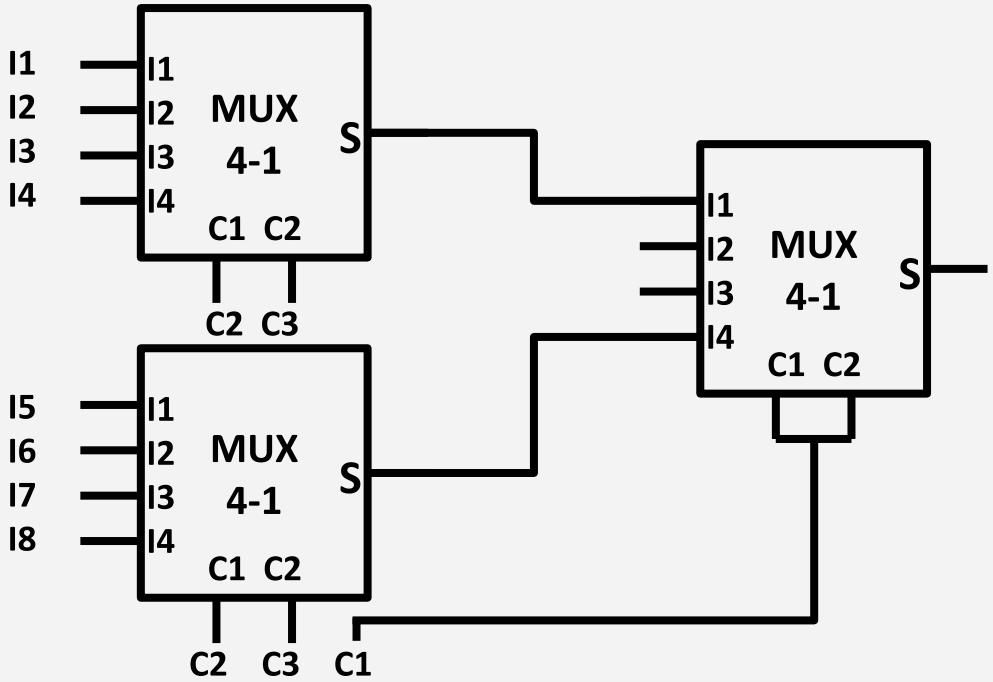


Multiplexadores

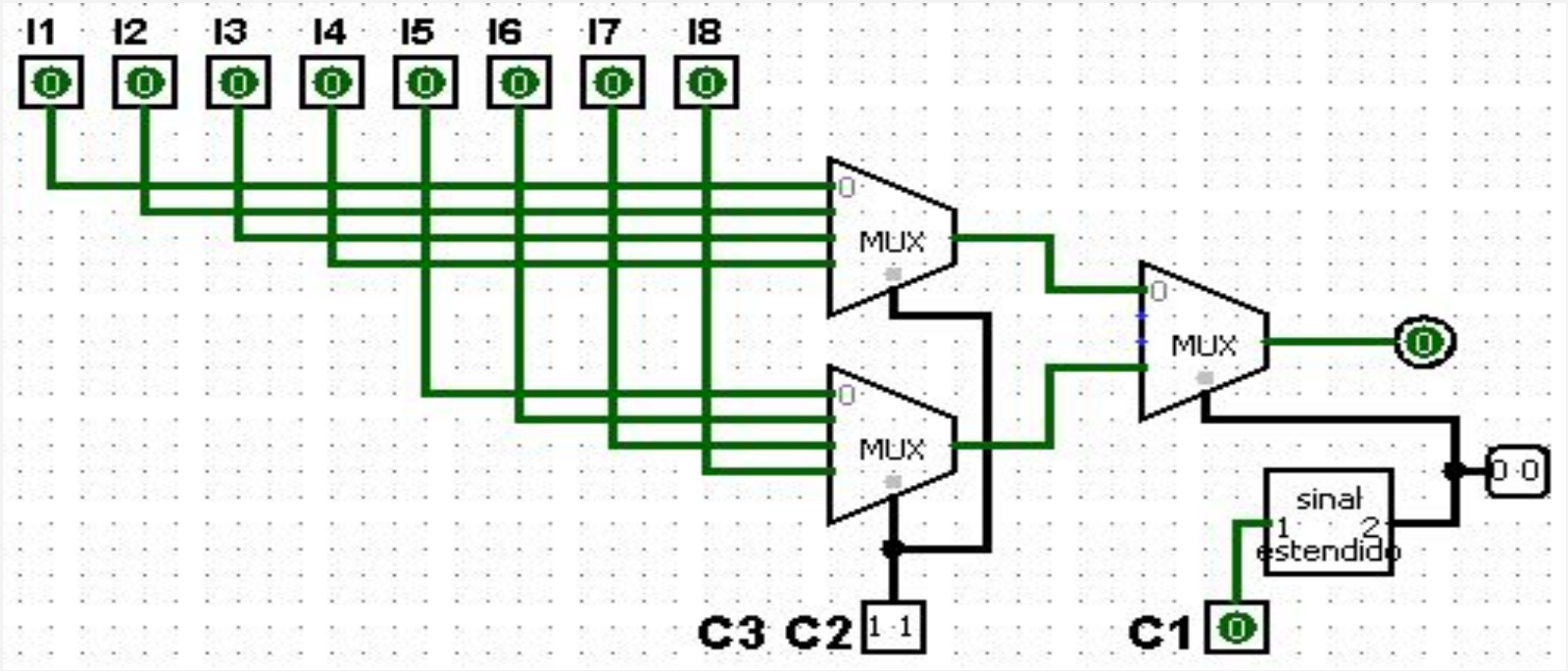
- É possível construir multiplexadores para mais que quatro canais a partir de MUX 4-1

I1	I2	I3	I4	I5	I6	I7	I8	C1	C2	C3	S
--	--	--	--	--	--	--	--	0	0	0	I1
--	--	--	--	--	--	--	--	0	0	1	I2
--	--	--	--	--	--	--	--	0	1	0	I3
--	--	--	--	--	--	--	--	0	1	1	I4
--	--	--	--	--	--	--	--	1	0	0	I5
--	--	--	--	--	--	--	--	1	0	1	I6
--	--	--	--	--	--	--	--	1	1	0	I7
--	--	--	--	--	--	--	--	1	1	1	I8

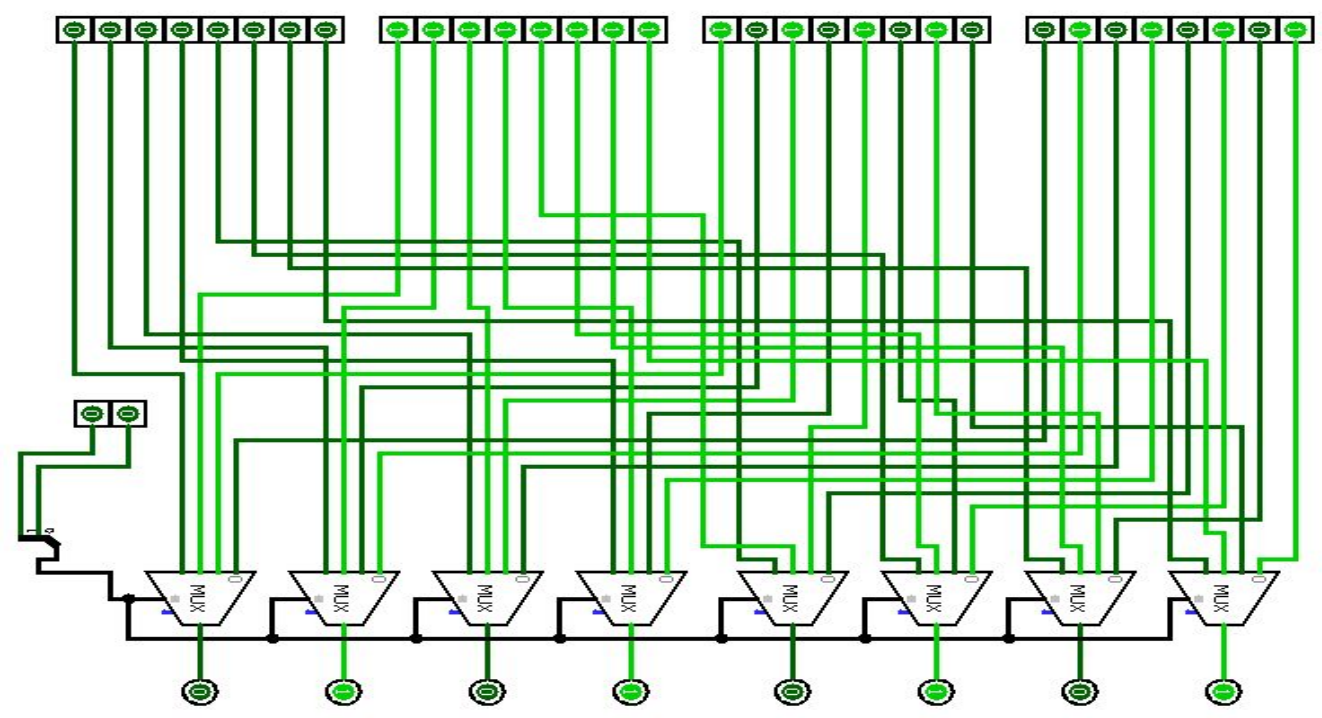
MUX 8-1


I1
I2
I3
I4
I1
I2
I3
I4
MUX
4-1
S
C1 C2
C2 C3
I1
I2
I3
I4
MUX
4-1
S
C1 C2
I5
I6
I7
I8
I1
I2
I3
I4
MUX
4-1
S
C1 C2
C2 C3 C1

MUX 8-1

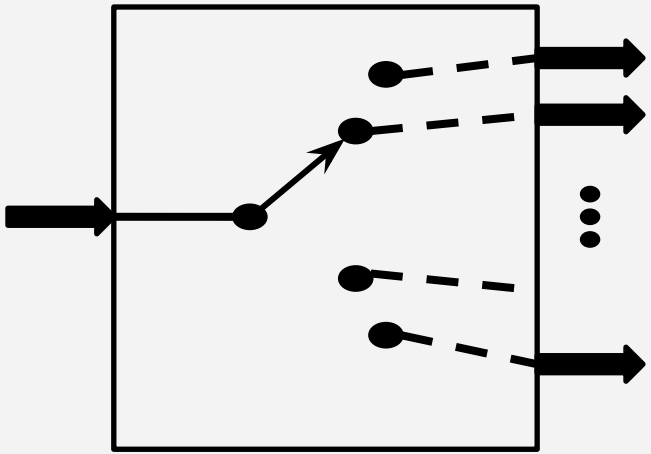


MUX 4x1 (8 bits)

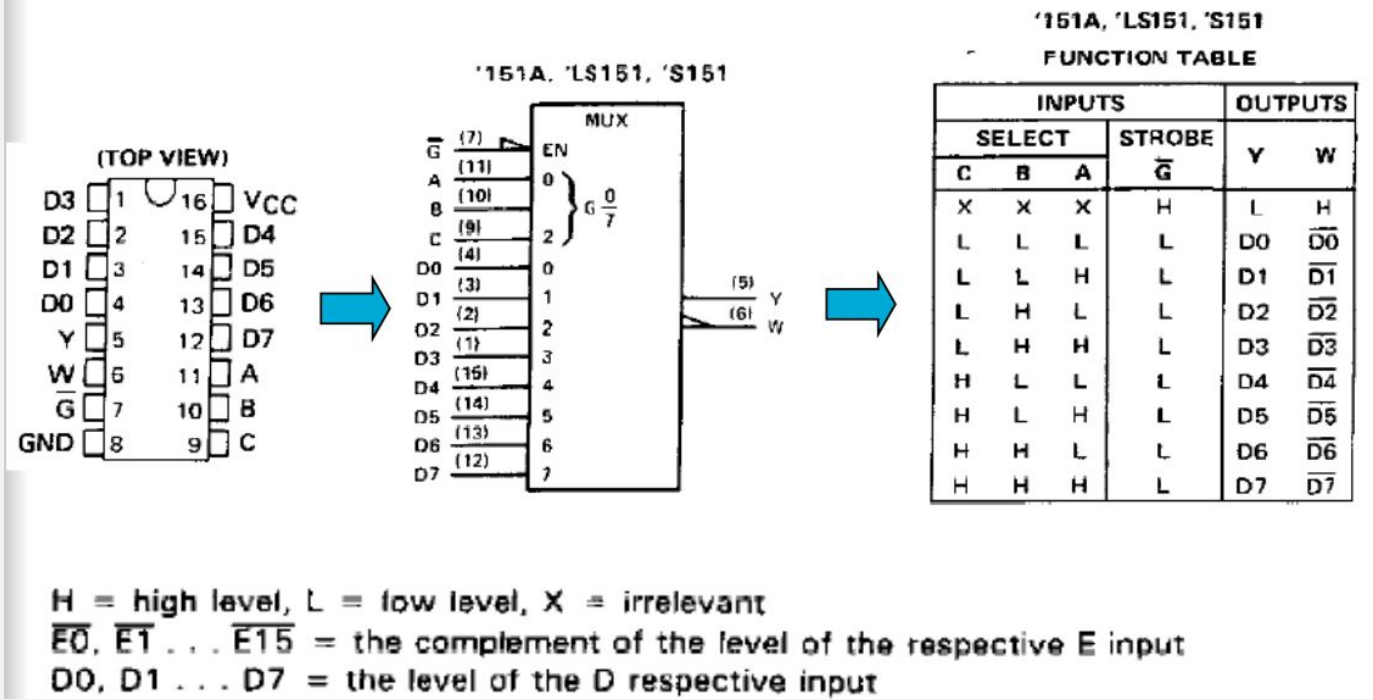


Demultiplexadores

- Permitem o roteamento de um único canal de informação para diferentes canais;

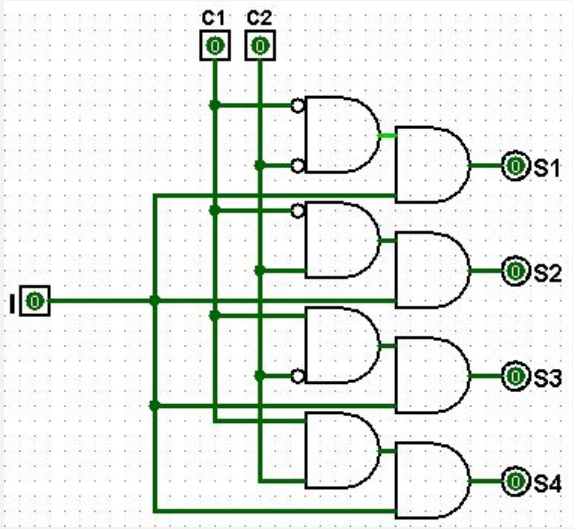


Multiplexador comercial - 74LS151

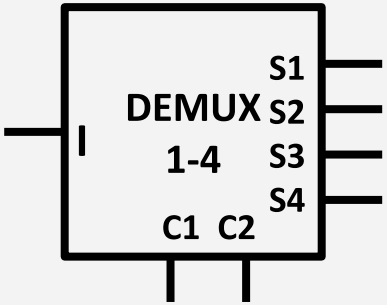


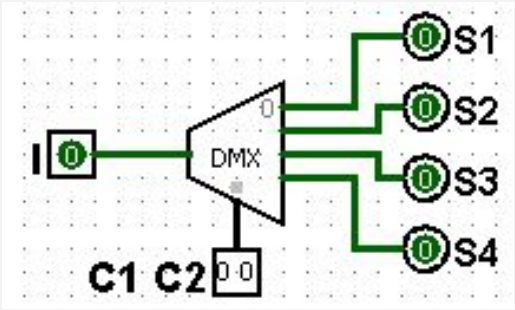
INPUTS				OUTPUTS	
SELECT			STROBE		
C	B	A	$\overline{G}$	Y	W
X	X	X	H	L	H
L	L	L	L	D0	$\overline{D0}$
L	L	H	L	D1	$\overline{D1}$
L	H	L	L	D2	$\overline{D2}$
L	H	H	L	D3	$\overline{D3}$
H	L	L	L	D4	$\overline{D4}$
H	L	H	L	D5	$\overline{D5}$
H	H	L	L	D6	$\overline{D6}$
H	H	H	L	D7	$\overline{D7}$

DEMUX 4-1



I	C1	C2	S1	S2	S3	S4
--	0	0	I	--	--	--
--	0	1	--	I	--	--
--	1	0	--	--	I	--
--	1	1	--	--	--	I





Demultiplexadores

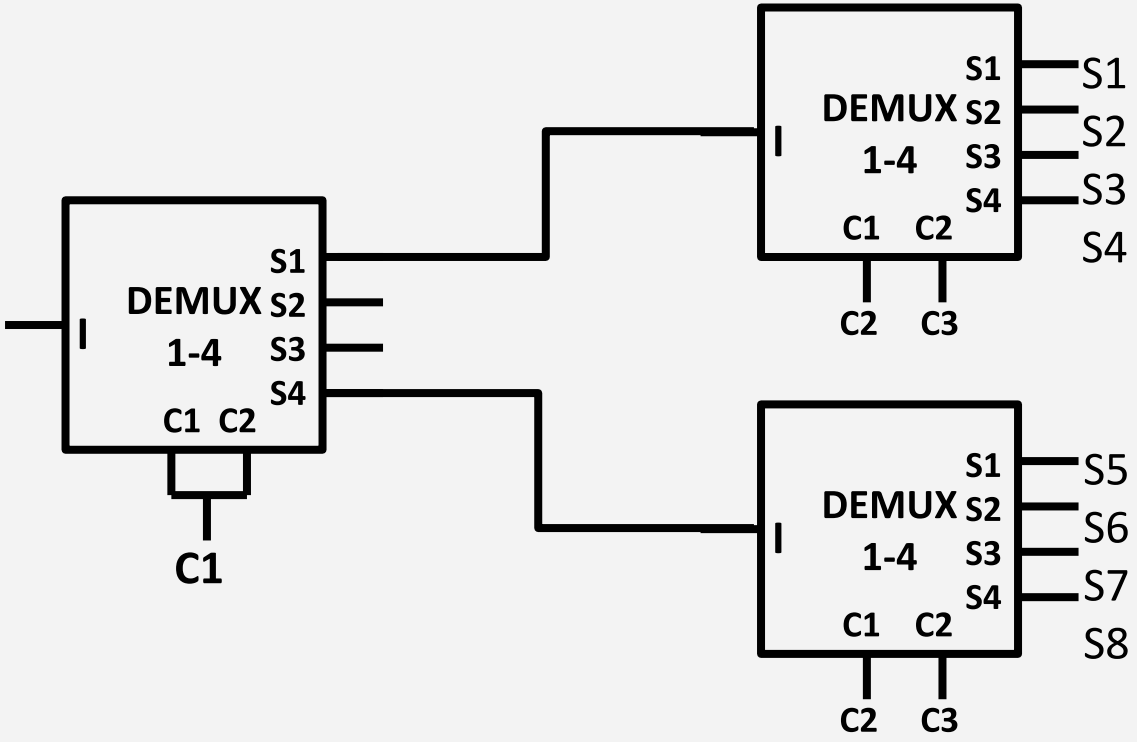
- É possível construir demultiplexadores para mais que quatro canais a partir de DEMUX 1-4

I	C1	C2	C3	S1	S2	S3	S4	S5	S6	S7	S8
--	0	0	0	I	--	--	--	--	--	--	--
--	0	0	1	--	I	--	--	--	--	--	--
--	0	1	0	--	--	I	--	--	--	--	--
--	0	1	1	--	--	--	I	--	--	--	--
--	1	0	0	--	--	--	--	I	--	--	--
--	1	0	1	--	--	--	--	--	I	--	--
--	1	1	0	--	--	--	--	--	--	I	--
--	1	1	1	--	--	--	--	--	--	--	I

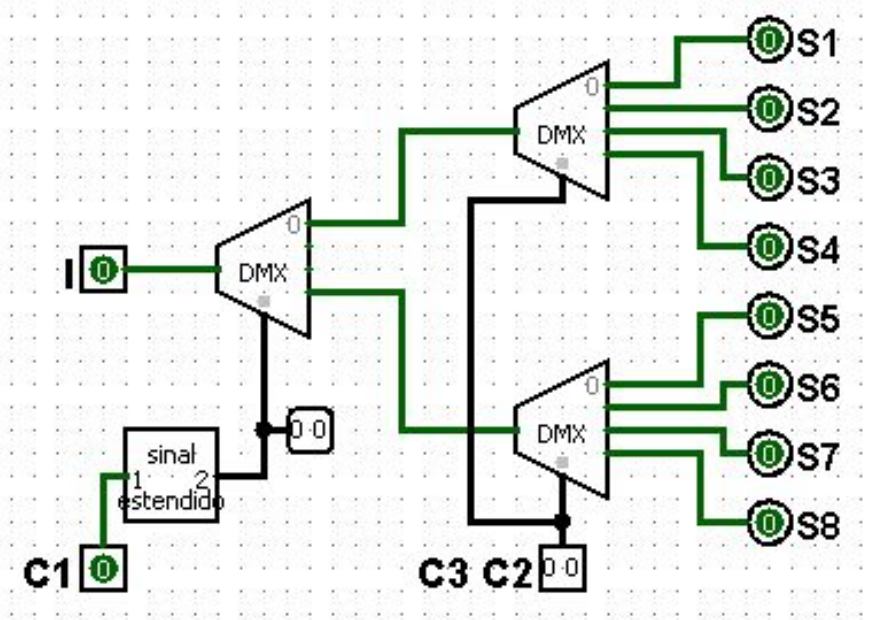
Demultiplexadores

- Da mesma forma que o Mux, no Demux o número de entradas está relacionado com o número de variáveis de seleção, ou seja:
  - n = 2m
  - n - número de canais de saída;
  - m - número de variáveis de seleção.
- Para:
  - m=2 o circuito possui quatro canais de saída,
  - m=3 o circuito possui oito canais de saída
- Algumas aplicações do Demux:
  - seleção de circuitos que devem receber uma determinada informação digital;
  - conversão de informação serial em paralela;

DEMUX 1-8


DEMUX
1-4
I
S1
S2
S3
S4
C1
C2
C1
DEMUX
1-4
I
S1
S2
S3
S4
C1
C2
C2
C3
S1
S2
S3
S4
DEMUX
1-4
I
S1
S2
S3
S4
C1
C2
C2
C3
S5
S6
S7
S8

DEMUX 1-8



Multiplexador comercial - 74LS138

PIN DESCRIPTION

PIN NO.	SYMBOL	NAME AND FUNCTION
1, 2, 3	A_0 to A_2	address inputs
4, 5	$\overline{E}_1$, $\overline{E}_2$	enable inputs (active LOW)
6	E_3	enable input (active HIGH)
8	GND	ground (0 V)
15, 14, 13, 12, 11, 10, 9, 7	$\overline{Y}_0$ to $\overline{Y}_7$	outputs (active LOW)
16	V_{CC}	positive supply voltage

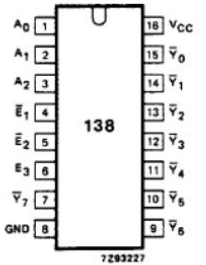


Fig.1 Pin configuration.

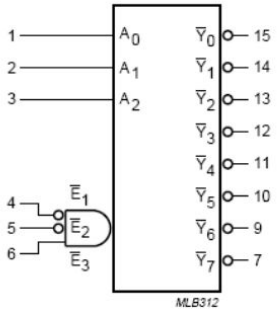


Fig.2 Logic symbol.

Multiplexador comercial - 74LS138

3-to-8 line decoder/demultiplexer; inverting

FUNCTION TABLE

INPUTS						OUTPUTS							
$\overline{E}_1$	$\overline{E}_2$	E_3	A_0	A_1	A_2	$\overline{Y}_0$	$\overline{Y}_1$	$\overline{Y}_2$	$\overline{Y}_3$	$\overline{Y}_4$	$\overline{Y}_5$	$\overline{Y}_6$	$\overline{Y}_7$
H	X	X	X	X	X	H	H	H	H	H	H	H	H
X	H	X	X	X	X	H	H	H	H	H	H	H	H
X	X	L	X	X	X	H	H	H	H	H	H	H	H
L	L	H	L	L	L	L	H	H	H	H	H	H	H
L	L	H	H	L	L	H	L	H	H	H	H	H	H
L	L	H	L	H	L	H	H	L	H	H	H	H	H
L	L	H	H	H	L	H	H	H	L	H	H	H	H
L	L	H	L	L	H	H	H	H	H	L	H	H	H
L	L	H	H	L	H	H	H	H	H	H	L	H	H
L	L	H	L	H	H	H	H	H	H	H	H	L	H
L	L	H	H	H	H	H	H	H	H	H	H	H	L

Notes

1. H = HIGH voltage level
   L = LOW voltage level
   X = don't care

Aula 06 - Projetos de Circuitos Combinacionais

Circuitos Digitais - CRT 0384

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