



Aula 06 - Projetos de Circuitos Combinacionais

Circuitos Digitais - CRT 0384

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Ciência da Computação

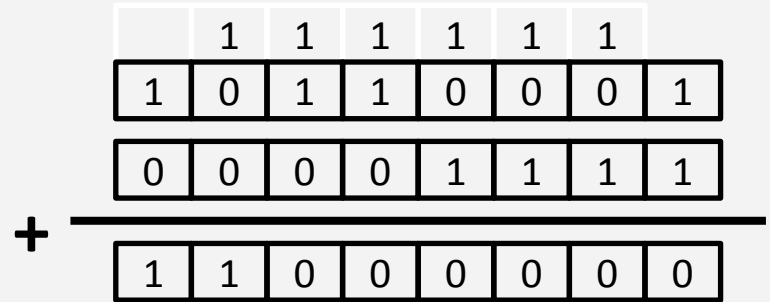
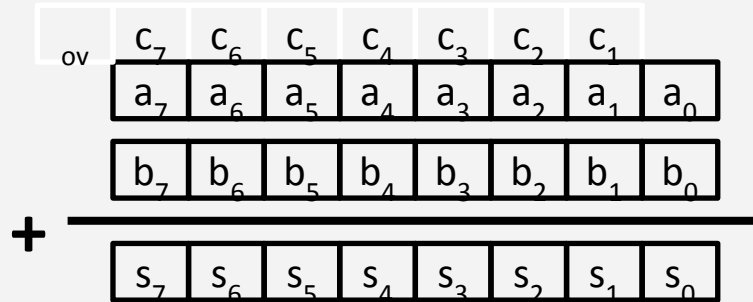
2020.1

Sumário

- Circuitos Somadores e Subtratores
- Multiplexadores e demultiplexadores

Problema

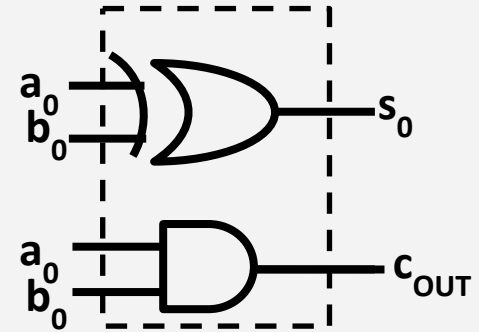
- Construir um circuito digital capaz de somar dois números 8 bits.



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

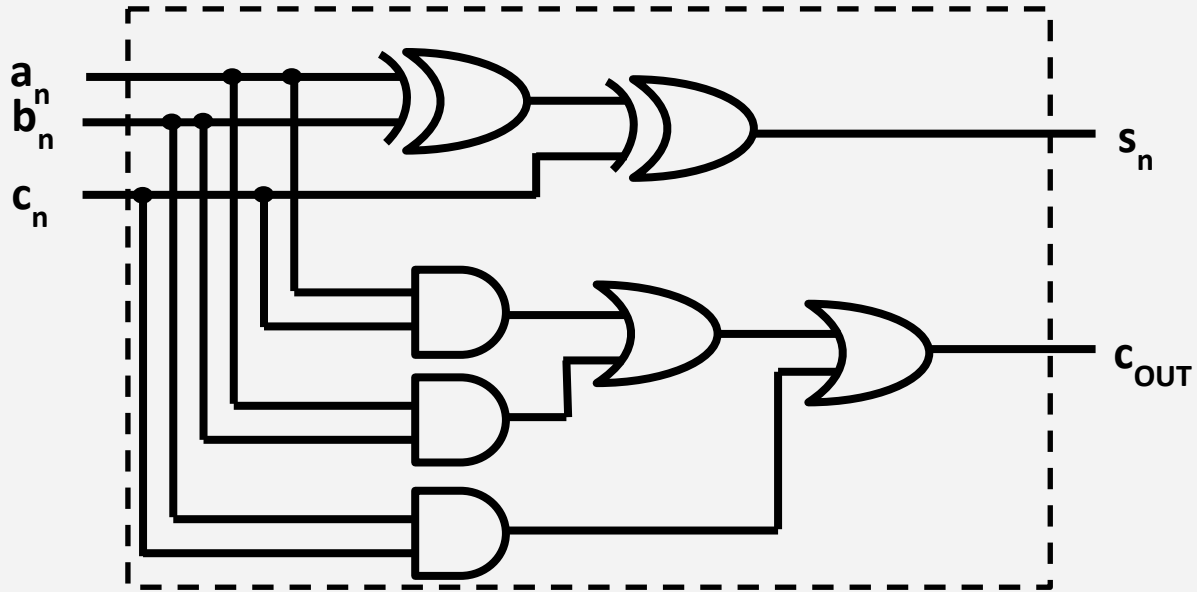
- Somador para os demais bits

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

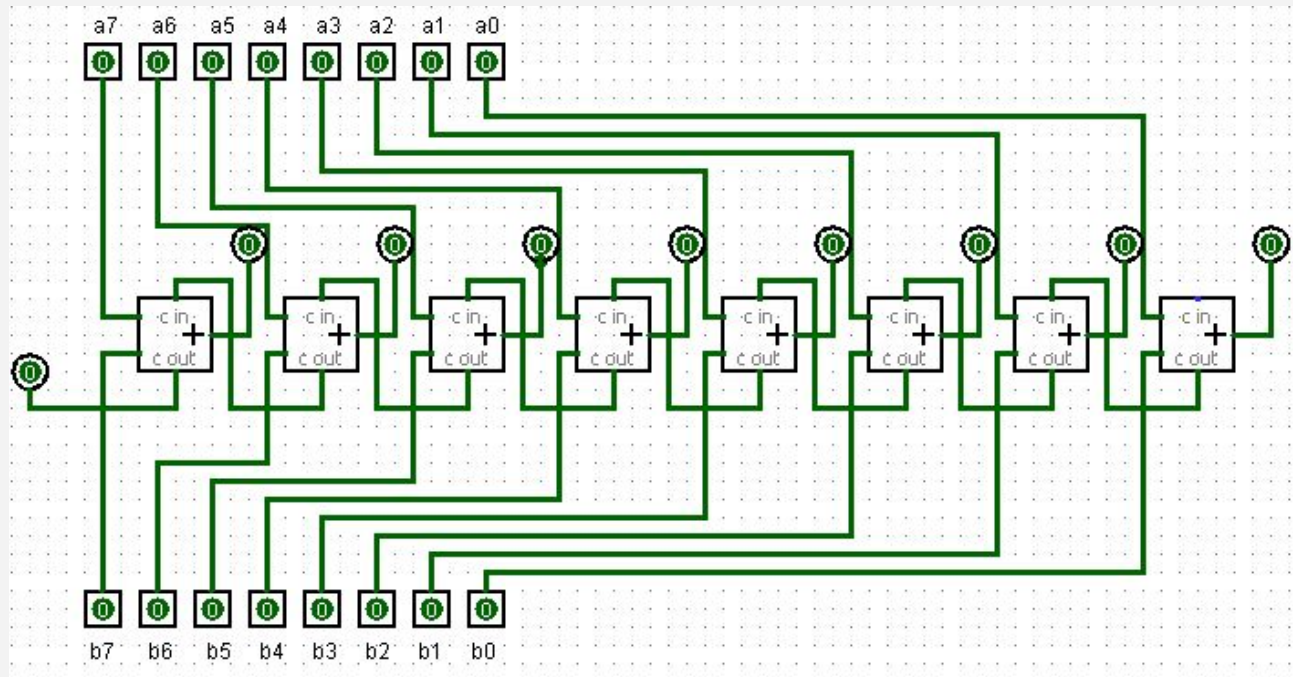
a_n	b_n	c_n	s_n	c_{OUT}
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

Somador Completo

Circuito Somador

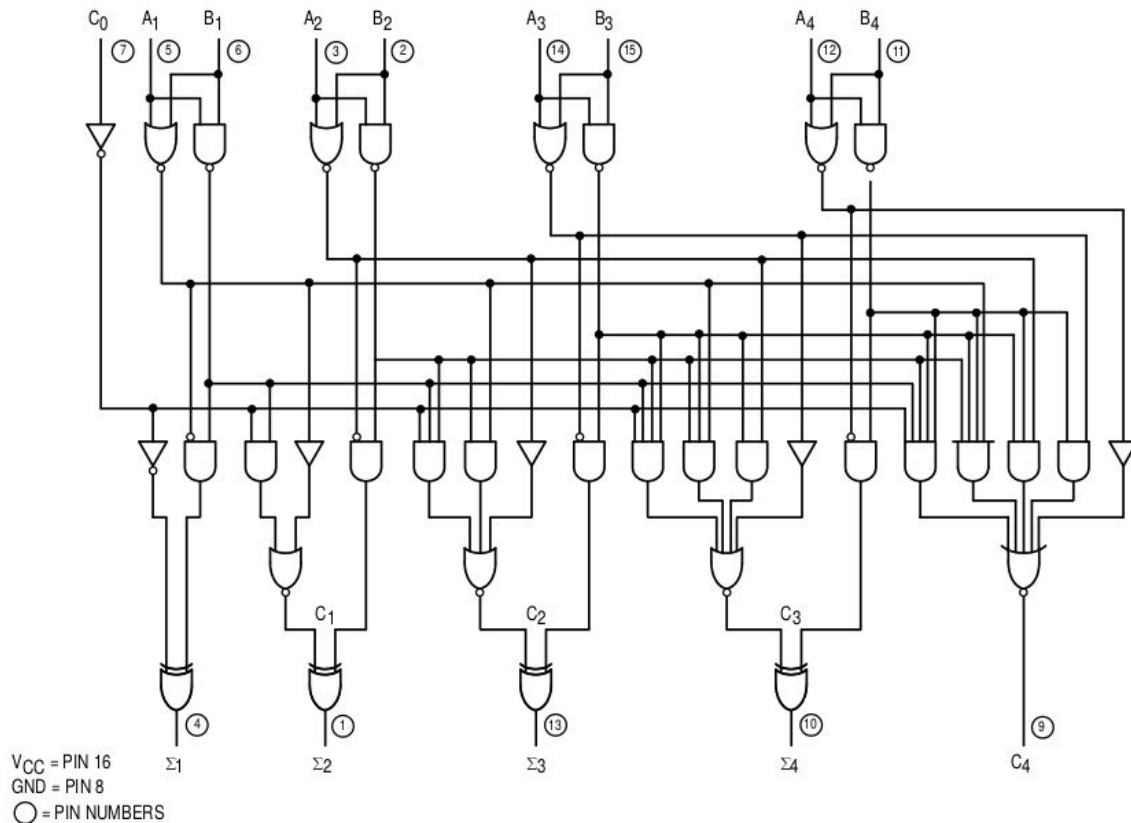


Somador de 8 bits



Somador comercial - 74LS283

LOGIC DIAGRAM

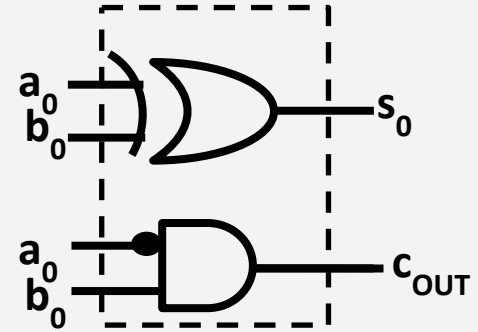


Meio Subtrator

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

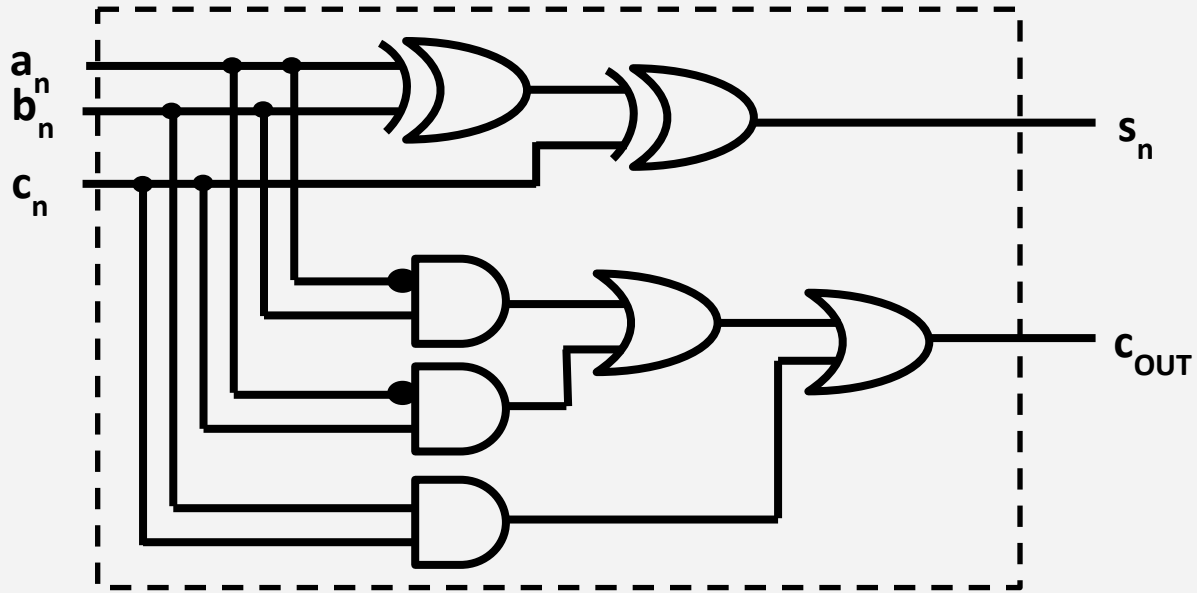
- Subtrator para os demais bits

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

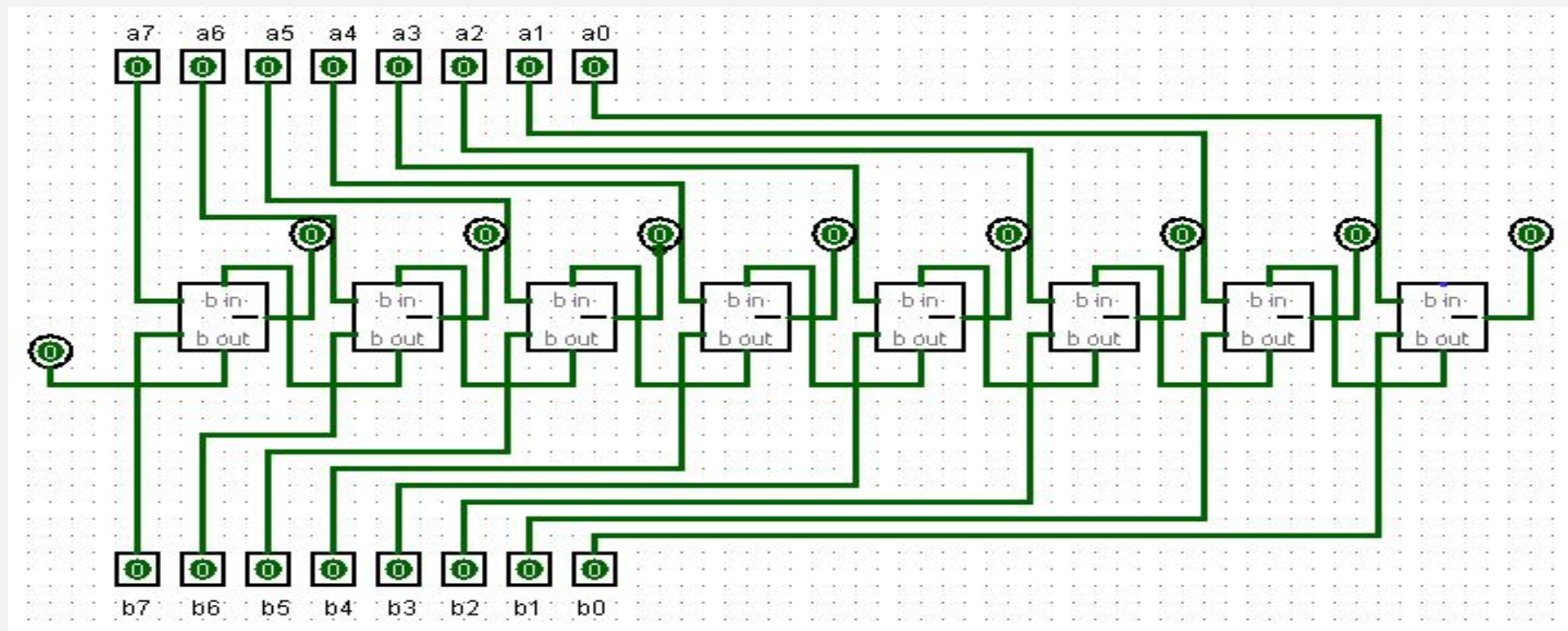
a_n	b_n	c_n	c_{OUT}	s_n
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

Subtrator Completo

Circuito Subtrator

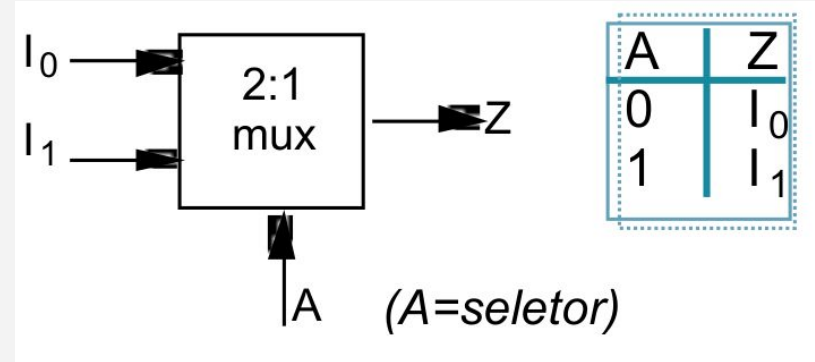


Subtrator de 8 bits

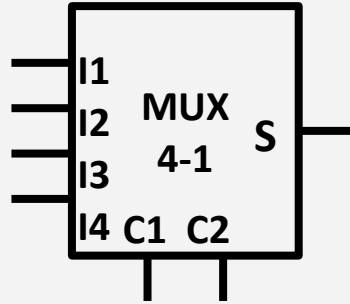
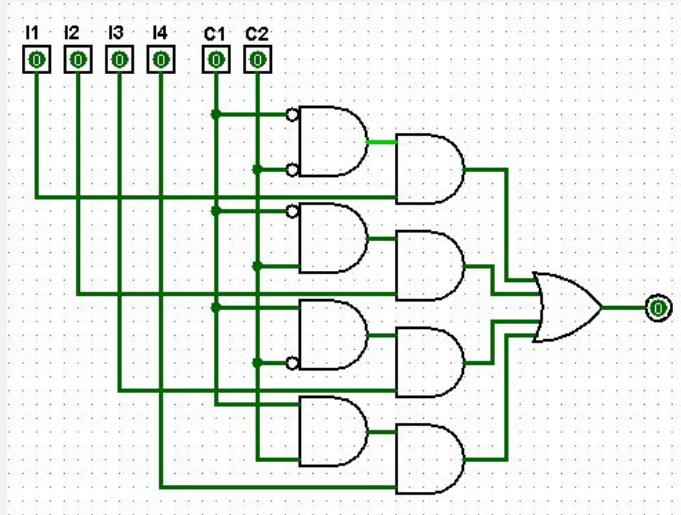


Multiplexadores

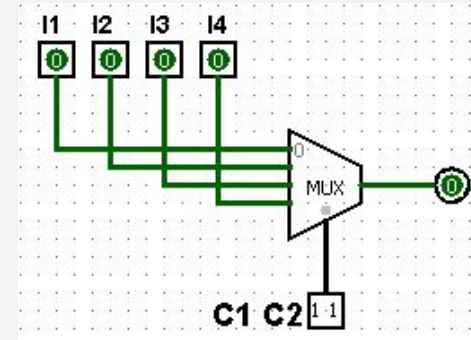
- A seleção de 2^n entradas é feita através de n linhas de controle que endereçam cada uma destas entradas para a saída.
- Cada entrada possui um endereço determinado, o qual é, em geral, associado a um mintermo.
- A saída recebe o valor da entrada correspondente ao endereço escolhido.
- **Exemplo de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



MUX 4-1



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

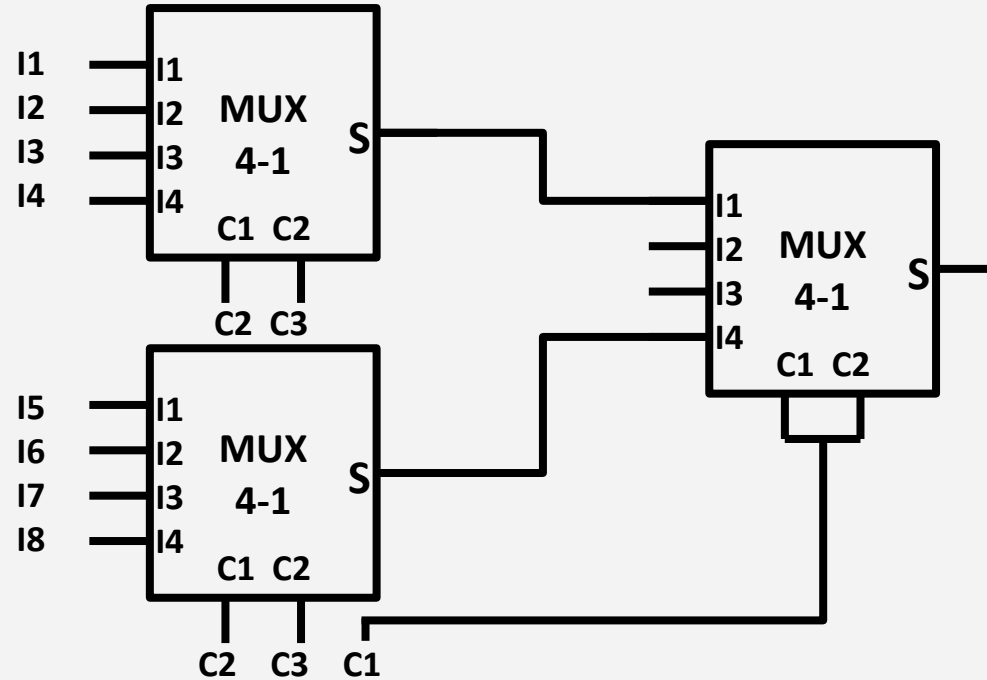


Multiplexadores

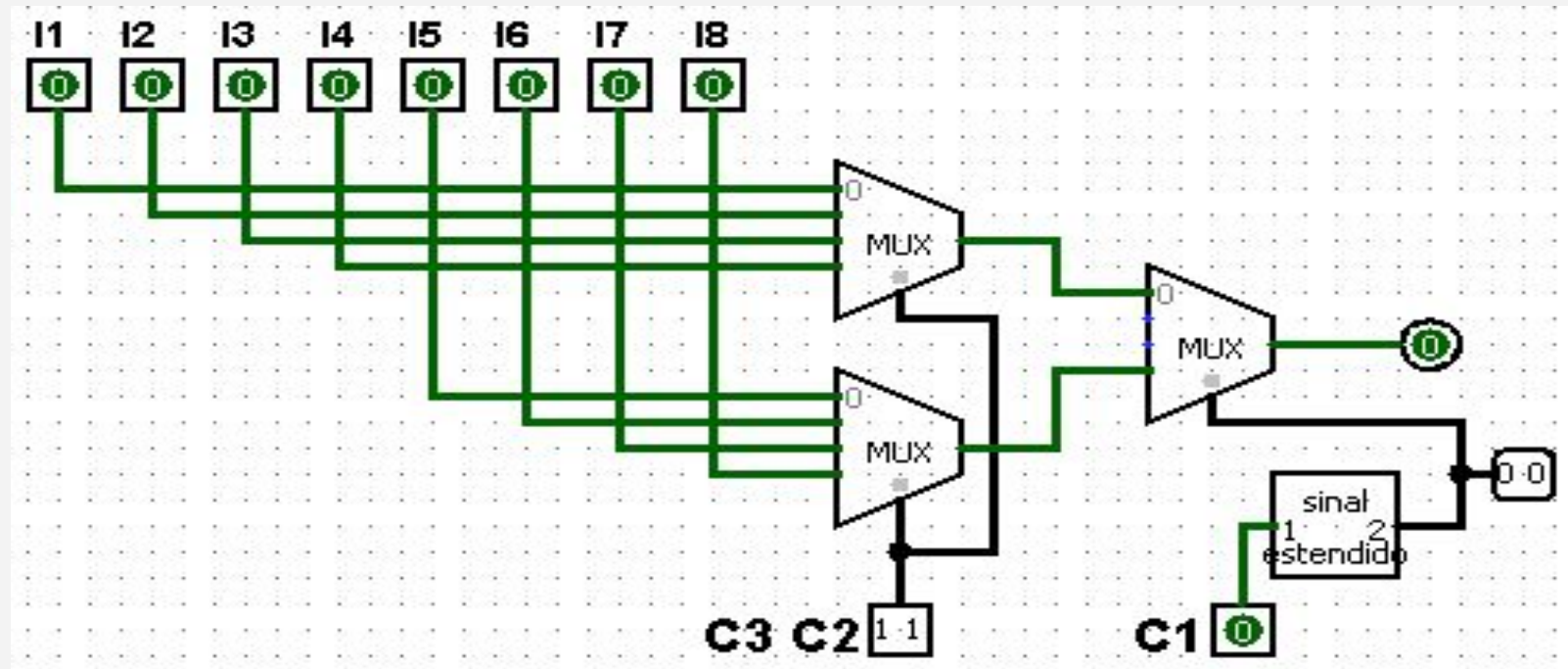
- É possível construir multiplexadores para mais que quatro canais a partir de MUX 4-1

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

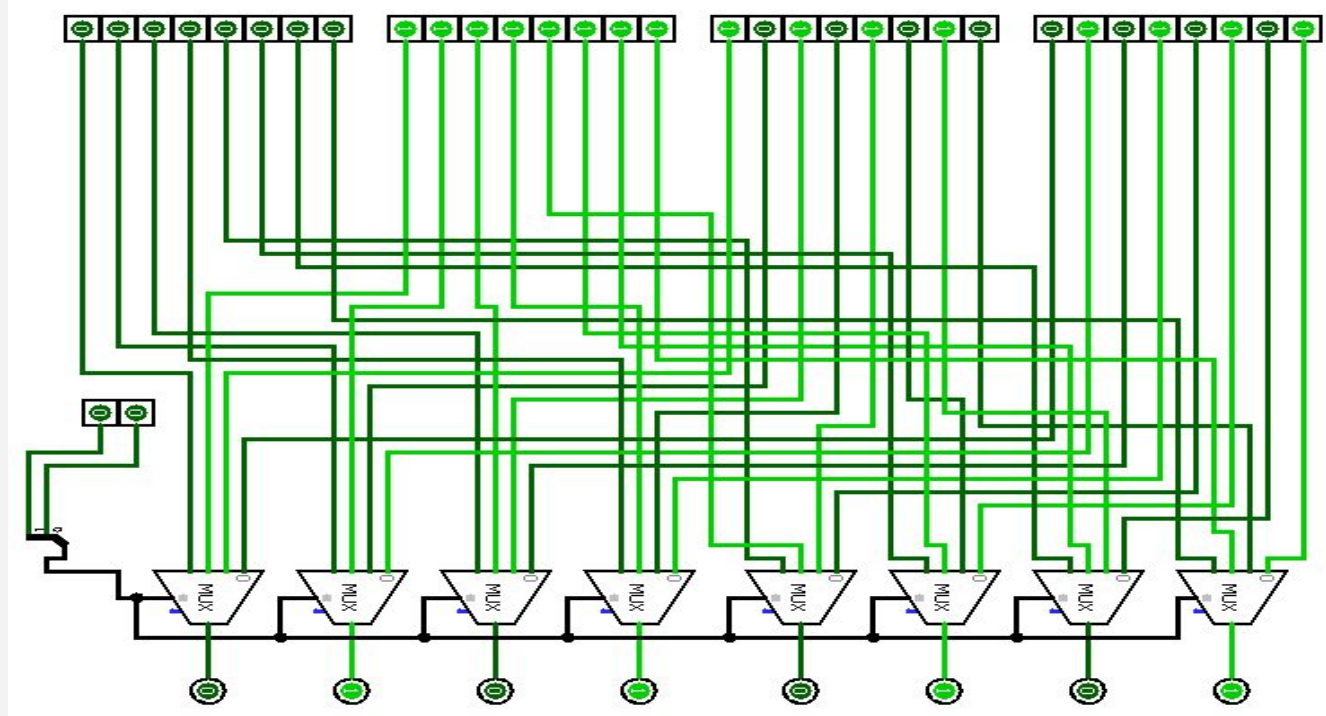
MUX 8-1



MUX 8-1

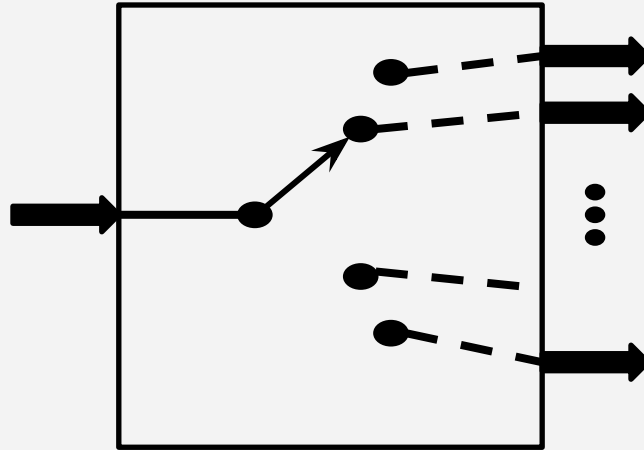


MUX 4x1 (8 bits)

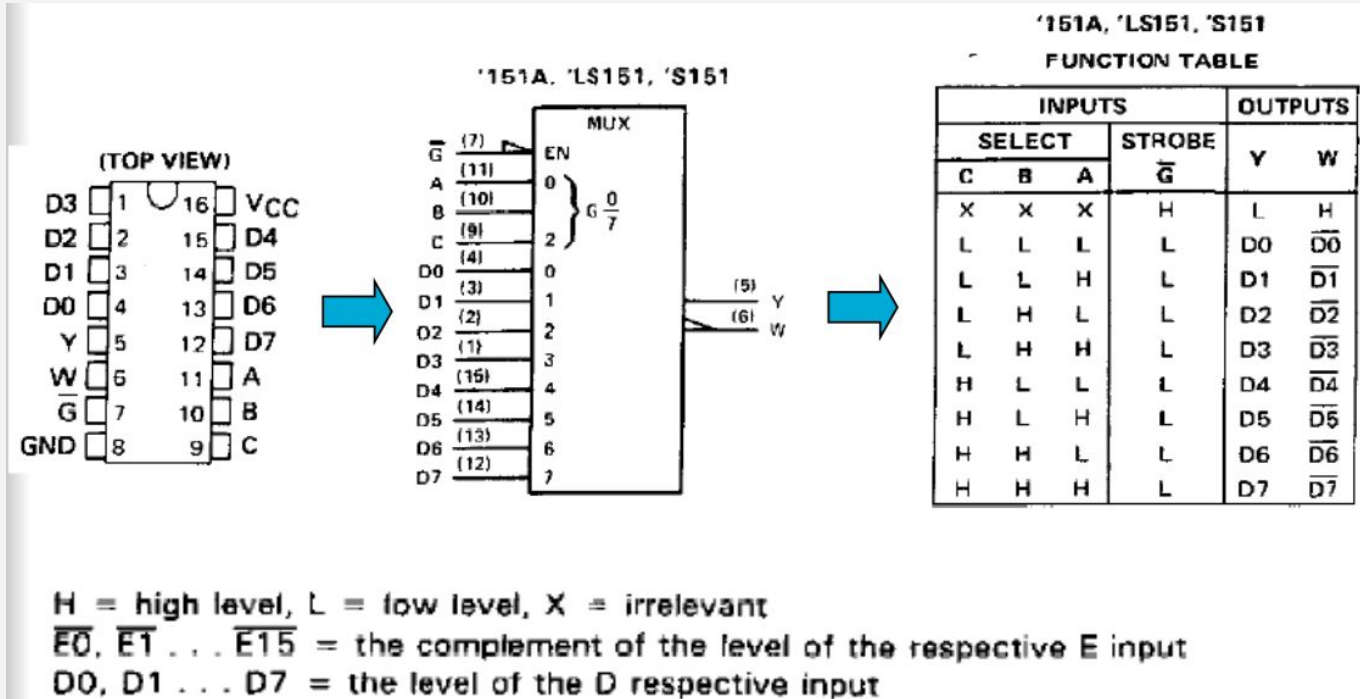


Demultiplexadores

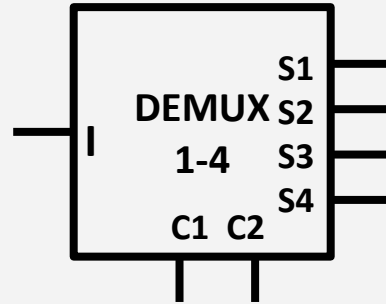
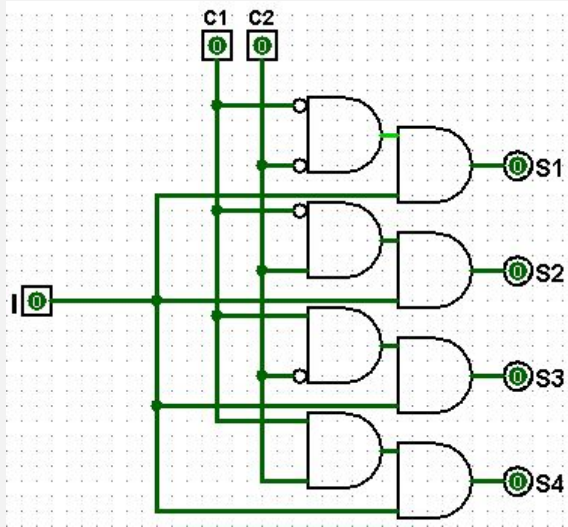
- Permitem o roteamento de um único canal de informação para diferentes canais;



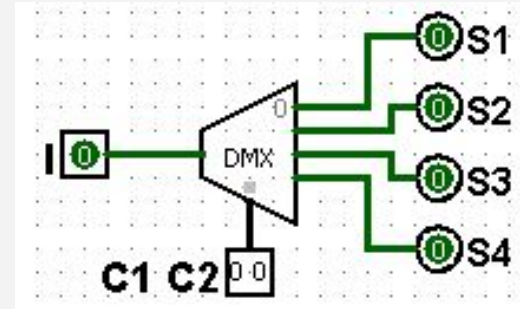
Multiplexador comercial - 74LS151



DEMUX 4-1



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



Demultiplexadores

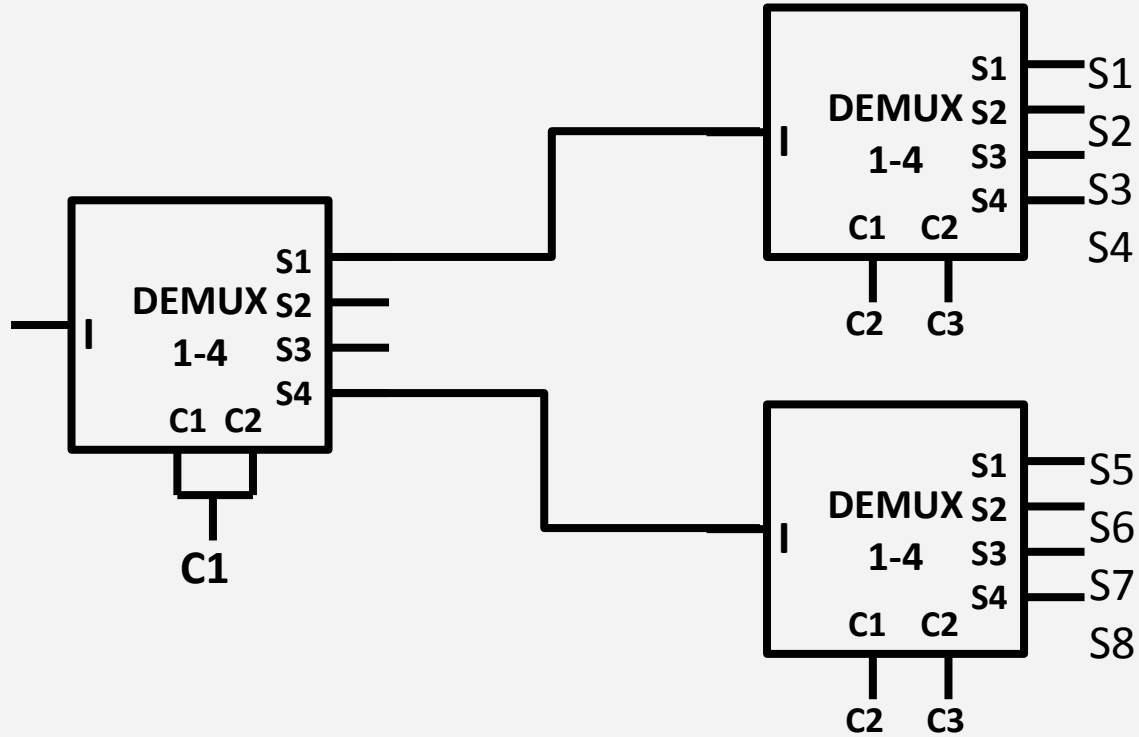
- É possível construir demultiplexadores para mais que quatro canais a partir de DEMUX 1-4

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

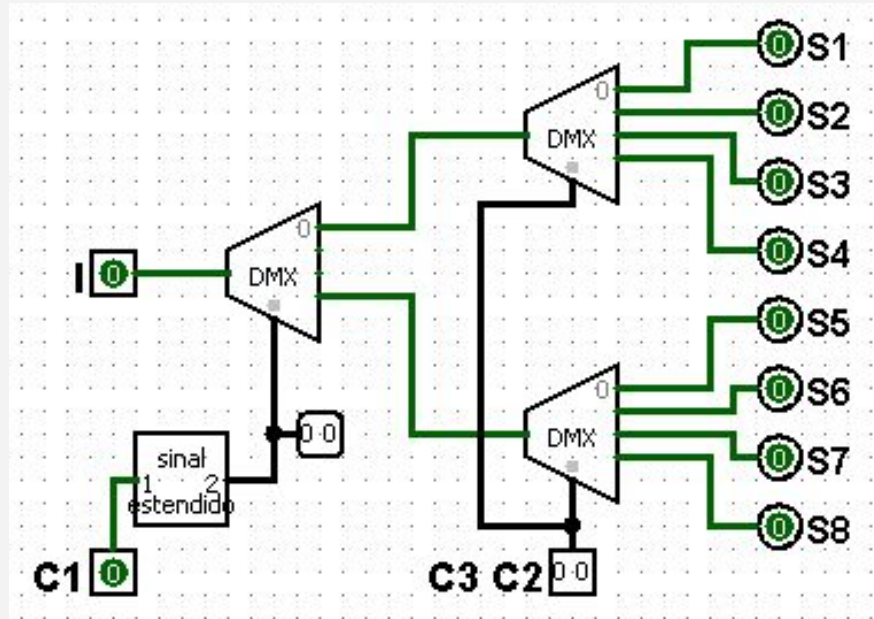
Demultiplexadores

- 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 1-8



Multiplexador comercial - 74LS138

PIN DESCRIPTION

PIN NO.	SYMBOL	NAME AND FUNCTION
1, 2, 3	A_0 to A_2	address inputs
4, 5	\bar{E}_1, \bar{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	\bar{Y}_0 to \bar{Y}_7	outputs (active LOW)
16	V_{CC}	positive supply voltage

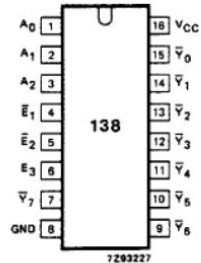


Fig.1 Pin configuration.

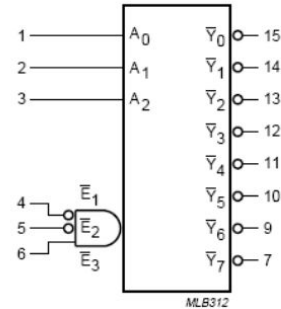


Fig.2 Logic symbol.

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



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