Arquitetura de Computadores

PVP 6 – Capítulo 5
Circuitos Aritméticos: Inteiros

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Circuito Somador 1b

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  - Somar 1 bit
  - Gerar transporte / somar transporte
- Iterativo:
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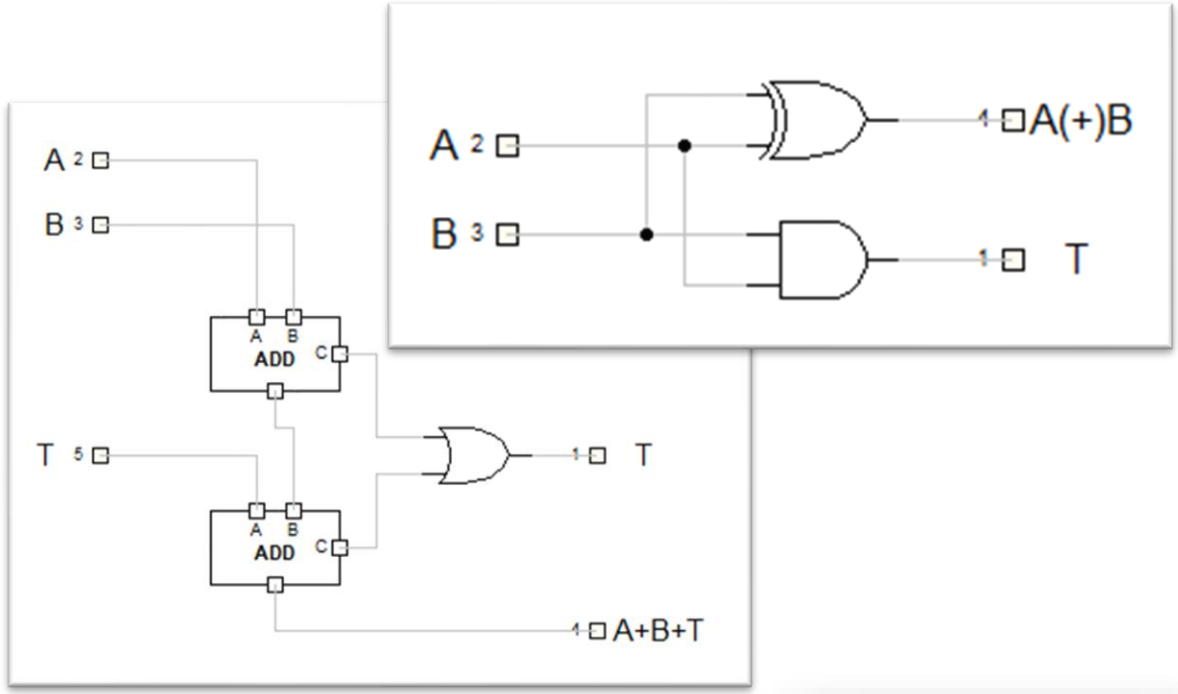
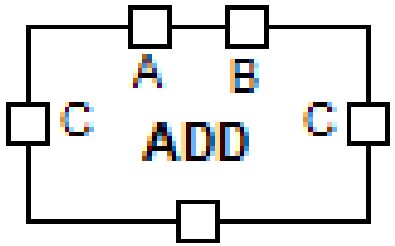
- Tabela de verdade
- Expressões lógicas
- Testes

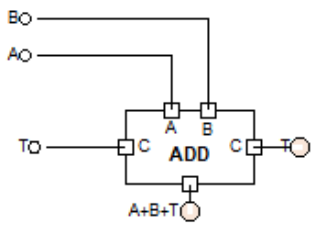


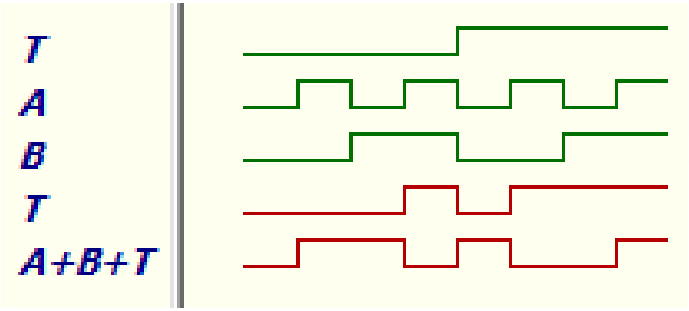


A	B	T	A+B+T	T
0	0	0	0	0
0	1	0	1	0
1	0	0	1	0
1	1	0	0	1
0	0	1	1	0
0	1	1	0	1
1	0	1	0	1
1	1	1	1	1

A	B	A+B	T
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

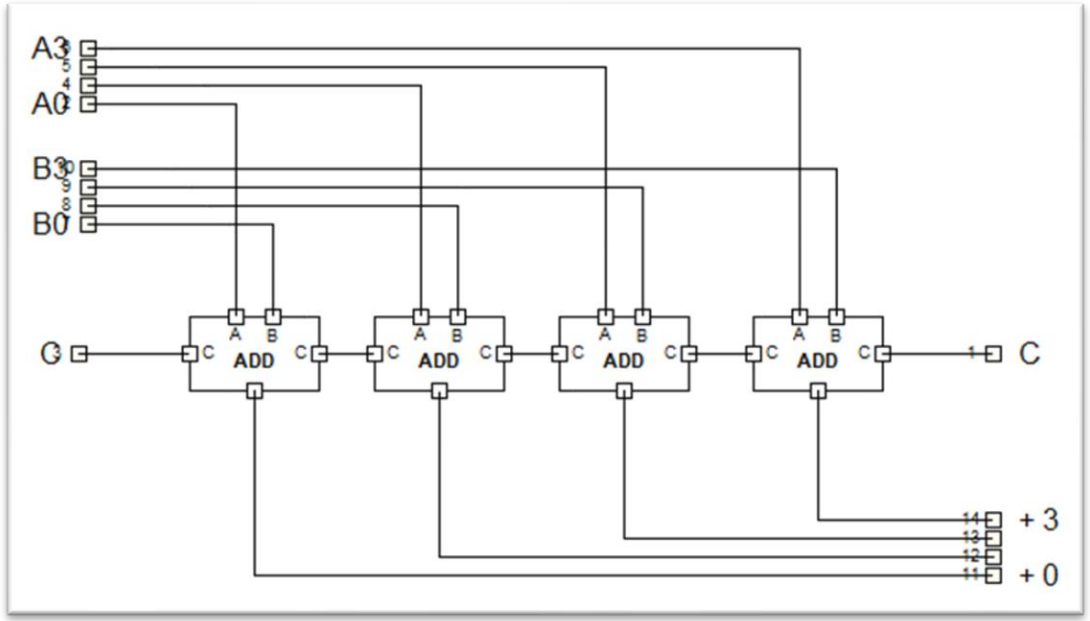
$A + B = A \oplus B;$
$T = AB$

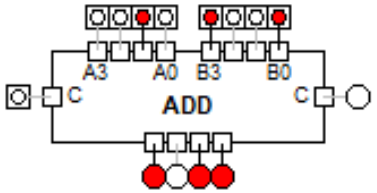


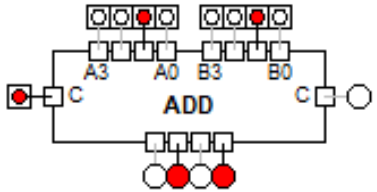


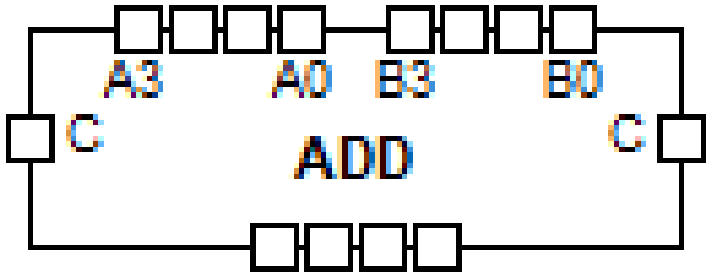
Somador 4b / 16b

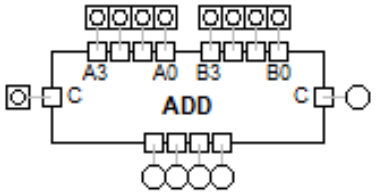
- Reutilização: ADD 1b

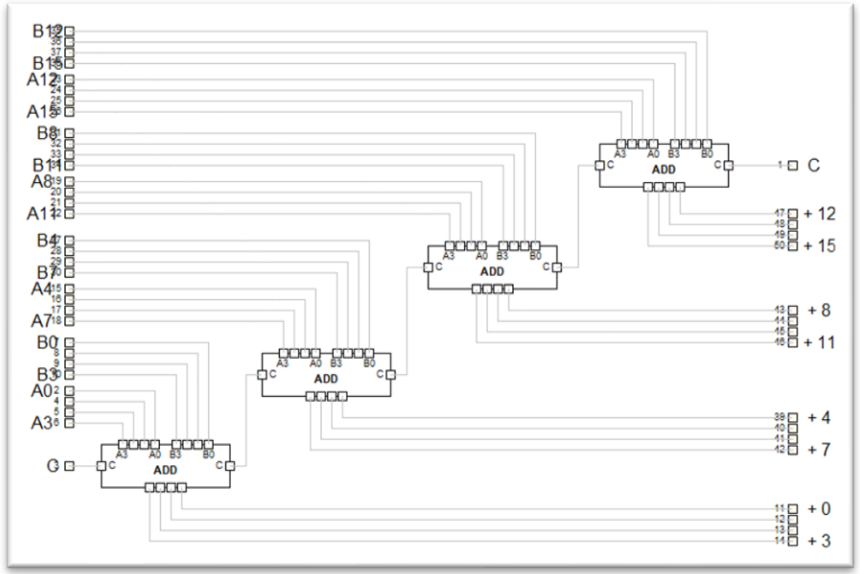


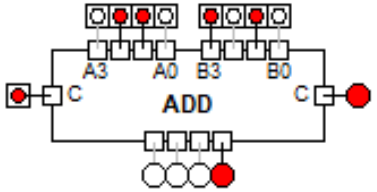


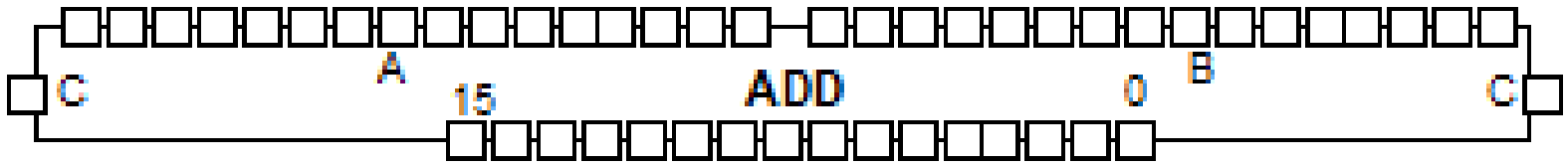












Números com Sinal

- Possibilidades:
  - Módulo e sinal
  - Complemento para 2: $2^n - x$
    - Complementar todos os bits
    - Somar 1
- Alteração de número de bits
  - Módulo e sinal
  - Complemento para 2

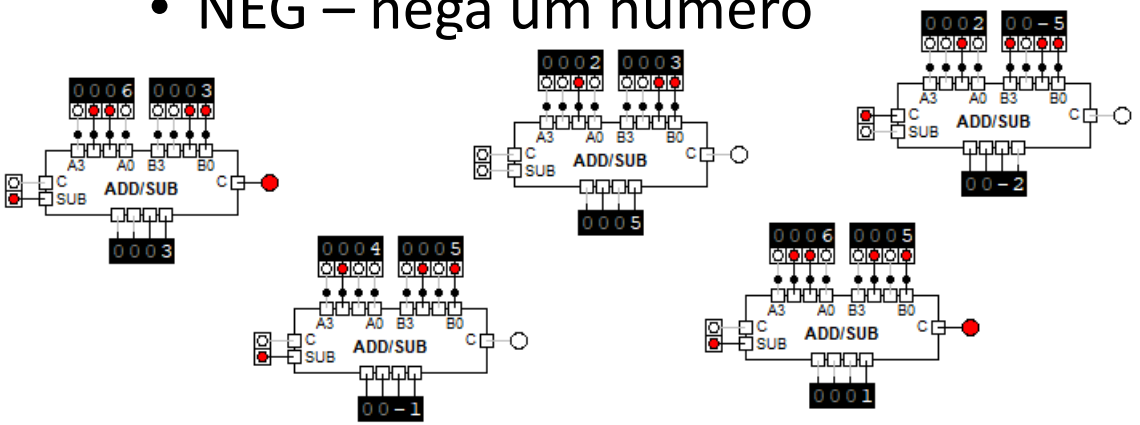
7	6	5	4	3	2	1	0	
Sinal	Bits com o módulo do número							Número
0	0	0	0	0	1	0	1	5
1	0	0	0	0	1	0	1	-5
0	0	0	0	0	1	1	0	6
1	0	0	0	0	1	1	0	-6

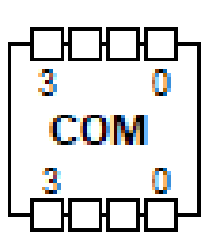
3	2	1	0	
Sinal	Módulo			Número
0	1	0	1	5
1	1	0	1	-5
0	1	1	0	6
1	1	1	0	-6

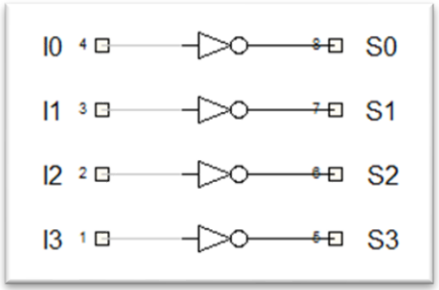
7	6	5	4	3	2	1	0	Número
0	0	0	0	0	1	0	1	5
1	1	1	1	1	0	1	0	~5
1	1	1	1	1	0	1	1	-5
0	0	0	0	0	1	1	0	6
1	1	1	1	1	0	0	1	~6
1	1	1	1	1	0	1	0	-6

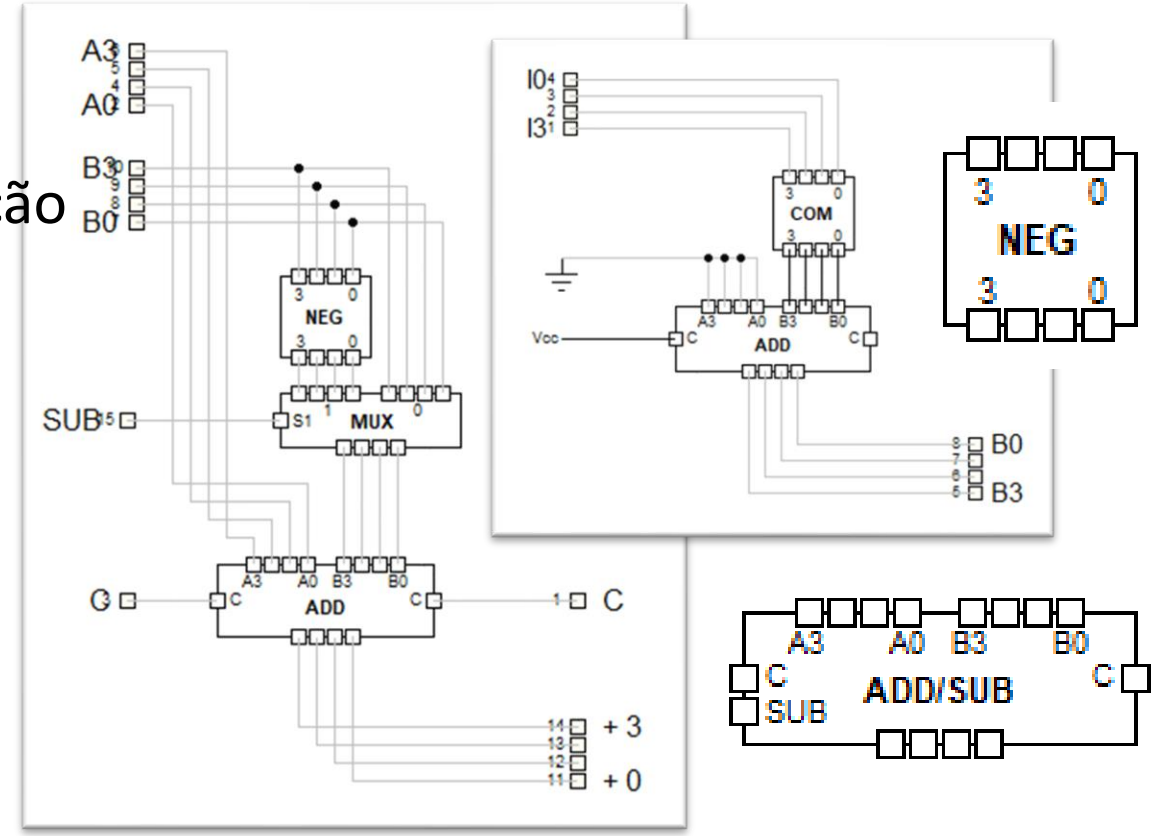
Somador/subtractor 4b

- Funcionalidade:
  - Somar ou subtrair dois números
- Metodologia:
  - Negar um dos números se for subtração
- Módulos:
  - COM – complementa todos os bits
  - NEG – nega um número



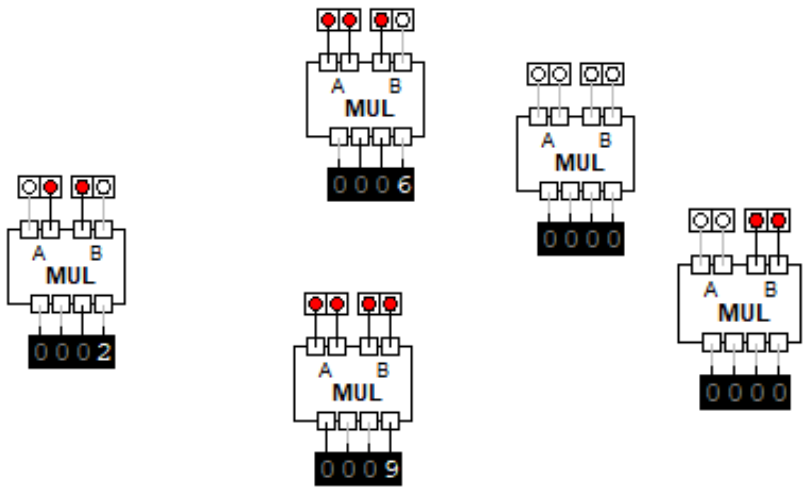




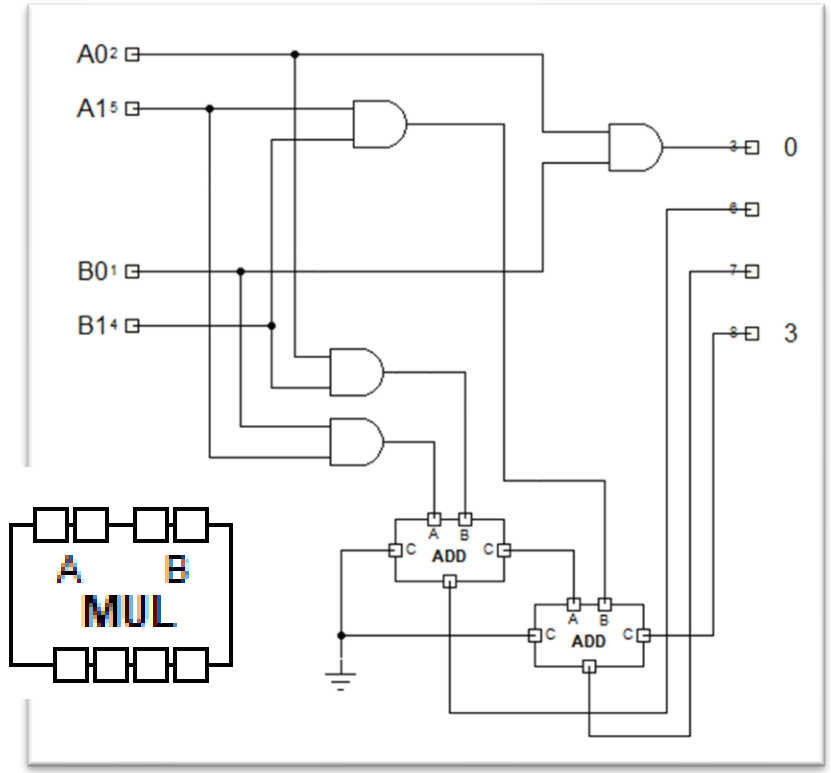


Multiplicação 2b

- Funcionalidade:
  - Multiplicar números de dois bits
- Metodologia:
  - Tirar partido do produto ser um AND

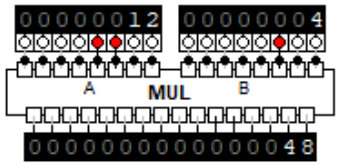


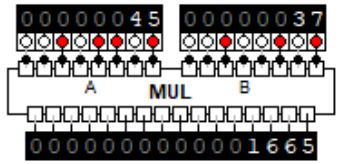
		A	B
	*	C	D
		AD	BD
	AC	BC	
T2	AC+T1	AD+BC	BD
	T2	T1	

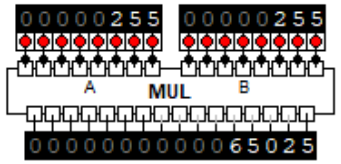


Multiplicador 4b / 8b

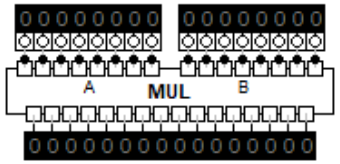
- Reutilização MUL 2b
- Utilizado para mais níveis
- Utilização de memória

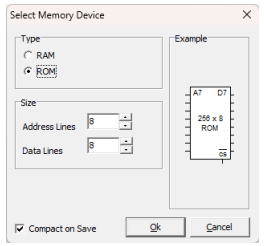


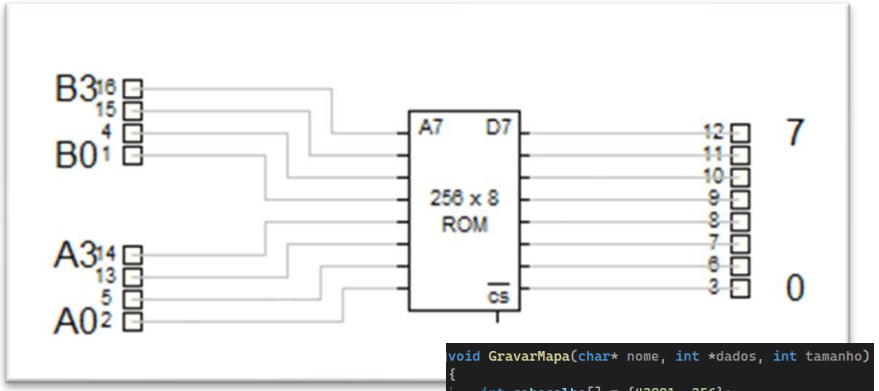


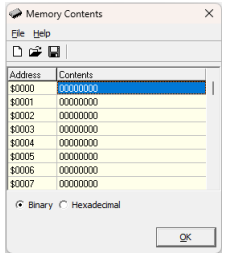


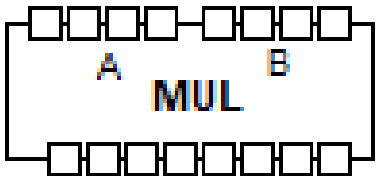
				AA	BB
			*	CC	DD
				BB.DD	
		AA.DD			
		BB.CC			
AA.CC					



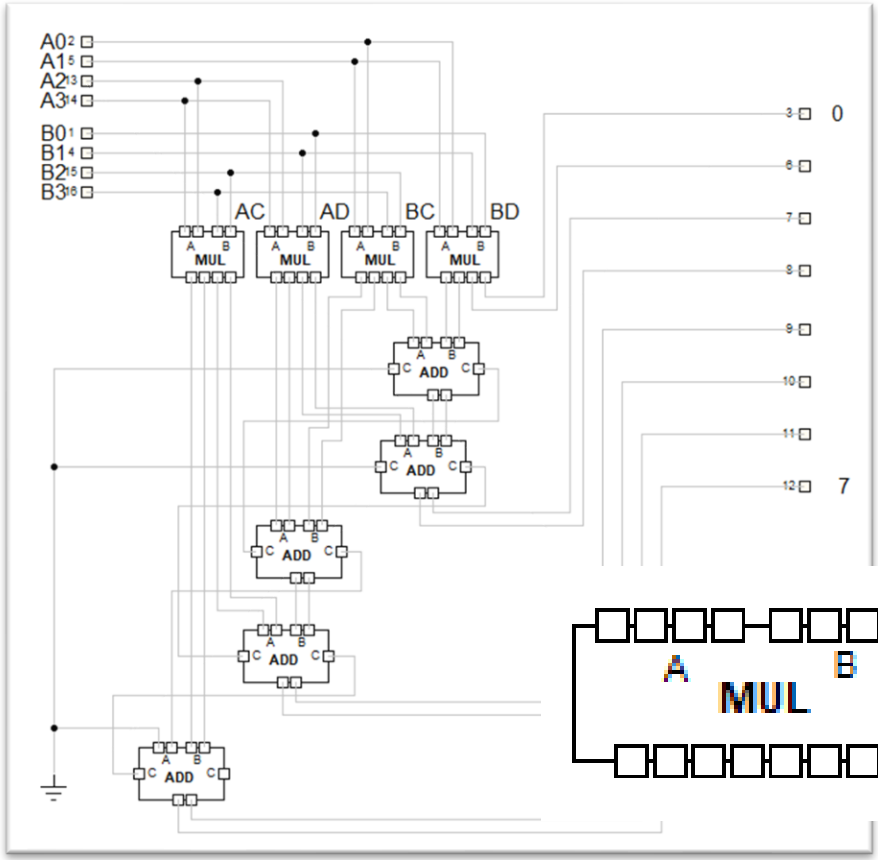


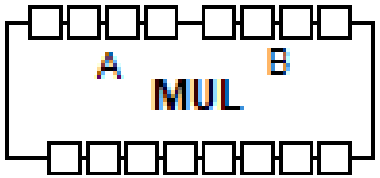






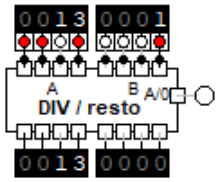

```
void GravarMapa(char* nome, int *dados, int tamanho)
{
    int cabecalho[] = {43981, 256};
    FILE* f = fopen(nome, "wb");
    if (f != NULL) {
        cabecalho[1] = tamanho;
        fwrite(cabecalho, sizeof(int), 2, f);
        fwrite(dados, sizeof(int), tamanho, f);
        fclose(f);
    }
}
```

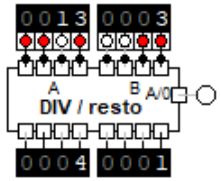


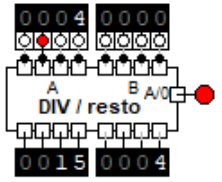


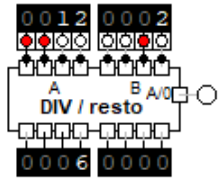
Divisores 4b

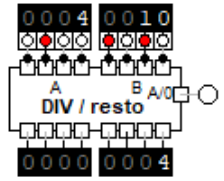
- Método de subtrações de potências de 2
  - A\B=DIV,resto:
    - A<B? DIV=0,resto=A
    - A-8B>=0? DIV=8+(A-8B)\B
    - A-4B>=0? DIV=4+(A-4B)\B
    - A-2B>=0? DIV=2+(A-2B)\B
    - DIV=1+(A-B)\B

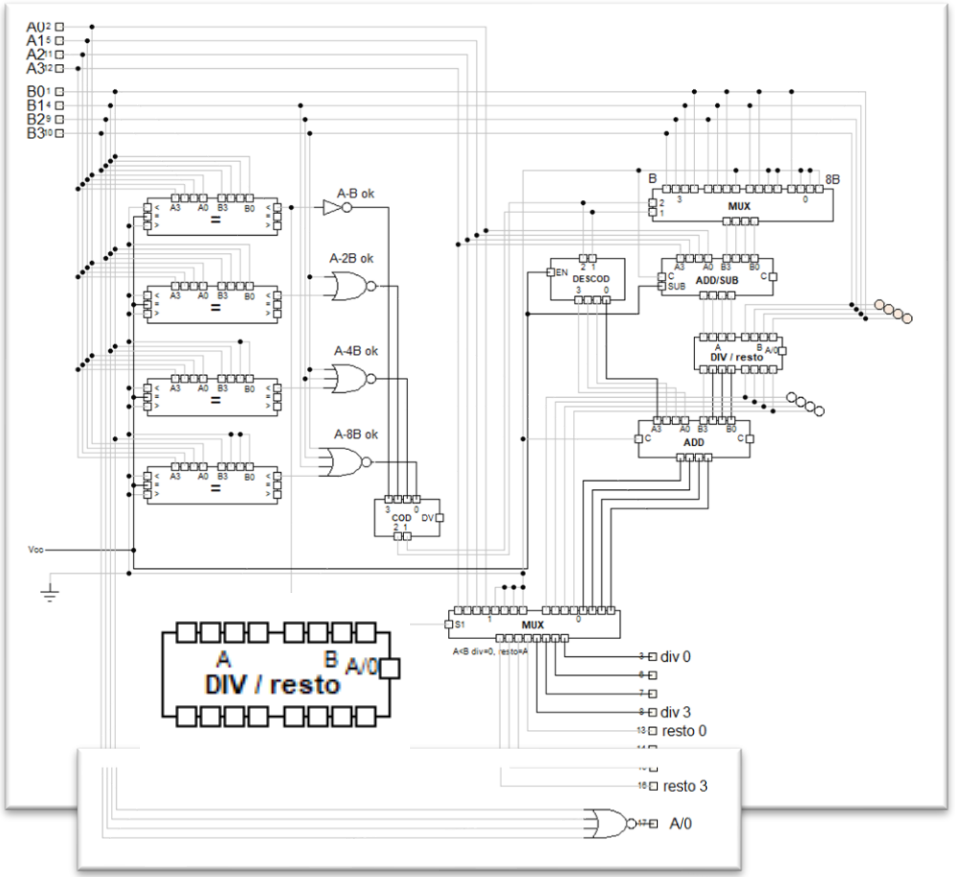






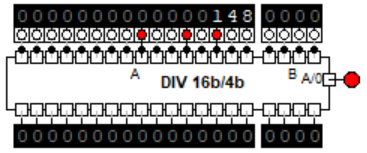


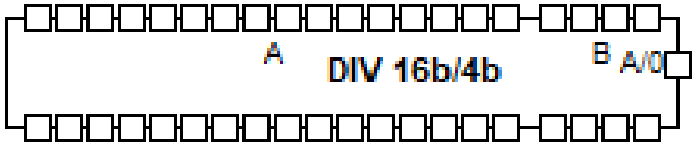


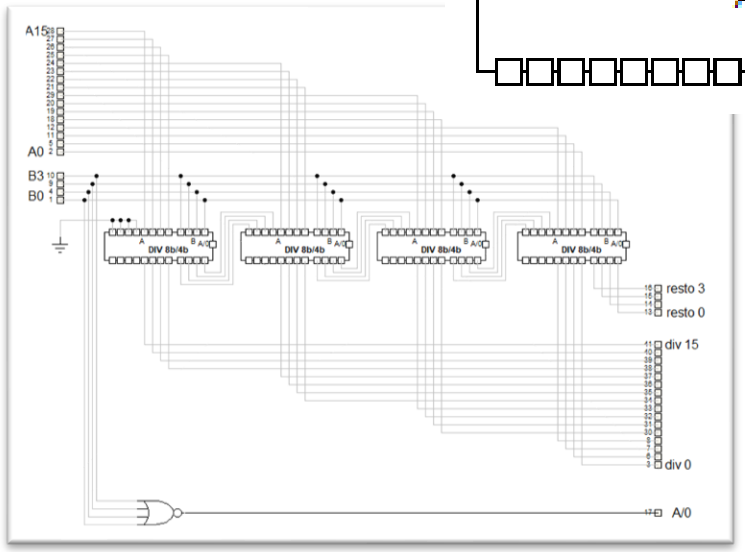


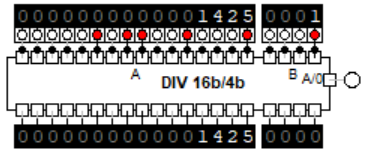
Divisores 8b4b, 16b/4b

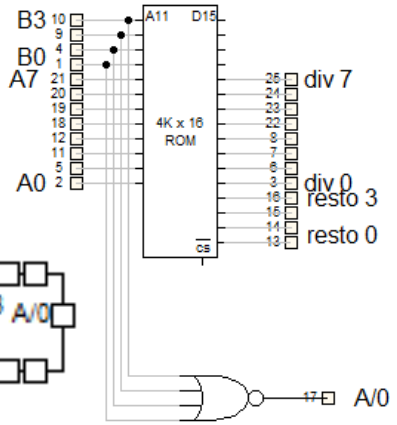
- Numerador com dobro dos bits
  - Metodologia: memória
- Permite estender o numerador

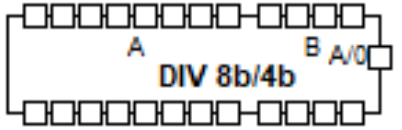


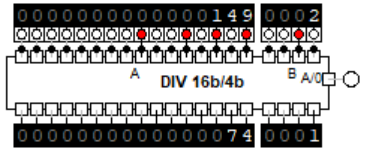


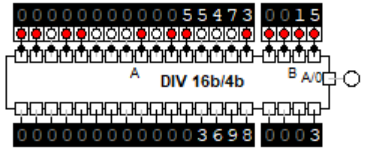


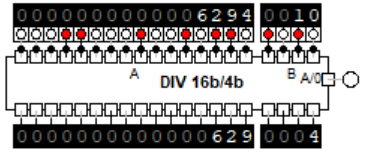












A	B	C	D	E			
r1(A/E)	B			d1(A/E)	d2(r1B/E)	d3(r2C/E)	d4(r3D/E
	r2(r1B/E)	C					
		r3(r2C/E)	D				
			r4(r3D/E)				

Recursos utilizados

- Microsoft Power Point
- Clipchamp, voz de síntese Fernanda
- Vimeo
- G. Arroz, J. Monteiro, A. Oliveira (2020). Arquitectura de Computadores: dos Sistemas Digitais aos Microprocessadores (5ª edição). IST Press