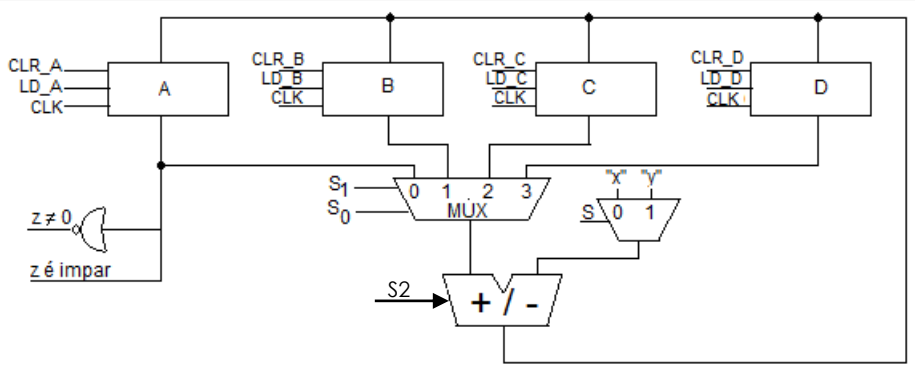
EXEMPLOS RTL

Exemplo: Montar um quadro de instruções para calcular as expressões a seguir.

A = A - 1, B = B + 2 e C = C - 1, faça as operações enquanto A ≠ 0. Cond.: A,B e C ≥ 0



Obs.: A variável z = 1 sempre que A = 0, x = 1 e y = 0

Pede-se:

a) Representação esquemática do sistema digital completo.

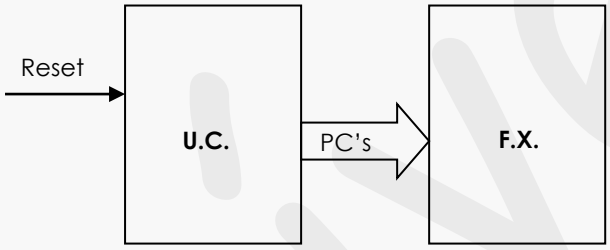
b) Projeto da unidade de controle.

c) Quadro de instruções

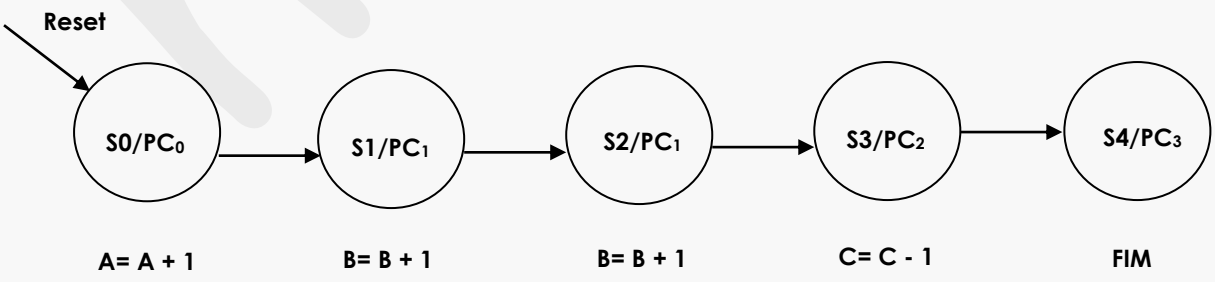
d) Circuito final

e) Formas de ondas.

a) Representação esquemática do sistema digital.



b) Projeto da U.C.



c) Quadro de instruções.

item	instrução	LDA	LDB	LDC	LDD	CLRA	CLRB	CLRC	CLRD	S1	S0	S2	S	PC'S
1	A = A – 1	1	0	0	0	0	0	0	0	0	0	1	0	0
2	B = B + 1	0	1	0	0	0	0	0	0	0	1	0	0	1
3	C = C – 1	0	0	1	0	0	0	0	0	1	0	0	0	1
4	FIM	0	0	0	0	0	0	0	0	0	0	0	0	2

d) Implementação da F.S.M.

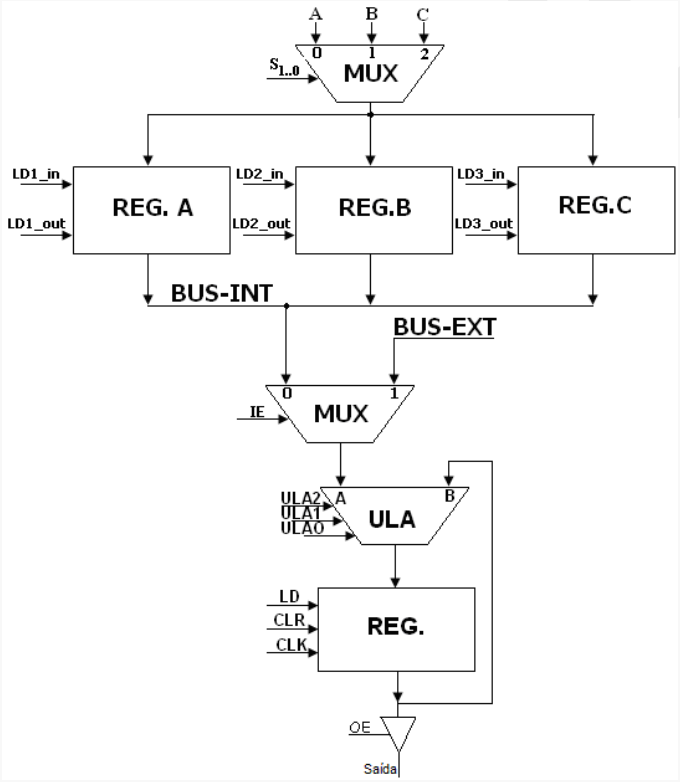
Q_2	Q_1	Q_0	Q_2	Q_1	Q_0	PC
0	0	0	0	0	1	0
0	0	1	0	1	0	1
0	1	0	0	1	1	1
0	1	1	1	0	0	2
1	0	0	1	0	0	3

d) Circuito final

$D_2 = Q_2 \oplus Q_1$ e $D_1 = Q_1 \oplus Q_0$ e $D_0 = Q_2'Q_0'$.

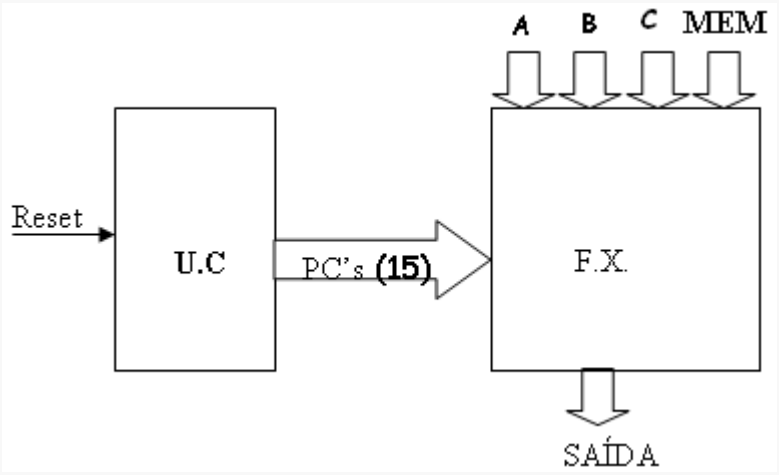
e) Formas de ondas.

Exemplo: Realizar Y = A + 2*B – BUS-EXT.

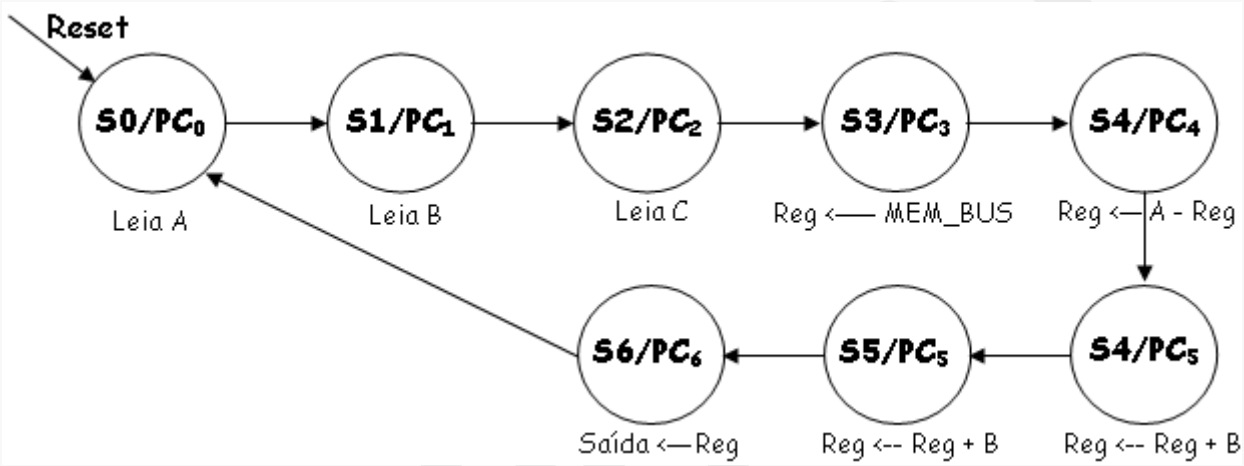


ULA_2	ULA_1	ULA_0	Operação
0	0	0	Passa A
0	0	1	A ∧ B
0	1	0	A ∨ B
0	1	1	A'
1	0	0	A + B
1	0	1	A - B
1	1	0	A + 1
1	1	1	A - 1

a)Representação esquemática do sistema digital.



b) Projeto da U.C.



c) Quadro de instruções

item	Instrução	$S_{1..0}$	In_R1	In_R2	In_R3	Out_R1	Out_R2	Out_R3	IE	$ULASEL_{2..0}$	LD_reg	CLRN	OE	PC's
1	LEIA A	00	1	0	0	0	0	0	0	XXX	0	0	0	0
2	LEIA B	01	0	1	0	0	0	0	0	XXX	0	1	0	1
3	LEIA C	10	0	0	1	0	0	0	0	XXX	0	1	0	2
4	Mem_bus → Reg	XX	0	0	0	0	0	0	1	000	1	1	0	3
5	Reg ← A – Reg	XX	0	0	0	1	0	0	0	101	1	1	0	4
6	Reg ← Reg + B	XX	0	0	0	0	1	0	0	100	1	1	0	5
7	Reg ← Reg + B	XX	0	0	0	0	1	0	0	100	1	1	0	5
8	Saída ← Reg	XX	0	0	0	0	0	0	0	XXX	0	1	1	6

d) Implementação da F.S.M.

S0 = 000, S1 = 001, S2 = 010, S3 = 011, S4 = 100, S5 = 101, S6 = 110

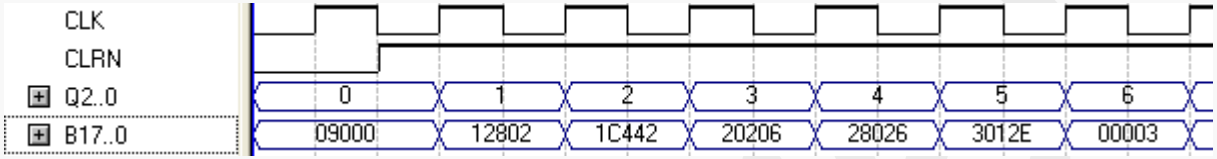
PC0 = 001000000XXX000; PC1 = 010100000XXX010; PC2 = 100010000XXX010; PC3 = XX0000001000110;

PC4 = XX0001000101110; PC5 = XX0000100100110; PC6 = XX0000000XXX011.

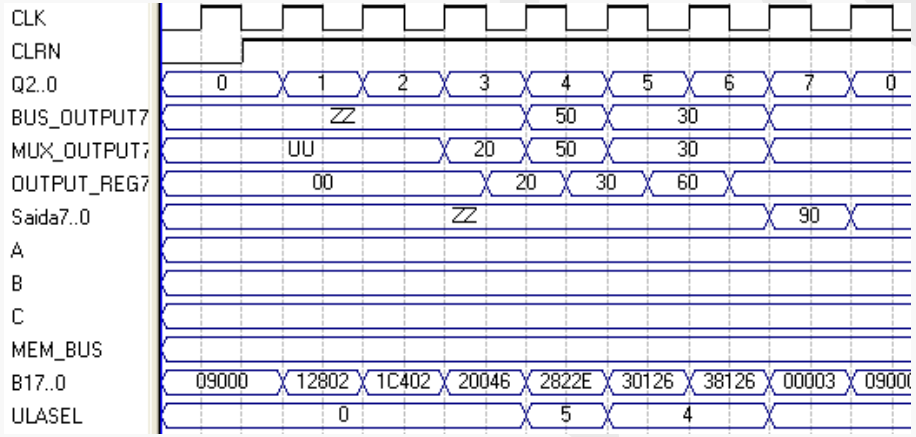
e) Tabela de estados completa entrada e saída com endereço e conteúdo da ROM.

A_2	A_1	A_0	B_{17}	B_{16}	B_{15}	B_{14}	B_{13}	B_{12}	B_{11}	B_{10}	B_9	B_8	B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_0	$A_{2..0}$	$B_{17..0}$
Q_2	Q_1	Q_0	Q_2	Q_1	Q_0	S_1	S_0	In_R1	In_R2	In_R3	Out_R1	Out_R2	Out_R3	IE	ULA_2	ULA_1	ULA_0	LD	CLRN	OE	Ender.	Conteúdo
0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	X	X	X	0	0	0	**0**	**09000**
0	0	1	0	1	0	0	1	0	1	0	0	0	0	0	X	X	X	0	1	0	**1**	**12802**
0	1	0	0	1	1	1	0	0	0	1	0	0	0	0	X	X	X	0	1	0	**2**	**1C402**
0	1	1	1	0	0	X	X	0	0	0	0	0	0	1	0	0	0	1	1	0	**3**	**20046**
1	0	0	1	0	1	X	X	0	0	0	1	0	0	0	1	0	1	1	1	0	**4**	**2842E**
1	0	1	1	1	0	X	X	0	0	0	0	1	0	0	1	0	0	1	1	0	**5**	**30126**
1	1	0	1	1	1	X	X	0	0	0	0	1	0	0	1	0	0	1	1	0	**6**	**38126**
1	1	1	0	0	0	X	X	0	0	0	0	0	0	0	0	0	0	0	1	1	**7**	**00003**

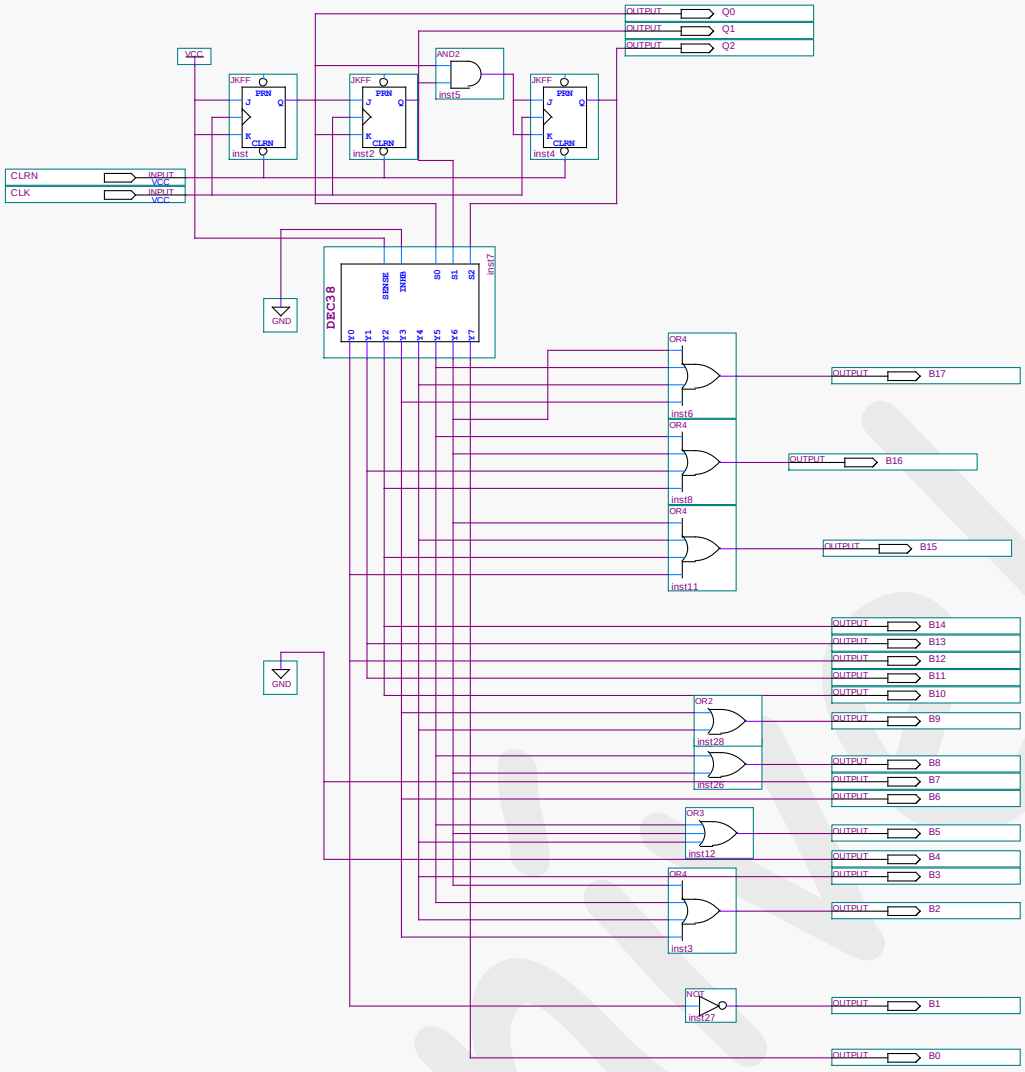
f) Formas de ondas U.C. com geração das saídas PC's.



b) Simulação com *A* = 50, MEM_BUS = 20, B = 30.



g) Circuito U.C. e saídas



7. Parte final:

1. Sugestões do aluno:

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