

PRÁCTICA 7 "APLICACIÓN DE CONTADORES "

Análisis de los circuitos con FF's

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Aplicaciones de contadores

Dado

$q_0 \rightarrow 000$

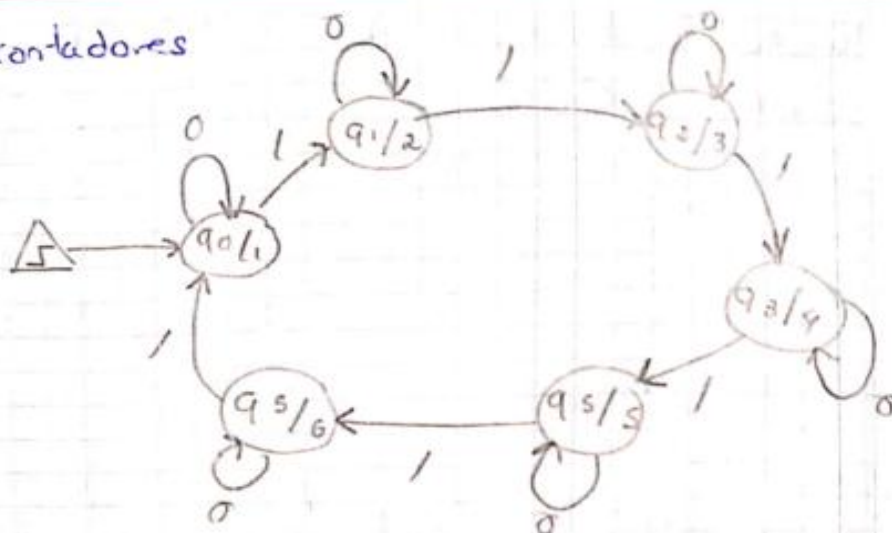
$q_1 \rightarrow 001$

$q_2 \rightarrow 011$

$q_3 \rightarrow 010$

$q_4 \rightarrow 110$

$q_5 \rightarrow 111$



Edo_Act	E	Edo_sig	a	b	c	d	e	f	g	
q0	1	q1	0	1	1	0	0	0	0	1
q1	1	q2	1	1	0	1	1	0	1	2
q2	1	q3	1	1	1	1	0	0	1	3
q3	1	q4	0	1	1	0	0	1	1	4
q4	1	q5	1	0	1	1	0	1	1	5
q5	1	q0	1	0	1	1	1	1	1	6
Edo_Act	E	Edo_sig	a	b	c	d	e	f	g	
q0	0	q0	0	1	1	0	0	0	0	1
q1	0	q1	1	1	0	1	1	0	1	2
q2	0	q2	1	1	1	1	0	0	1	3
q3	0	q3	0	1	1	0	0	1	1	4
q4	0	q4	1	0	1	1	0	1	1	5
q5	0	q5	1	0	1	1	1	1	1	6

Eda_Act Q_2, Q_1, Q_0	E	Eda_Sig Q_2^+, Q_1^+, Q_0^+	a	b	c	d	e	f	g	S ₂ R ₂ S ₁ R ₁ S ₀ R ₀
0 0 0	1	0 0 1	0	1	1	0	0	0	0	0 x 0 x 1 0
0 0 1	1	0 1 1	1	1	0	1	1	0	1	0 x 1 0 x 0
0 1 1	1	0 1 0	1	1	1	1	0	0	1	0 x x 0 0 1
0 1 0	1	1 1 0	0	1	1	0	0	1	1	1 0 x 0 0 x
1 1 0	1	1 1 1	1	0	1	1	0	1	1	x 0 x 0 1 0
1 1 1	1	0 0 0	1	0	1	1	1	1	1	0 1 0 1 0 1
Edo_Act Q_2, Q_1, Q_0	E	Edo_Sig Q_2^+, Q_1^+, Q_0^+	a	b	c	d	e	f	g	S ₂ R ₂ S ₁ R ₁ S ₀ R ₀
0 0 0	0	0 0 0	0	1	1	0	0	0	0	0 x 0 x 0 x
0 0 1	0	0 0 1	1	1	0	1	1	0	1	0 x 0 x x 0
0 1 1	0	0 1 1	1	1	1	1	0	0	1	0 x x 0 x 0
0 1 0	0	0 1 0	0	1	1	0	0	1	1	0 x x 0 0 x
1 1 0	0	1 1 0	1	0	1	1	0	1	1	x 0 x 0 0 x
1 1 1	0	1 1 1	1	0	1	1	1	1	1	x 0 x 0 x 0

$Q_2 Q_1$	$Q_0 E$	00	01	11	10
00	0	0	0	0	0
01	0	1	0	0	0
11	X	X	0	X	X
10	X	X	X	X	X

$S_2 = Q_1 \bar{Q}_0 E$

$Q_2 Q_1$	$Q_0 E$	00	01	11	10
00	X	X	X	X	X
01	X	0	X	X	X
11	0	0	1	0	0
10	X	X	X	X	X

$R_2 = Q_0 E$

$Q_2 Q_1$	$Q_0 E$	00	01	11	10
00	0	0	1	0	0
01	X	X	X	X	X
11	X	X	0	X	X
10	X	X	X	X	X

$S_1 = \bar{Q}_1 Q_0 E$

$Q_2 Q_1$	$Q_0 E$	00	01	11	10
00	X	X	0	X	X
01	0	0	0	0	0
11	0	0	1	0	0
10	X	X	X	X	X

$R_1 = Q_2 Q_0 E$

$Q_2 Q_1$	$Q_0 E$	00	01	11	10
00	0	1	X	X	X
01	0	0	0	X	X
11	0	1	0	X	X
10	X	X	X	X	X

$S_0 = Q_2 \bar{Q}_0 E + \bar{Q}_1 E$

$Q_2 Q_1$	$Q_0 E$	00	01	11	10
00	X	0	0	0	0
01	X	X	1	0	0
11	X	0	1	0	0
10	X	X	X	X	X

$R_0 = Q_1 Q_0 E$

$Q_2 Q_1$	$Q_0 E$	00	01	11	10
00	0	0	1	1	1
01	0	0	1	1	1
11	1	1	1	1	1
10	X	X	X	X	X

$a = Q_2 + Q_0$

$Q_2 Q_1$	$Q_0 E$	00	01	11	10
00	1	1	1	1	1
01	1	1	1	1	1
11	0	0	0	0	0
10	X	X	X	X	X

$b = \bar{Q}_2$

$Q_2 Q_1$	$Q_0 E$	00	01	11	10
00	1	1	0	0	0
01	1	1	1	1	1
11	1	1	1	1	1
10	X	X	X	X	X

$c = \bar{Q}_0 + Q_1$

$$Q_2 \backslash Q_0 E$$

	00	01	11	10
00	0	0	1	1
01	0	0	1	1
11	1	1	1	1
10	X	X	X	X

$$d = Q_2 + Q_0$$

$$Q_2 \backslash Q_0 E$$

	00	01	11	10
00	0	0	1	1
01	0	0	0	0
11	0	0	1	1
10	X	X	X	X

$$e = Q_2 Q_0 + \bar{Q}_1 Q_0$$

$$Q_2 \backslash Q_0 E$$

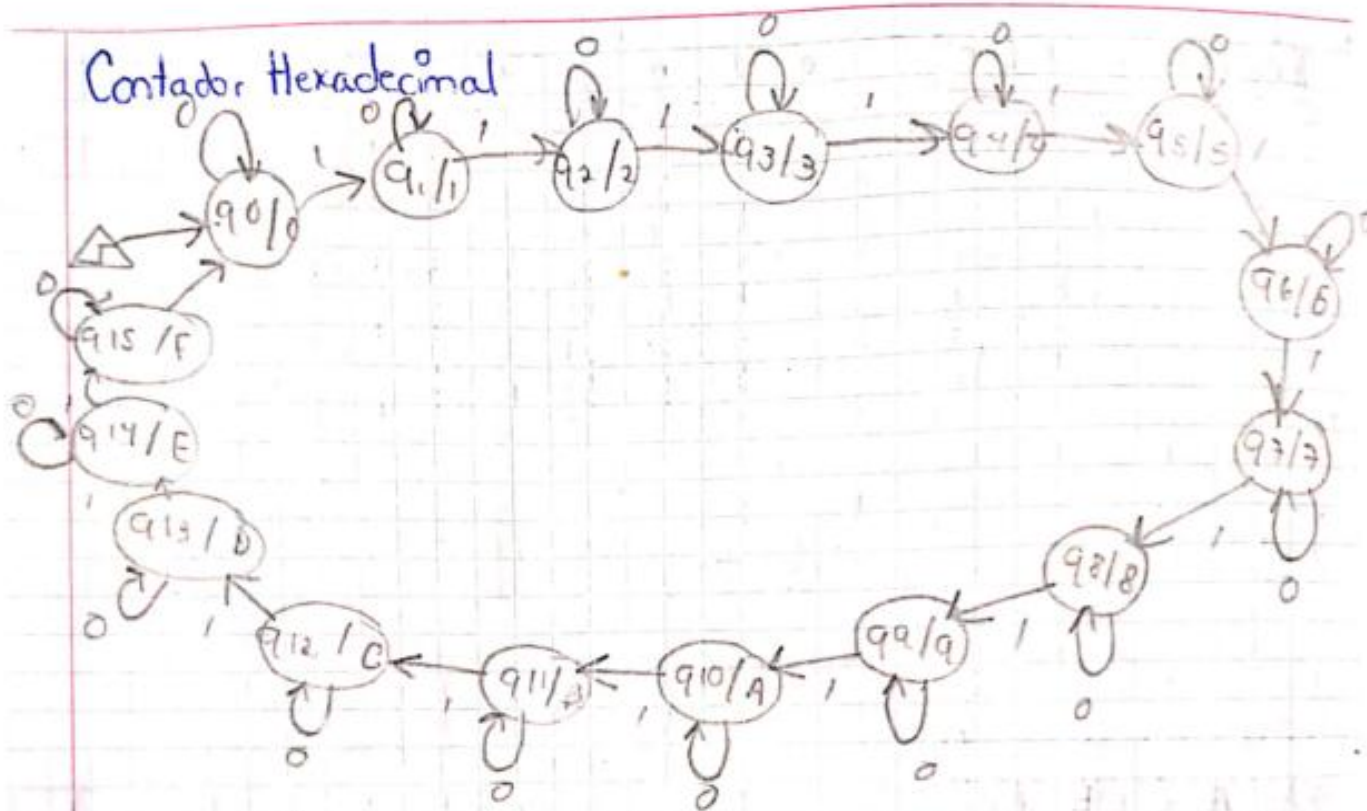
	00	01	11	10
00	0	0	0	0
01	1	1	0	0
11	1	1	1	1
10	X	X	X	X

$$f = Q_2 + Q_1 \bar{Q}_0$$

$$Q_2 \backslash Q_0 E$$

	00	01	11	10
00	0	0	1	1
01	1	1	1	1
11	1	1	1	1
10	X	X	X	X

$$g = Q_0 + Q_1$$



Edo Act	E!	Edo-Sig	a	b	c	d	e	f	g
q0	1	q1	1	1	1	1	1	1	0
q1	1	q2	0	1	1	0	0	0	0
q2	1	q3	1	1	0	1	1	0	1
q3	1	q4	1	1	1	1	0	0	1
q4	1	q5	0	1	1	0	0	1	1
q5	1	q6	1	0	1	1	0	1	1
q6	1	q7	1	0	1	1	1	1	1
q7	1	q8	1	1	1	0	0	0	1
q8	1	q9	1	1	1	1	1	1	1
q9	1	q10	1	1	1	0	0	1	1
q10	1	q11	1	1	1	0	1	1	1
q11	1	q12	0	0	1	1	1	1	1
q12	1	q13	1	0	0	1	1	1	0
q13	1	q14	0	1	1	1	1	0	1
q14	1	q15	1	0	0	1	1	1	1
q15	1	q0	1	0	0	0	1	1	1

Edo-Act	E	Edo-Sig	a	b	c	d	e	f	g
q0	0	q0	1	1	1	1	1	1	0
q1	0	q1	0	1	1	0	0	0	0
q2	0	q2	1	1	0	1	1	0	1
q3	0	q3	1	1	1	1	0	0	1
q4	0	q4	0	1	1	0	0	1	1
q5	0	q5	1	0	1	1	0	1	1
q6	0	q6	1	0	1	1	1	1	1
q7	0	q7	1	1	1	0	0	0	1
q8	0	q8	1	1	1	1	1	1	1
q9	0	q9	1	1	1	0	0	1	1
q10	0	q10	1	1	1	0	1	1	1
q11	0	q11	0	0	1	1	1	1	1
q12	0	q12	1	0	0	1	1	1	0
q13	0	q13	0	1	1	1	1	0	1
q14	0	q14	1	0	0	1	1	1	1
q15	0	q15	1	0	0	0	1	1	1

Edo-Act	E	Edo-Sig	a	b	c	d	e	f	g	τ_3	τ_2	τ_1	τ_0
$q_3 q_2 q_1 q_0$		$q_3^+ q_2^+ q_1^+ q_0^+$											
0 0 0 0	1	0 0 0 1	1	1	1	1	1	1	0	0	0	0	1
0 0 0 1	1	0 0 1 0	0	1	1	0	0	0	0	0	0	1	1
0 0 1 0	1	0 0 1 1	1	1	0	1	1	0	1	0	0	0	1
0 0 1 1	1	0 1 0 0	1	1	1	1	0	0	1	0	1	1	1
0 1 0 0	1	0 1 0 1	0	1	1	0	0	1	1	0	0	0	1
0 1 0 1	1	0 1 1 0	1	0	1	1	0	1	1	0	0	1	1
0 1 1 0	1	0 1 1 1	1	0	1	1	1	1	1	0	0	0	1
0 1 1 1	1	1 0 0 0	1	1	1	0	0	0	1	1	1	1	1
1 0 0 0	1	1 0 0 1	1	1	1	1	1	1	1	0	0	0	1
1 0 0 1	1	1 0 1 0	1	1	1	0	0	1	1	0	0	1	1
1 0 1 0	1	1 0 1 1	1	1	1	0	1	1	1	0	0	1	1
1 0 1 1	1	1 1 0 0	0	0	1	1	1	1	1	0	1	1	1
1 1 0 0	1	1 1 0 1	1	0	0	1	1	1	0	0	0	0	1
1 1 0 1	1	1 1 1 0	0	1	1	1	1	0	1	0	0	1	1
1 1 1 0	1	1 1 1 1	1	0	0	1	1	1	1	0	0	0	1
1 1 1 1	1	0 0 0 0	1	0	0	0	1	1	1	1	1	1	1

Eda Act	E	Eda Sig	a	b	c	d	e	F	g	T ₃	T ₂	T ₁	T ₀
Q ₃ Q ₂ Q ₁ Q ₀		Q ₃ ⁺ Q ₂ ⁺ Q ₁ ⁺ Q ₀ ⁺											
0 0 0 0	0	0 0 0 0	1	1	1	1	1	1	0	0	0	0	0
0 0 0 1	0	0 0 0 1	0	1	1	0	0	0	0	0	0	0	0
0 0 1 0	0	0 0 1 0	1	1	0	1	1	0	1	0	0	0	0
0 0 1 1	0	0 0 1 1	1	1	1	1	0	0	1	0	0	0	0
0 1 0 0	0	0 1 0 0	0	1	1	0	0	1	1	0	0	0	0
0 1 0 1	0	0 1 0 1	1	0	1	1	0	1	1	0	0	0	0
0 1 1 0	0	0 1 1 0	1	0	1	1	1	1	1	0	0	0	0
0 1 1 1	0	0 1 1 1	1	1	1	0	0	0	1	0	0	0	0
1 0 0 0	0	1 0 0 0	1	1	1	1	1	1	1	0	0	0	0
1 0 0 1	0	1 0 0 1	1	1	1	0	0	1	1	0	0	0	0
1 0 1 0	0	1 0 1 0	1	1	1	0	1	1	1	0	0	0	0
1 0 1 1	0	1 0 1 1	0	0	1	1	1	1	1	0	0	0	0
1 1 0 0	0	1 1 0 0	1	0	0	1	1	1	0	0	0	0	0
1 1 0 1	0	1 1 0 1	0	1	1	1	1	0	1	0	0	0	0
1 1 1 0	0	1 1 1 0	1	0	0	1	1	1	1	0	0	0	0
1 1 1 1	0	1 1 1 1	1	0	0	0	1	1	1	0	0	0	0

Q ₀ E	00	01	11	10
Q ₂ Q ₁				
00	0	0	0	0
01	0	0	0	0
11	0	0	1	0
10	0	0	0	0

Q₃ = 0

Q ₀ E	00	01	11	10
Q ₂ Q ₁				
00	0	0	0	0
01	0	0	0	0
11	0	0	1	0
10	0	0	0	0

Q₃ = 1

$$T_3 = Q_2 Q_1 Q_0 E$$

$Q_2 Q_1$	E	00	01	11	10	$Q_2 Q_1$	E	00	01	11	10
00		0	0	0	0	00		0	0	0	0
01		0	0	1	0	01		0	0	1	0
11		0	0	1	0	11		0	0	1	0
10		0	0	0	0	10		0	0	0	0

$Q_3 = 0$ $Q_3 = 1$

$$T_2 = Q_1 Q_0 E$$

$Q_2 Q_1$	E	00	01	11	10	$Q_2 Q_1$	E	00	01	11	10
00		0	0	1	0	00		0	0	1	0
01		0	0	1	0	01		0	0	1	0
11		0	0	1	0	11		0	0	1	0
10		0	0	1	0	10		0	0	1	0

$Q_3 = 0$ $Q_3 = 1$

$$T_1 = Q_0 E$$

$Q_2 Q_1$	E	00	01	11	10	$Q_2 Q_1$	E	00	01	11	10
00		0	1	1	0	00		0	1	1	0
01		0	1	1	0	01		0	1	1	0
11		0	1	1	0	11		0	1	1	0
10		0	1	1	0	10		0	1	1	0

$Q_3 = 0$ $Q_3 = 1$

$$T_0 = E$$

$Q_0 E$	Q_2	Q_1	Q_0	Q_1	Q_0
00	00	01	11	10	
00	1	1	0	0	
01	1	1	1	1	
11	1	1	1	1	
10	0	0	1	1	

$Q_3 = 0$

$Q_0 E$	Q_2	Q_1	Q_0	Q_1	Q_0
00	00	01	11	10	
00	1	1	1	1	
01	1	1	0	0	
11	1	1	1	1	
10	1	1	0	0	

$Q_3 = 1$

$$a = \bar{Q}_2 \bar{Q}_0 + Q_2 Q_1 + \bar{Q}_3 Q_1 + \bar{Q}_3 Q_2 Q_0 + Q_3 \bar{Q}_0 + Q_3 \bar{Q}_2 \bar{Q}_1$$

$Q_0 E$	Q_2	Q_1	Q_0	Q_1	Q_0
00	00	01	11	10	
00	1	1	1	1	
01	1	1	1	1	
11	0	0	1	1	
10	1	1	0	0	

$Q_3 = 0$

$Q_0 E$	Q_2	Q_1	Q_0	Q_1	Q_0
00	00	01	11	10	
00	1	1	1	1	
01	1	1	0	0	
11	0	0	0	0	
10	0	0	1	1	

$Q_3 = 1$

$$b = \bar{Q}_2 \bar{Q}_1 + \bar{Q}_2 \bar{Q}_0 + \bar{Q}_3 \bar{Q}_1 \bar{Q}_0 + \bar{Q}_3 Q_1 Q_0 + Q_3 \bar{Q}_1 Q_0$$

$Q_0 E$	Q_2	Q_1	Q_0	Q_1	Q_0
00	00	01	11	10	
00	1	1	1	1	
01	0	0	1	1	
11	1	1	1	1	
10	1	1	1	1	

$Q_3 = 0$

$Q_0 E$	Q_2	Q_1	Q_0	Q_1	Q_0
00	00	01	11	10	
00	1	1	1	1	
01	1	1	1	1	
11	0	0	0	0	
10	0	0	1	1	

$Q_3 = 1$

$$c = \bar{Q}_2 \bar{Q}_1 + \bar{Q}_2 Q_0 + \bar{Q}_3 Q_2 + Q_3 \bar{Q}_2 + \bar{Q}_1 Q_0$$

$Q_2 \backslash Q_0 E$	00	01	11	10
00	1	1	0	0
01	1	1	1	1
11	1	1	0	0
10	0	0	1	1

$Q_3 = 0$

$Q_2 \backslash Q_0 E$	00	01	11	10
00	1	1	0	0
01	0	0	1	1
11	1	1	0	0
10	1	1	1	1

$Q_3 = 0$

$$d = \bar{Q}_2 \bar{Q}_1 \bar{Q}_0 + \bar{Q}_2 Q_1 \bar{Q}_0 + \bar{Q}_3 Q_1 \bar{Q}_0 + Q_2 \bar{Q}_1 Q_0 + \bar{Q}_3 Q_2 \bar{Q}_0$$

$Q_2 \backslash Q_0 E$	00	01	11	10
00	1	1	0	0
01	1	1	0	0
11	1	1	0	0
10	0	0	0	0

$Q_3 = 0$

$Q_2 \backslash Q_0 E$	00	01	11	10
00	1	1	0	0
01	1	1	1	1
11	1	1	1	1
10	1	1	1	1

$Q_3 = 1$

$$e = \bar{Q}_2 \bar{Q}_0 + Q_1 \bar{Q}_0 + Q_3 Q_1 + Q_3 Q_2$$

$Q_2 \backslash Q_0 E$	00	01	11	10
00	1	1	0	0
01	0	0	0	0
11	1	1	0	0
10	1	1	1	1

$Q_3 = 0$

$Q_2 \backslash Q_0 E$	00	01	11	10
00	1	1	1	1
01	1	1	1	1
11	1	1	1	1
10	1	1	0	0

$Q_3 = 1$

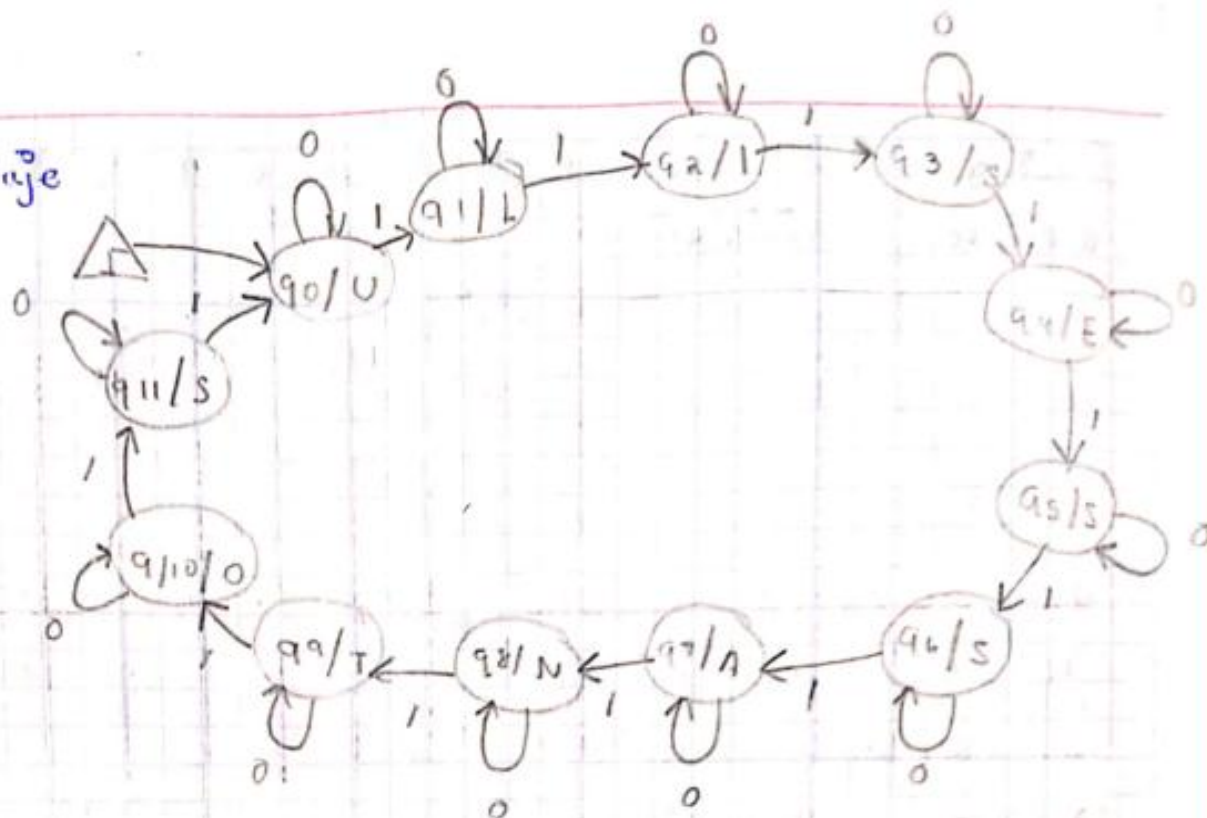
$$f = Q_2 \bar{Q}_0 + \bar{Q}_1 \bar{Q}_0 + \bar{Q}_3 Q_2 \bar{Q}_1 + Q_3 \bar{Q}_2 + Q_3 Q_1$$

$Q_3 \backslash Q_2 Q_1$		$Q_0 E$			
Q_3	Q_2	00	01	11	10
	00	0	0	0	0
	01	1	1	1	1
	11	1	1	1	1
	10	1	1	1	1
		$Q_3 = 0$			

$Q_3 \backslash Q_2 Q_1$		$Q_0 E$			
Q_3	Q_2	00	01	11	10
	00	1	1	1	1
	01	1	1	1	1
	11	1	1	1	1
	10	0	0	1	1
		$Q_3 = 1$			

$$g = \overline{Q_3} \overline{Q_2} + Q_1 + Q_3 \overline{Q_2} + Q_3 Q_0$$

Mensaje



Edo Act	E	Edo - sig	a	b	c	d	e	f	g
q0	1	q1	0	1	1	1	1	1	0
q1	1	q2	0	0	0	1	1	1	0
q2	1	q3	0	1	1	0	0	0	0
q3	1	q4	1	0	1	1	0	1	1
q4	1	q5	1	0	0	1	1	1	1
q5	1	q6	1	0	1	1	0	1	1
q6	1	q7	1	0	1	1	0	1	1
q7	1	q8	1	1	1	0	1	1	1
q8	1	q9	0	0	1	0	1	0	1
q9	1	q10	0	0	0	1	1	1	1
q10	1	q11	1	1	1	1	1	1	0
q11	1	q0	1	0	1	1	0	1	1



Eda Act	E	Eda Sig	a	b	c	d	e	f	g	D3 D2 D1 D0
Q3 Q2 Q1 Q0		Q3 ⁺ Q2 ⁺ Q1 ⁺ Q0 ⁺								
0 0 0 0	1	0 0 0 1	0	1	1	1	1	1	0	0 0 0 1
0 0 0 1	1	0 0 1 1	0	0	0	1	1	1	0	0 0 1 1
0 0 1 1	1	0 0 1 0	0	1	1	0	0	0	0	0 0 1 0
0 0 1 0	1	0 1 1 0	1	0	1	1	0	1	1	0 1 1 0
0 1 1 0	1	0 1 1 1	1	0	0	1	1	1	1	0 1 1 1
0 1 1 1	1	0 1 0 1	1	0	1	1	0	1	1	0 1 0 1
0 1 0 1	1	0 1 0 0	1	0	1	1	0	1	1	0 1 0 0
0 1 0 0	1	1 1 0 0	1	1	1	0	1	1	1	1 1 0 0
1 1 0 0	1	1 1 0 1	0	0	1	0	1	0	1	1 1 0 1
1 1 0 1	1	1 1 1 1	0	0	0	1	1	1	1	1 1 1 1
1 1 1 1	1	1 1 1 0	1	1	1	1	1	1	0	1 1 1 0
1 1 1 0	1	0 0 0 0	1	0	1	1	0	1	1	0 0 0 0
Eda Act		Eda Sig								
Q3 Q2 Q1 Q0	E	Q3 ⁺ Q2 ⁺ Q1 ⁺ Q0 ⁺	a	b	c	d	e	f	g	D3 D2 D1 D0
0 0 0 0	0	0 0 0 0	0	1	1	1	1	1	0	0 0 0 0
0 0 0 1	0	0 0 0 1	0	0	0	1	1	1	0	0 0 0 1
0 0 1 1	0	0 0 1 1	0	1	1	0	0	0	0	0 0 1 1
0 0 1 0	0	0 0 1 0	1	0	1	1	0	1	1	0 0 1 0
0 1 1 0	0	0 1 1 0	1	0	0	1	1	1	1	0 1 1 0
0 1 1 1	0	0 1 1 1	1	0	1	1	0	1	1	0 1 1 1
0 1 0 1	0	0 1 0 1	1	0	1	1	0	1	1	0 1 0 1
0 1 0 0	0	0 1 0 0	1	1	1	0	1	1	1	0 1 0 0
1 1 0 0	0	1 1 0 0	0	0	1	0	1	0	1	1 1 0 0
1 1 0 1	0	1 1 0 1	0	0	0	1	1	1	1	1 1 0 1
1 1 1 1	0	1 1 1 1	1	1	1	1	1	1	0	1 1 1 1
1 1 1 0	0	1 1 1 0	1	0	1	1	0	1	1	1 1 1 0

$Q_2 Q_1$ \ $Q_0 E$	00	01	11	10
00	0	0	0	0
01	0	0	0	0
11	0	0	0	0
10	0	1	0	0

$Q_3 = 0$

$Q_2 Q_1$ \ $Q_0 E$	00	01	11	10
00	X	X	X	X
01	X	X	X	X
11	1	0	1	1
10	1	1	1	1

$Q_3 = 1$

$$D_3 = Q_2 \bar{Q}_1 \bar{Q}_0 E + Q_3 \bar{E} + Q_3 Q_0$$

$Q_2 Q_1$ \ $Q_0 E$	00	01	11	10
00	0	0	0	0
01	0	1	0	0
11	1	1	1	1
10	1	1	1	1

$Q_3 = 0$

$Q_2 Q_1$ \ $Q_0 E$	00	01	11	10
00	X	X	X	X
01	X	X	X	X
11	1	0	1	1
10	1	1	1	1

$Q_3 = 1$

$$D_2 = \bar{Q}_3 \bar{Q}_1 \bar{Q}_0 E + Q_2 \bar{Q}_1 + Q_2 \bar{E} + Q_2 Q_0$$

$Q_2 Q_1$ \ $Q_0 E$	00	01	11	10
00	0	0	1	0
01	1	1	1	1
11	1	1	0	1
10	0	0	0	0

$Q_3 = 0$

$Q_2 Q_1$ \ $Q_0 E$	00	01	11	10
00	X	X	X	X
01	X	X	X	X
11	1	0	1	1
10	0	0	1	0

$Q_3 = 1$

$$D_1 = \bar{Q}_3 \bar{Q}_1 \bar{Q}_0 + \bar{Q}_2 Q_0 E + Q_3 Q_0 E + Q_1 \bar{E}$$

$Q_2 \backslash Q_1 \backslash E$	00	01	11	10
00	0	1	1	1
01	0	0	0	1
11	0	1	1	1
10	0	0	0	1

$Q_3 = 0$

$Q_2 \backslash Q_1 \backslash E$	00	01	11	10
00	X	X	X	X
01	X	X	X	X
11	0	0	0	1
10	0	1	1	1

$Q_3 = 1$

$$D_0 = \bar{Q}_3 \bar{Q}_2 Q_1 E + \bar{Q}_2 \bar{Q}_1 E + Q_3 \bar{Q}_1 E + Q_0 E$$

$Q_2 \backslash Q_1 \backslash E$	00	01	11	10
00	0	0	0	0
01	1	1	0	0
11	1	1	1	1
10	1	1	1	1

$Q_3 = 0$

$Q_2 \backslash Q_1 \backslash E$	00	01	11	10
00	X	X	X	X
01	X	X	X	X
11	1	1	1	1
10	0	0	0	0

$Q_3 = 1$

$$a = Q_1 \bar{Q}_0 + \bar{Q}_3 Q_2 + Q_2 Q_1$$

$Q_2 \backslash Q_1 \backslash E$	00	01	11	10
00	1	1	0	0
01	0	0	1	1
11	0	0	0	0
10	1	1	0	0

$Q_3 = 0$

$Q_2 \backslash Q_1 \backslash E$	00	01	11	10
00	X	X	X	X
01	X	X	X	X
11	0	0	1	1
10	0	0	0	0

$Q_3 = 1$

$$b = \bar{Q}_3 \bar{Q}_1 \bar{Q}_0 + \bar{Q}_2 Q_1 Q_0 + Q_3 Q_1 Q_0$$

$Q_3 \backslash Q_2 Q_1 Q_0$	00	01	11	10
00	1	1	0	0
01	1	1	1	1
11	0	0	1	1
10	1	1	1	1

$Q_3 = 0$

$Q_3 \backslash Q_2 Q_1 Q_0$	00	01	11	10
00	X	X	X	X
01	X	X	X	X
11	1	1	1	0
10	1	1	0	1

$Q_3 = 1$

$$C = Q_2 \bar{Q}_1 \bar{E} + \bar{Q}_3 Q_2 Q_0 + Q_1 Q_0 \bar{E} + \bar{Q}_1 \bar{Q}_0 + Q_3 \bar{Q}_0 + \bar{Q}_2 Q_1$$

$Q_3 \backslash Q_2 Q_1 Q_0$	00	01	11	10
00	1	1	1	1
01	1	1	0	0
11	1	1	1	1
10	0	0	1	1

$Q_3 = 0$

$Q_3 \backslash Q_2 Q_1 Q_0$	00	01	11	10
00	X	X	X	X
01	X	X	X	X
11	1	1	1	1
10	0	0	1	1

$Q_3 = 1$

$$d = \bar{Q}_2 \bar{Q}_0 + \bar{Q}_1 Q_0 + Q_2 Q_1$$

$Q_3 \backslash Q_2 Q_1 Q_0$	00	01	11	10
00	1	1	1	1
01	0	0	0	0
11	1	1	0	0
10	1	1	0	0

$Q_3 = 0$

$Q_3 \backslash Q_2 Q_1 Q_0$	00	01	11	10
00	X	X	X	X
01	X	X	X	X
11	0	0	1	1
10	1	1	1	1

$Q_3 = 1$

$$e = \bar{Q}_3 Q_2 \bar{Q}_0 + \bar{Q}_2 \bar{Q}_1 + Q_3 \bar{Q}_1 + Q_3 Q_0$$

$Q_3 = 0$

$Q_2 \backslash Q_1$	00	01	11	10
00	1	1	1	1
01	1	1	0	0
11	1	1	1	1
10	1	1	1	1

$Q_3 = 1$

$Q_2 \backslash Q_1$	00	01	11	10
00	x	x	x	x
01	x	x	x	x
11	1	1	1	1
10	0	0	1	1

$$f = \bar{Q}_3 \bar{Q}_0 + \bar{Q}_1 Q_0 + Q_2 Q_1$$

$Q_3 = 0$

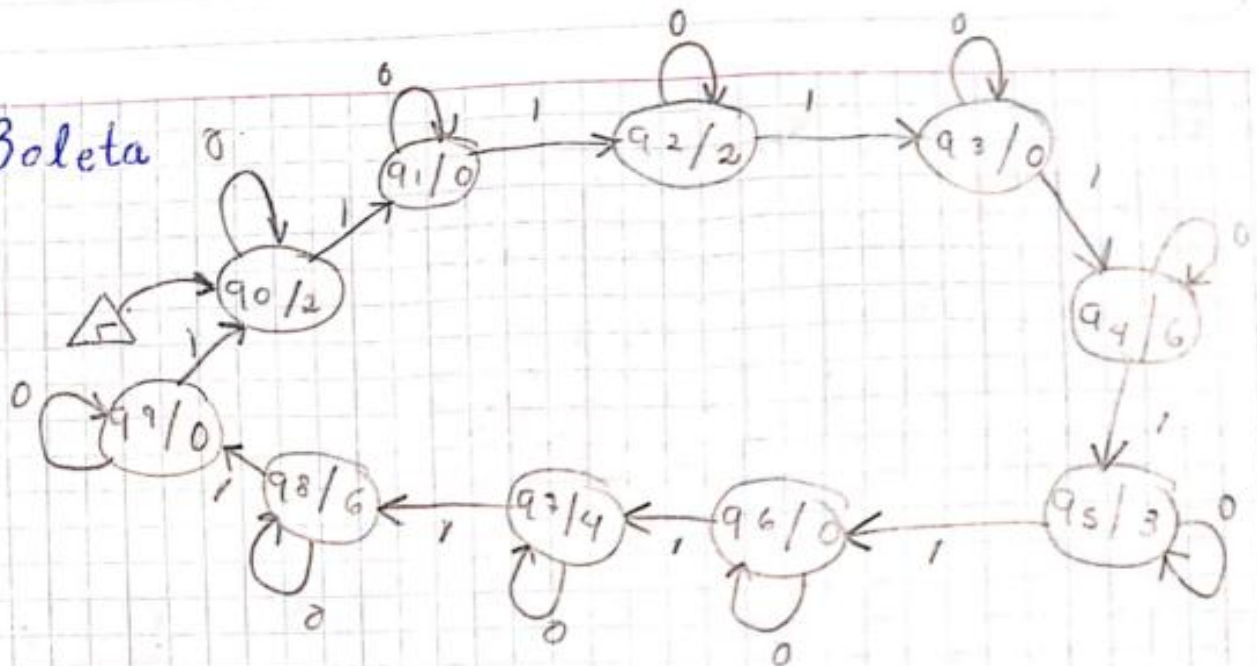
$Q_2 \backslash Q_1$	00	01	11	10
00	0	0	0	0
01	1	1	0	0
11	1	1	1	1
10	1	1	1	1

$Q_3 = 1$

$Q_2 \backslash Q_1$	00	01	11	10
00	x	x	x	x
01	x	x	x	x
11	1	1	0	0
10	1	1	1	1

$$g = Q_1 \bar{Q}_0 + \bar{Q}_3 Q_2 + Q_2 \bar{Q}_1$$

Boleta



Edo-Act		Edo- Sig												
$Q_3 Q_2 Q_1 Q_0$	F	$Q_3^+ Q_2^+ Q_1^+ Q_0^+$	a	b	c	d	e	f	g	$T_3 T_2 T_1 T_0$				
0 0 0 0	1	0 0 0 1	1	1	0	1	1	0	1	0 0 0 1				
0 0 0 1	1	0 0 1 0	1	1	1	1	1	1	0	0 0 1 1				
0 0 1 0	1	0 0 1 1	1	1	0	1	1	0	1	0 0 0 1				
0 0 1 1	1	0 1 0 0	1	1	1	1	1	1	0	0 1 1 1				
0 1 0 0	1	0 1 0 1	1	0	1	1	1	1	1	0 0 0 1				
0 1 0 1	1	0 1 1 0	1	1	1	1	0	0	1	0 0 1 1				
0 1 1 0	1	0 1 1 1	1	1	1	1	1	1	0	0 0 0 1				
0 1 1 1	1	1 0 0 0	0	1	1	0	0	1	1	1 1 1 1				
1 0 0 0	1	1 0 0 1	1	0	1	1	1	1	1	0 0 0 1				
1 0 0 1	1	0 0 0 0	1	1	1	1	1	1	0	1 0 0 1				
0 0 0 0	0	0 0 0 0	1	1	0	1	1	0	1	0 0 0 0				
0 0 0 1	0	0 0 0 1	1	1	1	1	1	1	0	0 0 0 0				
0 0 1 0	0	0 0 1 0	1	1	0	1	1	0	1	0 0 0 0				
0 0 1 1	0	0 0 1 1	1	1	1	1	1	1	0	0 0 0 0				
0 1 0 0	0	0 1 0 0	1	0	1	1	1	1	1	0 0 0 0				
0 1 0 1	0	0 1 0 1	1	1	1	1	0	0	1	0 0 0 0				
0 1 1 0	0	0 1 1 0	1	1	1	1	1	1	0	0 0 0 0				
0 1 1 1	0	0 1 1 1	0	1	1	1	1	1	1	0 0 0 0				
1 0 0 0	0	1 0 0 0	1	0	1	1	1	1	1	0 0 0 0				
1 0 0 1	0	1 0 0 1	1	1	1	1	1	1	0	0 0 0 0				

100%

Escaneado con CamScanner

$Q_3 \backslash Q_2 Q_1 Q_0$	00	01	11	10
00	0	0	0	0
01	0	0	0	0
11	0	0	1	0
10	0	0	0	0

$Q_3 = 0$

$Q_3 \backslash Q_2 Q_1 Q_0$	00	01	11	10
00	0	0	1	0
01	X	X	X	X
11	X	X	X	X
10	X	X	X	X

$Q_3 = 1$

$$T_3 = \bar{Q}_3 Q_1 Q_0 E + Q_3 Q_0 E$$

$Q_3 \backslash Q_2 Q_1 Q_0$	00	01	11	10
00	0	0	0	0
01	0	0	1	0
11	0	0	1	0
10	0	0	0	0

$Q_3 = 0$

$Q_3 \backslash Q_2 Q_1 Q_0$	00	01	11	10
00	0	0	0	0
01	X	X	X	X
11	X	X	X	X
10	X	X	X	X

$Q_3 = 1$

$$T_2 = Q_1 Q_0 E$$

$Q_3 \backslash Q_2 Q_1 Q_0$	00	01	11	10
00	0	0	1	0
01	0	0	1	0
11	0	0	1	0
10	0	0	1	0

$Q_3 = 0$

$Q_3 \backslash Q_2 Q_1 Q_0$	00	01	11	10
00	0	0	0	0
01	X	X	X	X
11	X	X	X	X
10	X	X	X	X

$Q_3 = 1$

$$T_1 = \bar{Q}_3 Q_0 E$$

$Q_3 \backslash Q_2 Q_1 Q_0$	00	01	11	10
00	0	1	1	0
01	0	1	1	0
11	0	1	1	0
10	0	1	1	0

$Q_3 = 0$

$Q_3 \backslash Q_2 Q_1 Q_0$	00	01	11	10
00	0	1	1	0
01	X	X	X	X
11	X	X	X	X
10	X	X	X	X

$Q_3 = 1$

$$T_0 = E$$

Q_0, Q_1 Q_2, Q_3
 $Q_3 = 0$

$Q_0 \backslash Q_1$	00	01	11	10
00	1	1	1	1
01	1	1	1	1
11	1	1	0	0
10	1	1	1	1

Q_0, Q_1 Q_2, Q_3
 $Q_3 = 1$

$Q_0 \backslash Q_1$	00	01	11	10
00	1	1	1	1
01	X	X	X	X
11	X	X	X	X
10	X	X	X	X

$$a = \bar{Q}_2 + \bar{Q}_1 + \bar{Q}_0$$

Q_0, Q_1 Q_2, Q_3
 $Q_3 = 0$

$Q_0 \backslash Q_1$	00	01	11	10
00	1	1	1	1
01	1	1	1	1
11	1	1	1	1
10	0	0	1	1

Q_0, Q_1 Q_2, Q_3
 $Q_3 = 1$

$Q_0 \backslash Q_1$	00	01	11	10
00	0	0	1	1
01	X	X	X	X
11	X	X	X	X
10	X	X	X	X

$$b = \bar{Q}_3 \bar{Q}_2 + Q_0 + Q_1$$

Q_0, Q_1 Q_2, Q_3
 $Q_3 = 0$

$Q_0 \backslash Q_1$	00	01	11	10
00	0	0	1	1
01	0	0	1	1
11	1	1	1	1
10	1	1	1	1

Q_0, Q_1 Q_2, Q_3
 $Q_3 = 1$

$Q_0 \backslash Q_1$	00	01	11	10
00	1	1	1	1
01	X	X	X	X
11	X	X	X	X
10	X	X	X	X

$$c = Q_0 + Q_2 + Q_3$$

$$Q_3 \oplus Q_2 \oplus Q_1 \oplus Q_0$$

$Q_3 \backslash Q_2 \backslash Q_1 \backslash Q_0$	00	01	11	10
00	1	1	1	1
01	1	1	1	1
11	1	1	0	0
10	1	1	1	1

$Q_3 \oplus Q_2$

$$Q_3 \oplus Q_2$$

$Q_3 \backslash Q_2 \backslash Q_1 \backslash Q_0$	00	01	11	10
00	1	1	1	1
01	1	x	x	x
11	x	x	x	x
10	x	x	x	x

$Q_3 \oplus Q_1$

$$d = \bar{Q}_2 + \bar{Q}_1 + \bar{Q}_0$$

$$Q_3 \oplus Q_2$$

$Q_3 \backslash Q_2 \backslash Q_1 \backslash Q_0$	00	01	11	10
00	1	1	1	1
01	1	1	1	1
11	1	1	0	0
10	1	1	0	0

$Q_3 \oplus Q_0$

$$Q_3 \oplus Q_1$$

$Q_3 \backslash Q_2 \backslash Q_1 \backslash Q_0$	00	01	11	10
00	1	1	1	1
01	x	x	x	x
11	x	x	x	x
10	x	x	x	x

$Q_3 \oplus Q_0$

$$e = \bar{Q}_2 + \bar{Q}_0$$

$$Q_3 \oplus Q_2$$

$Q_3 \backslash Q_2 \backslash Q_1 \backslash Q_0$	00	01	11	10
00	0	0	1	1
01	0	0	1	1
11	1	1	1	1
10	1	1	0	0

$Q_3 \oplus Q_0$

$$Q_3 \oplus Q_1$$

$Q_3 \backslash Q_2 \backslash Q_1 \backslash Q_0$	00	01	11	10
00	1	1	1	1
01	x	x	x	x
11	x	x	x	x
10	x	x	x	x

$Q_3 \oplus Q_0$

$$f = \bar{Q}_2 Q_0 + Q_2 \bar{Q}_0 + Q_2 Q_1 + Q_3$$

$Q_2 \backslash Q_1$	00	01	11	10
00	1	1	0	0
01	1	1	0	0
11	0	0	1	1
10	1	1	1	1

$Q_3 = 0$

$Q_2 \backslash Q_1$	00	01	11	10
00	1	1	0	0
01	X	X	X	X
11	X	X	X	X
10	X	X	X	X

$Q_3 = 1$

$$g = \overline{Q_2} \overline{Q_0} + Q_2 \overline{Q_1} + Q_2 Q_0$$

Código VHDL

1) Datos

```
1  --Santos Méndez Ulises Jesus
2  --2CV8
3  --Práctica 7"Aplicacion"//datos
4  library ieee;
5  use ieee.std_logic_1164.all;
6
7  entity dados is
8  port (clk,clr,en: in std_logic;
9        display: out std_logic_vector(6 downto 0));
10
11     attribute pin_numbers of dados: entity is
12     "clr:13 en:2 display(6):21 display(5):20 "
13 &    "display(4):19 display(3):18 display(2):17 "
14 &    "display(1):16 display(0):15 ";
15 end dados;
16
17 architecture arqdados of dados is
18 constant s1: std_logic_vector(6 downto 0) := "0110000";
19 constant s2: std_logic_vector(6 downto 0) := "1101101";
20 constant s3: std_logic_vector(6 downto 0) := "1111001";
21 constant s4: std_logic_vector(6 downto 0) := "0110011";
22 constant s5: std_logic_vector(6 downto 0) := "1011011";
23 constant s6: std_logic_vector(6 downto 0) := "1011111";
24 begin
```



```
25
26     process (clk,clr)
27     begin
28         if (clr = '1') then
29             display <= s1;
30         elsif (rising_edge(clk)) then
31             if (en = '1') then
32                 case display is
33                     when s1 => display <= s2;
34                     when s2 => display <= s3;
35                     when s3 => display <= s4;
36                     when s4 => display <= s5;
37                     when s5 => display <= s6;
38                     when s6 => display <= s1;
39                     when others => display <= s1;
40                 end case;
41             else
42                 display <= display;
43             end if;
44         end if;
45     end process;
46 end arqdados;
```

2) Contador Hexadecimal

```
1 --Santos Mèndez Ulises Jesus
2 --2CV8
3 --Pràctica 7"Aplicacion">//contador hexadecimal
4 library ieee;
5 use ieee.std_logic_1164.all;
6
7 entity chexad is
8 port (clk,clr,en: in std_logic;
9       display: out std_logic_vector(6 downto 0));
10
11     attribute pin_numbers of chexad: entity is
12         "clr:13 en:2 display(6):21 display(5):20 "
13 &     "display(4):19 display(3):18 display(2):17 "
14 &     "display(1):16 display(0):15 ";
15 end chexad;
16
17 architecture arqchex of chexad is
18 constant s0: std_logic_vector(6 downto 0) := "1111110";
19 constant s1: std_logic_vector(6 downto 0) := "0110000";
20 constant s2: std_logic_vector(6 downto 0) := "1101101";
21 constant s3: std_logic_vector(6 downto 0) := "1111001";
22 constant s4: std_logic_vector(6 downto 0) := "0110011";
23 constant s5: std_logic_vector(6 downto 0) := "1011011";
24 constant s6: std_logic_vector(6 downto 0) := "1011111";
```

```
25 constant s7: std_logic_vector(6 downto 0) := "1110001";
26 constant s8: std_logic_vector(6 downto 0) := "1111111";
27 constant s9: std_logic_vector(6 downto 0) := "1110011";
28 constant sA: std_logic_vector(6 downto 0) := "1110111";
29 constant sB: std_logic_vector(6 downto 0) := "0011111";
30 constant sC: std_logic_vector(6 downto 0) := "1001110";
31 constant sD: std_logic_vector(6 downto 0) := "0111101";
32 constant sE: std_logic_vector(6 downto 0) := "1001111";
33 constant sF: std_logic_vector(6 downto 0) := "1000111";
34 begin
35     process(clk,clr)
36     begin
37         if(clr = '1')then
38             display <= s0;
39         elsif(rising_edge(clk))then
40             if(en = '1')then
41                 case display is
42                     when s0 => display <= s1;
43                     when s1 => display <= s2;
44                     when s2 => display <= s3;
45                     when s3 => display <= s4;
46                     when s4 => display <= s5;
47                     when s5 => display <= s6;
48                     when s6 => display <= s7;
```



```
49         when s7 => display <= s8;
50         when s8 => display <= s9;
51         when s9 => display <= sA;
52         when sA => display <= sB;
53         when sB => display <= sC;
54         when sC => display <= sD;
55         when sD => display <= sE;
56         when sE => display <= sF;
57         when sF => display <= s0;
58         when others => display <= s0;
59         end case;
60     else
61         display <= display;
62     end if;
63 end if;
64 end process;
65 end arquhex;
```

3) Mensaje (Letras repetidas)

```
1 --Santos Mèndez Ulises Jesus
2 --2CV8
3 --Pràctica 7"Aplicacion">//mensaje
4 library ieee;
5 use ieee.std_logic_1164.all;
6
7 entity mensaje is
8 port (clk,clr,en: in std_logic;
9       display: out std_logic_vector(6 downto 0));
10
11     attribute pin_numbers of mensaje: entity is
12     "clr:13 en:2 display(6):21 display(5):20 "
13 &    "display(4):19 display(3):18 display(2):17 "
14 &    "display(1):16 display(0):15 ";
15 end mensaje;
16
17 architecture arqmensaje of mensaje is
18 constant l0: std_logic_vector(1 downto 0) := "00";
19 constant l1: std_logic_vector(1 downto 0) := "01";
20 constant l2: std_logic_vector(1 downto 0) := "10";
21 constant l3: std_logic_vector(1 downto 0) := "11";
22
23 constant sU: std_logic_vector(6 downto 0) := "0111110";
24 constant sL: std_logic_vector(6 downto 0) := "0001110";
```

```
25 constant sI: std_logic_vector(6 downto 0) := "0110000";
26 constant sS: std_logic_vector(6 downto 0) := "1011011";
27 constant sE: std_logic_vector(6 downto 0) := "1001111";
28 constant sA: std_logic_vector(6 downto 0) := "1110111";
29 constant sN: std_logic_vector(6 downto 0) := "0010101";
30 constant sT: std_logic_vector(6 downto 0) := "0001111";
31 constant sO: std_logic_vector(6 downto 0) := "1111110";
32
33 signal estado: std_logic_vector(8 downto 0);
34 begin
35
36     process(clk,clr)
37     begin
38         if(clr = '1')then
39             estado <= 10&sU;
40         elsif(rising_edge(clk))then
41             if(en = '1')then
42                 case estado is
43                     when 10&sU => estado <= 10&sL;
44                     when 10&sL => estado <= 10&sI;
45                     when 10&sI => estado <= 10&sS;
46                     when 10&sS => estado <= 10&sE;
47                     when 10&sE => estado <= 11&sS;
48                     when 11&sS => estado <= 12&sS;
49                     when 12&sS => estado <= 10&sA;
50                     when 10&sA => estado <= 10&sN;
51                     when 10&sN => estado <= 10&sT;
52                     when 10&sT => estado <= 10&sO;
53                     when 10&sO => estado <= 13&sS;
54                     when 13&sS => estado <= 10&sU;
55                     when others => estado <= "-----";
56                 end case;
57             else
58                 estado <= estado;
59             end if;
60         end if;
61     end process;
62     display <= estado(6 downto 0);
63 end arqmensaje;
```

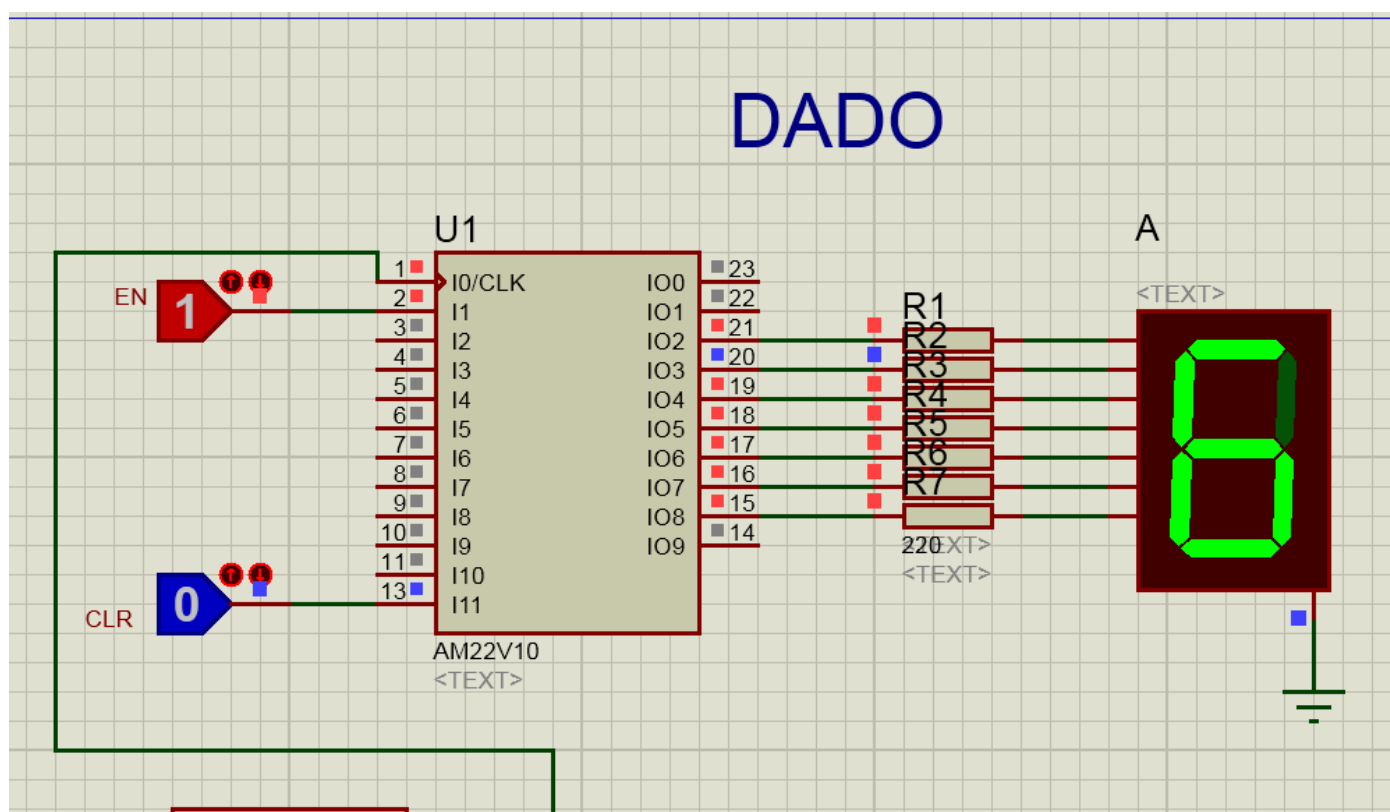
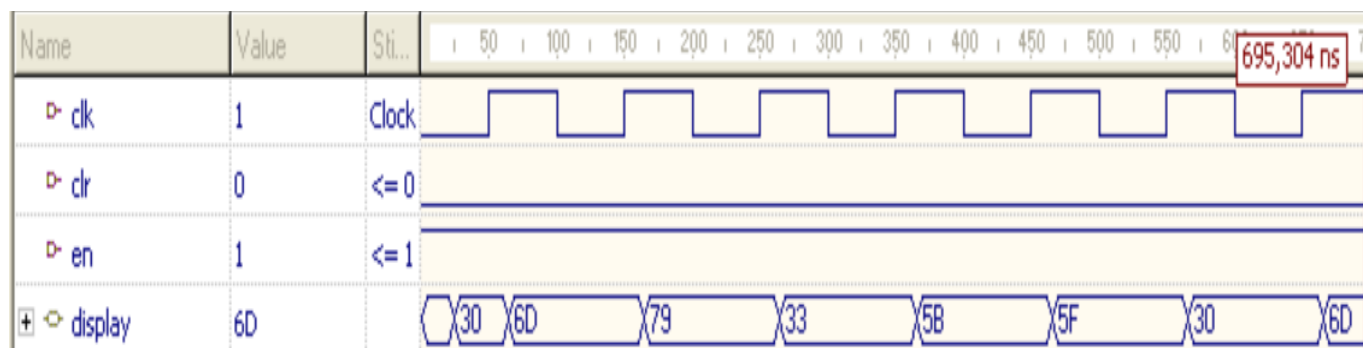

4) Boleta alumno

```
1 --Santos Méndez Ulises Jesus
2 --2CV8
3 --Práctica 7"Aplicacion">//No.Boleta
4 library ieee;
5 use ieee.std_logic_1164.all;
6
7 entity boleta is
8 port (clk,clr,en: in std_logic;
9       display: out std_logic_vector(6 downto 0));
10
11     attribute pin_numbers of boleta: entity is
12     "clr:13 en:2 display(6):21 display(5):20 "
13 &    "display(4):19 display(3):18 display(2):17 "
14 &    "display(1):16 display(0):15 ";
15 end boleta;
16
17 architecture arqboleta of boleta is
18 constant l0: std_logic_vector(1 downto 0) := "00";
19 constant l1: std_logic_vector(1 downto 0) := "01";
20 constant l2: std_logic_vector(1 downto 0) := "10";
21 constant l3: std_logic_vector(1 downto 0) := "11";
22
23 constant s2: std_logic_vector(6 downto 0) := "1101101";
24 constant s0: std_logic_vector(6 downto 0) := "1111110";
```

```
25 constant s6: std_logic_vector(6 downto 0) := "1011111";
26 constant s3: std_logic_vector(6 downto 0) := "1111001";
27 constant s4: std_logic_vector(6 downto 0) := "0110011";
28
29 signal estado: std_logic_vector(8 downto 0);
30 begin
31
32     process(clk,clr)
33     begin
34         if(clr = '1') then
35             estado <= 10&s2;
36         elsif(rising_edge(clk)) then
37             if(en = '1') then
38                 case estado is
39                     when 10&s2 => estado <= 10&s0;
40                     when 10&s0 => estado <= 11&s2;
41                     when 11&s2 => estado <= 11&s0;
42                     when 11&s0 => estado <= 10&s6;
43                     when 10&s6 => estado <= 10&s3;
44                     when 10&s3 => estado <= 12&s0;
45                     when 12&s0 => estado <= 10&s4;
46                     when 10&s4 => estado <= 11&s6;
47                     when 11&s6 => estado <= 13&s0;
48                     when 13&s0 => estado <= 10&s2;
49
50                     when others => estado <= "-----";
51                 end case;
52             else
53                 estado <= estado;
54             end if;
55         end process;
56         display <= estado(6 downto 0);
57     end arqboleta;
```

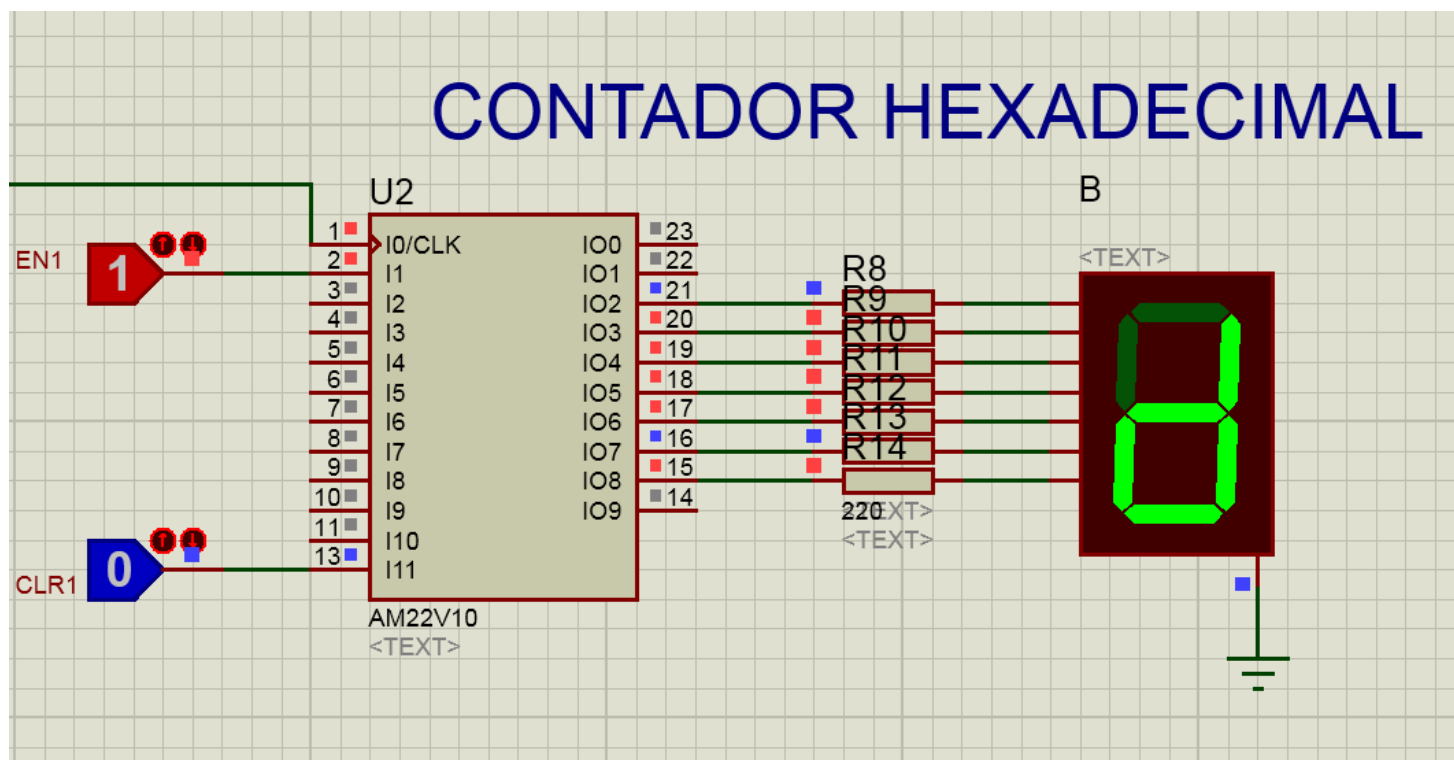
Simulación en Proteus y en Active HDL-Sim

1) Datos

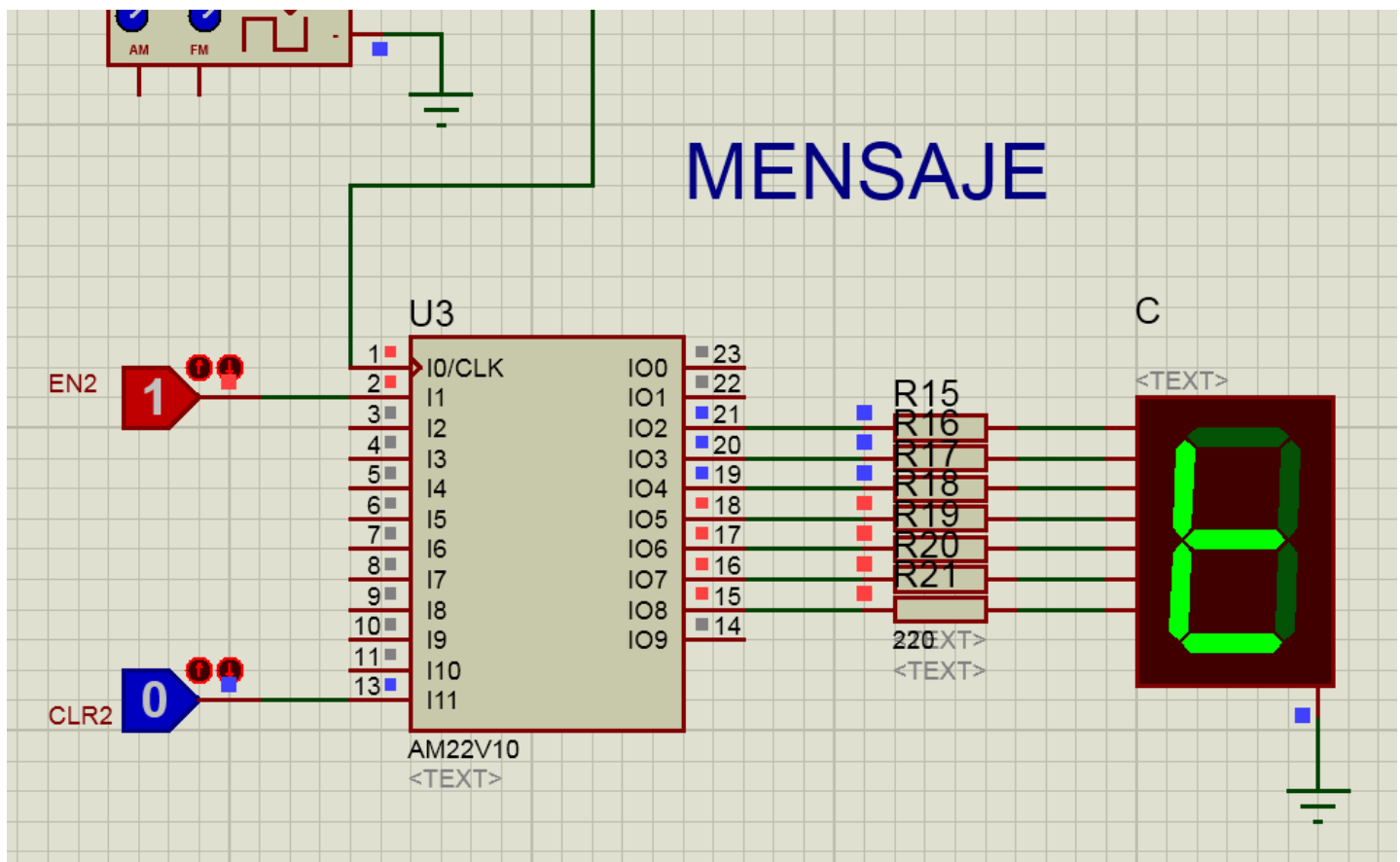
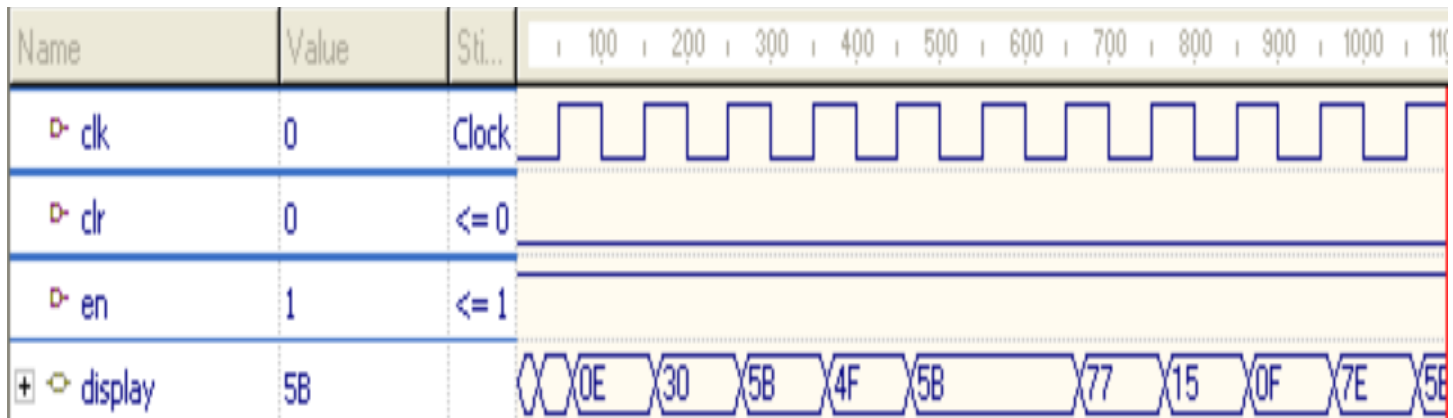


2) Contador Hexadecimal

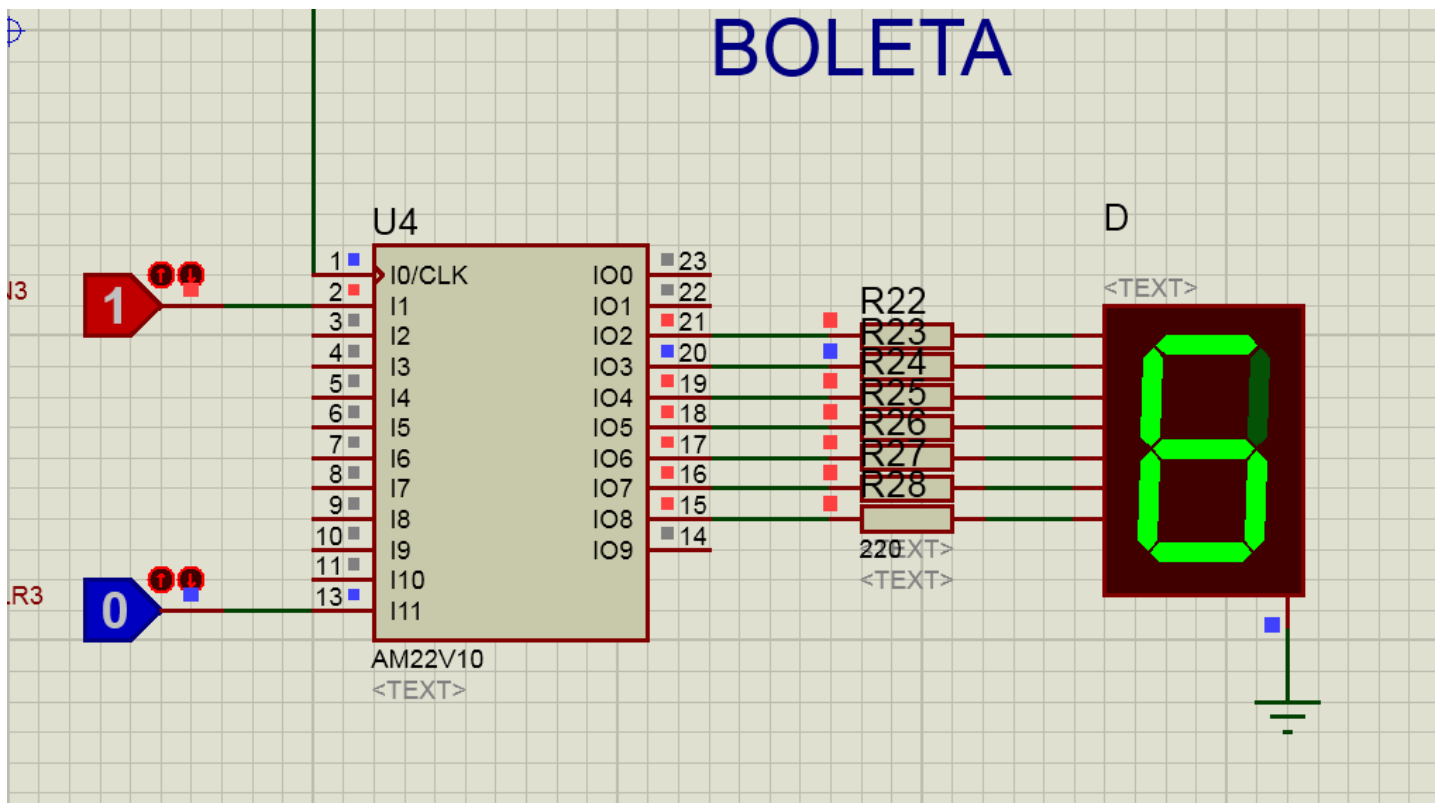
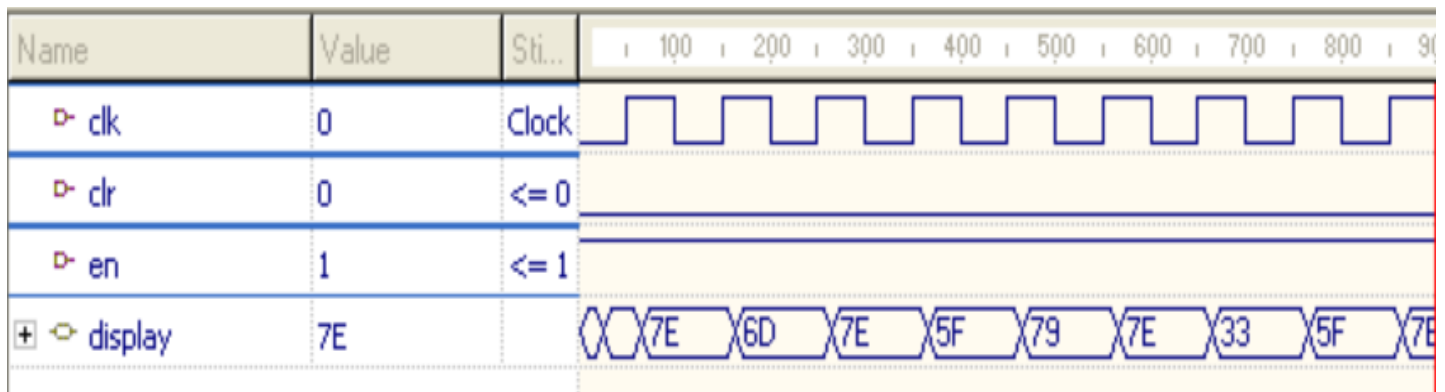
Name	Value	Sti...	100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1566,432
clk	1	Clock	
clr	0	<= 0	
en	1	<= 1	
display	7E		30 6D 79 33 5B 5F 71 7F 73 77 1F 4E 3D 4F 47



3) Mensaje (con letras repetidas)



4) Boleta alumno





CUESTIONARIO:

1. ¿Cuántos dispositivos PLD 22V10 son necesarios para el desarrollo de esta práctica?
R= 1 dispositivo PLD 22V10.
2. ¿Cuántos dispositivos de la serie 74xx (TTL) ó 40xx (CMOS) hubieras necesitado para el desarrollo de esta práctica?
R= 1 555, 5 FF's 4023, 1 74ls139, 1 decodificador 7447, 12 7408, 12 7432, 12 7404
3. ¿Cuántos pines de entrada/salida del PLD 22V10 se usan en los diseños?
R= 3 pines de entrada y 7 de salida.
4. ¿Cuántos términos producto ocupan las ecuaciones para cada señal de salida y que porcentaje se usa en total del PLD 22V10 en cada aplicación?
R= Para el programa de los dados se ocupan 28 términos producto y un 45% del PLD, para el contador hexadecimal se ocupan 43 términos producto y un 45% del PLD, para el mensaje se ocupan 36 términos producto y un 54% del PLD, para la boleta del alumno se ocupan 33 términos producto y un 54% del PLD.
5. ¿Es posible implementar los diseños usando cualquier tipo de codificación en el PLD22V10?
R= Si, considerando el número de entradas y salidas del PLD que estés utilizando.
6. ¿Cuáles son las señales que funcionan de manera síncrona y cuáles de manera asíncrona?
R= clear es asíncrona, enable es síncrona.
7. ¿Qué puedes concluir de esta práctica?
R= Vimos distintas formas de usar los tipos de código para la implementación de un diseño con componentes limitadas usando nuevos comandos para facilitar la codificación.