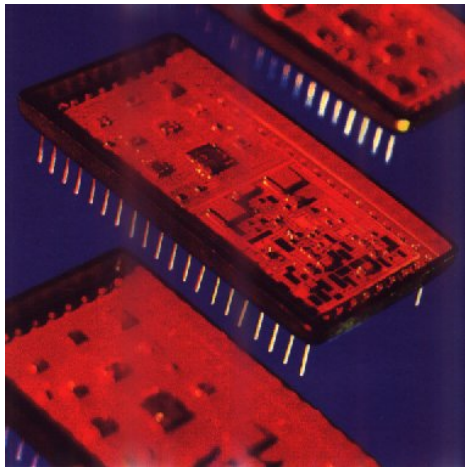
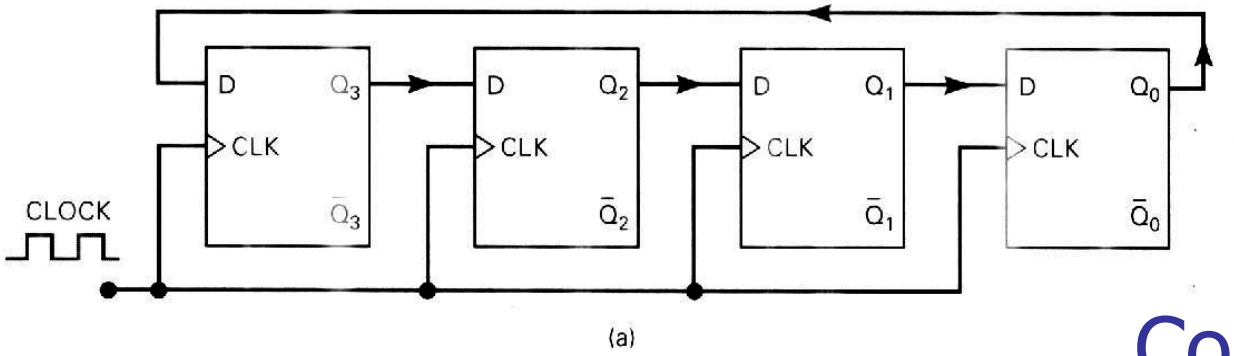
Contadores Especiais

Circuitos Digitais II

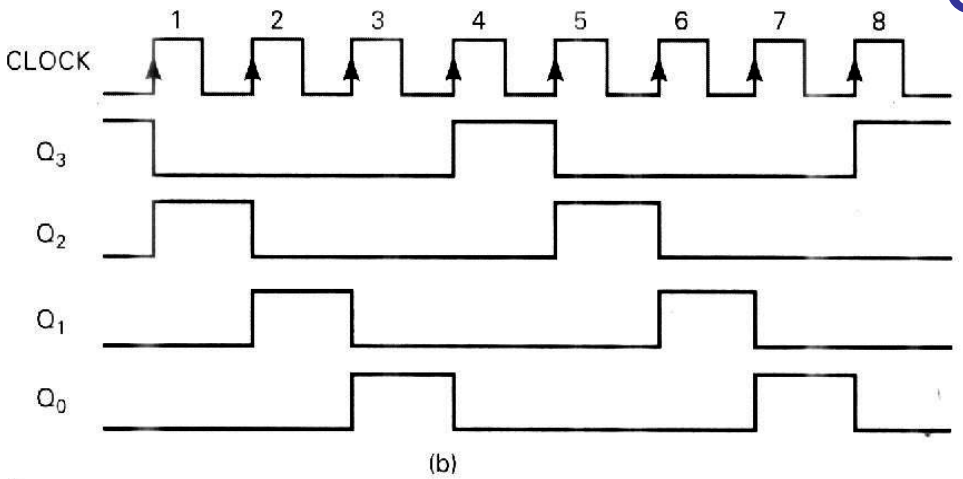
Prof. Fernando Passold



Contador em Anel 4 bits



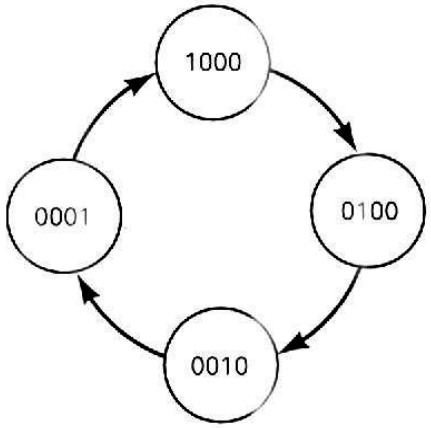
(a)



(b)

Q_3	Q_2	Q_1	Q_0	Pulso de CLOCK
1	0	0	0	0
0	1	0	0	1
0	0	1	0	2
0	0	0	1	3
1	0	0	0	4
0	1	0	0	5
0	0	1	0	6
0	0	0	1	7
.	.	.	.	.
.	.	.	.	.

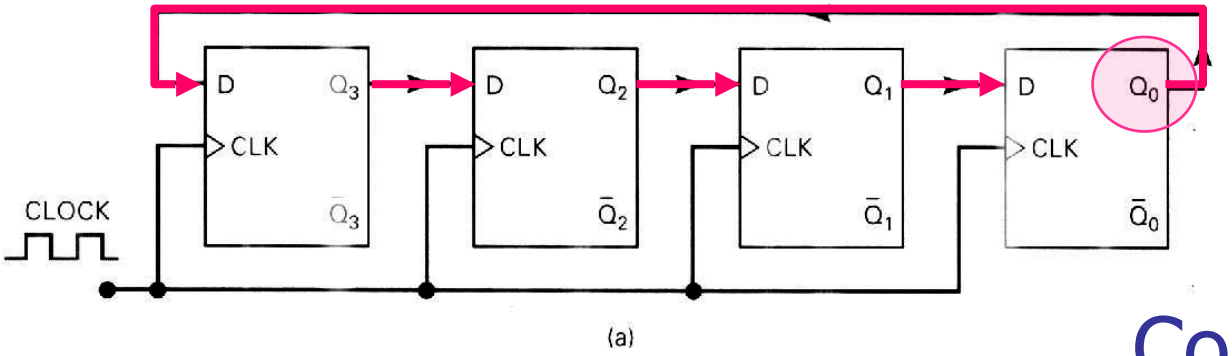
(c)



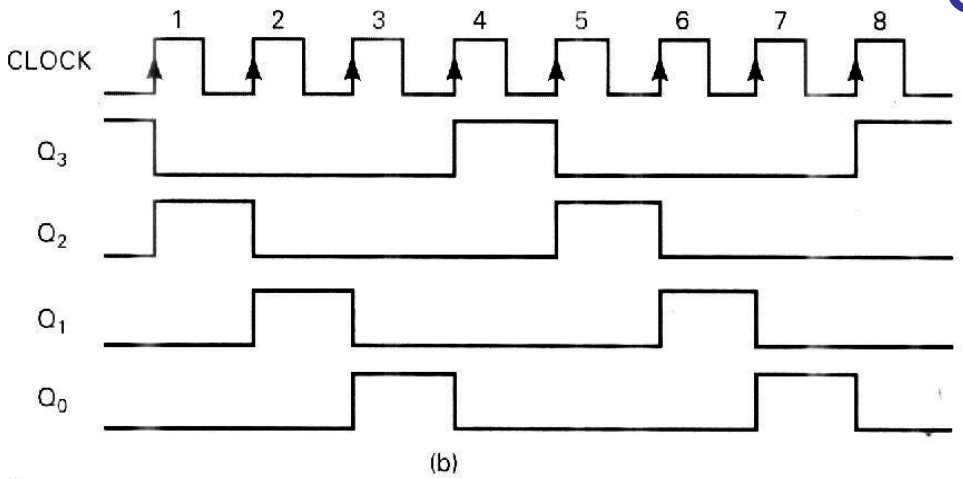
(d)

Figura:
(a) Contador en anel de 4 bits;
(b) Formas de onda;
(c) Sequencia de contagem;
(d) Diagrama de estados.

Contador em Anel 4 bits



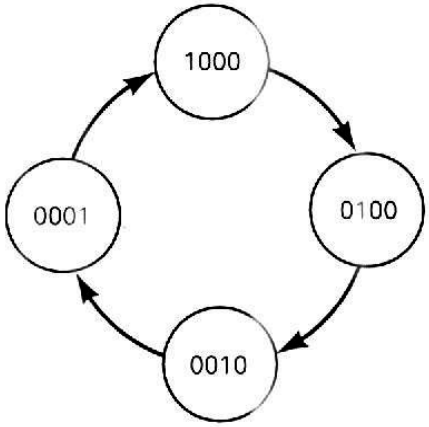
(a)



(b)

Q_3	Q_2	Q_1	Q_0	Pulso de CLOCK
1	0	0	0	0
0	1	0	0	1
0	0	1	0	2
0	0	0	1	3
1	0	0	0	4
0	1	0	0	5
0	0	1	0	6
0	0	0	1	7
.	.	.	.	.
.	.	.	.	.

(c)

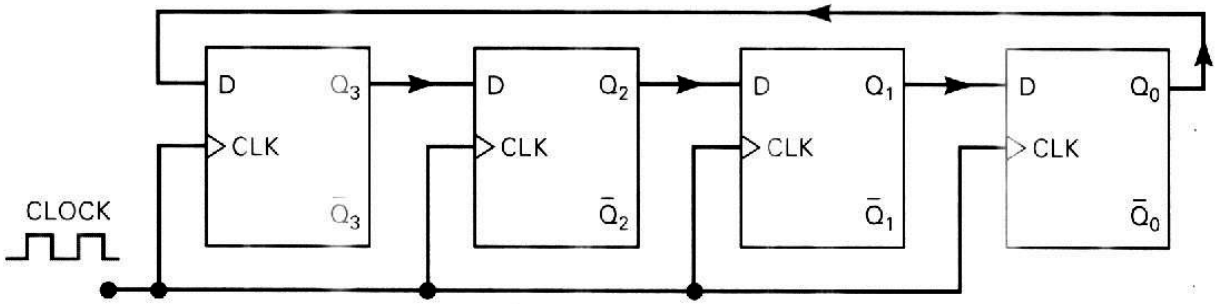


(d)

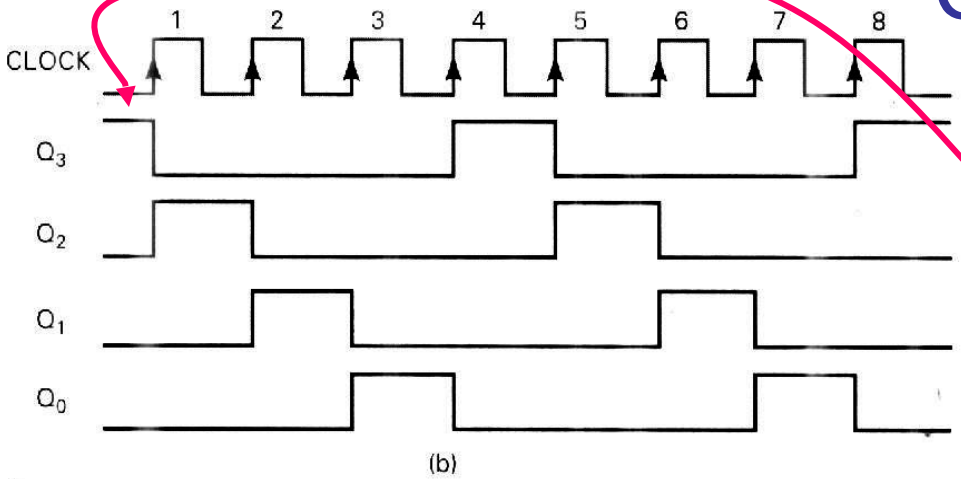
Fácil de obter: basta conectar as salidas dos FFs-D à entrada D do FF seguinte.

Figura:
(a) Contador en anel de 4 bits;
(b) Formas de onda;
(c) Sequencia de contagem;
(d) Diagrama de estados.

Contador em Anel 4 bits



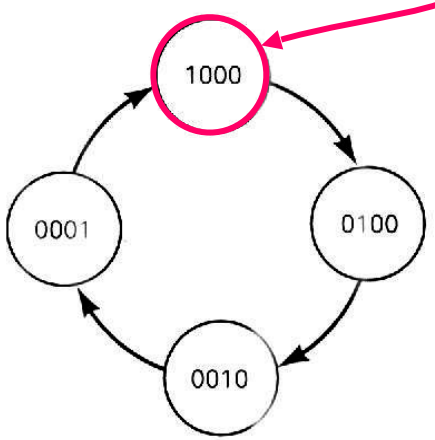
(a)



(b)

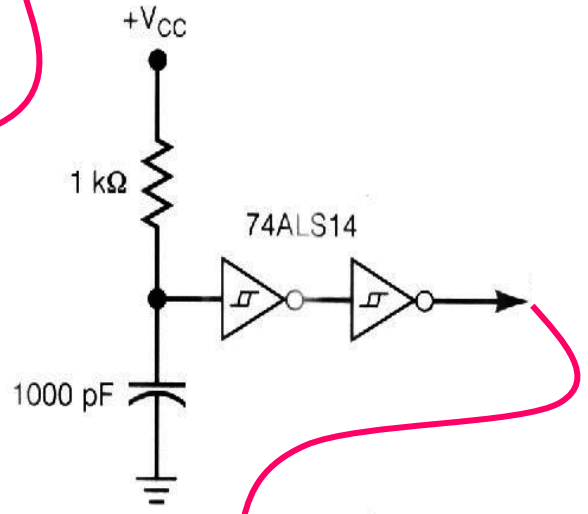
Q_3	Q_2	Q_1	Q_0	Pulso de CLOCK
1	0	0	0	0
0	1	0	0	1
0	0	1	0	2
0	0	0	1	3
1	0	0	0	4
0	1	0	0	5
0	0	1	0	6
0	0	0	1	7
.	.	.	.	.
.	.	.	.	.

(c)



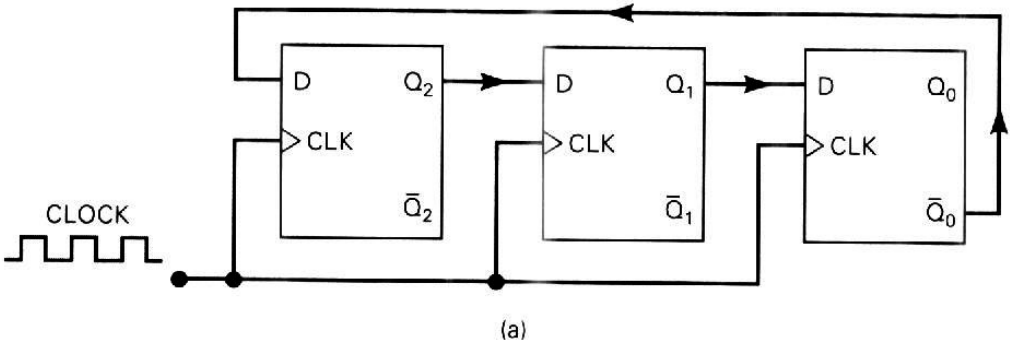
(d)

Problema: garantir este estado inicial

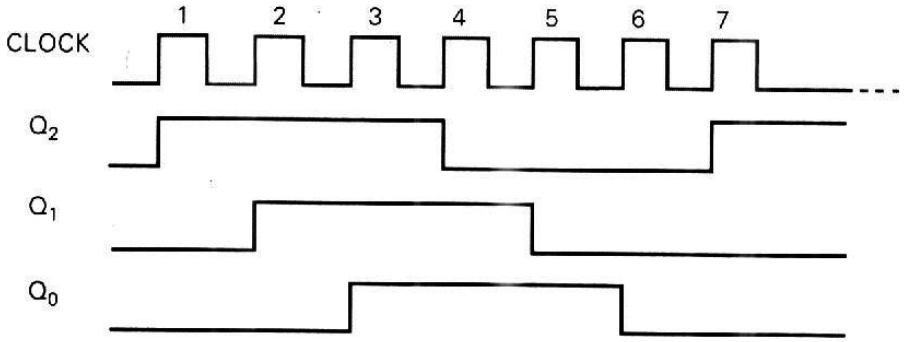


Para as entradas /PRE de Q3 y / CLR de Q2, Q1 e Q0 da figura (a).

Contador Johnson



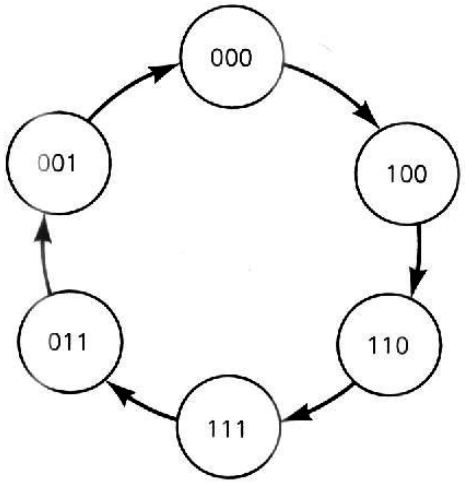
(a)



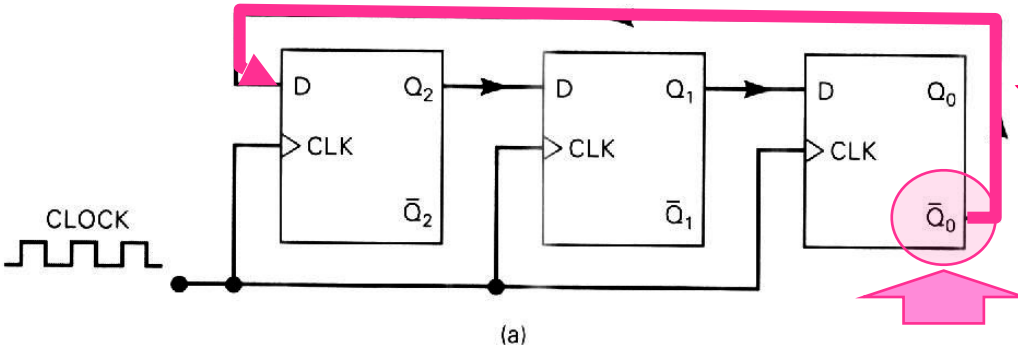
(b)

Q_2	Q_1	Q_0	Pulso de CLOCK
0	0	0	0
1	0	0	1
1	1	0	2
1	1	1	3
0	1	1	4
0	0	1	5
0	0	0	6
1	0	0	7
1	1	0	8
.	.	.	.
.	.	.	.
.	.	.	.

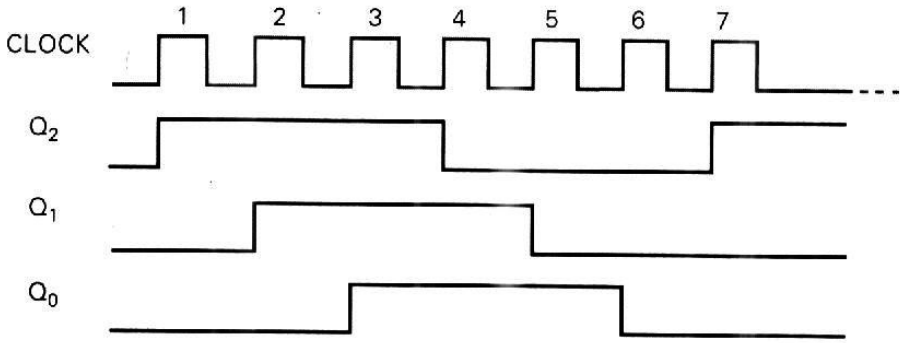
(c)



(d)



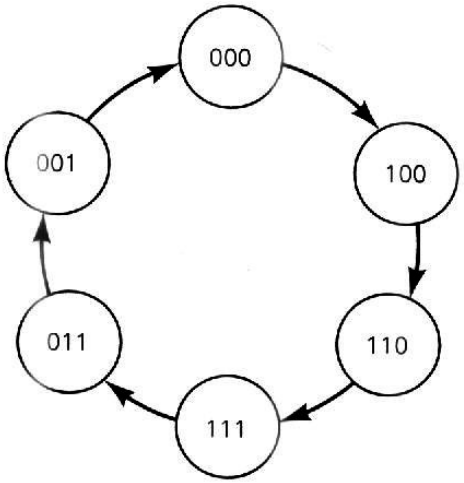
(a)



(b)

Q_2	Q_1	Q_0	Pulso de CLOCK
0	0	0	0
1	0	0	1
1	1	0	2
1	1	1	3
0	1	1	4
0	0	1	5
0	0	0	6
1	0	0	7
1	1	0	8
.	.	.	.
.	.	.	.
.	.	.	.

(c)

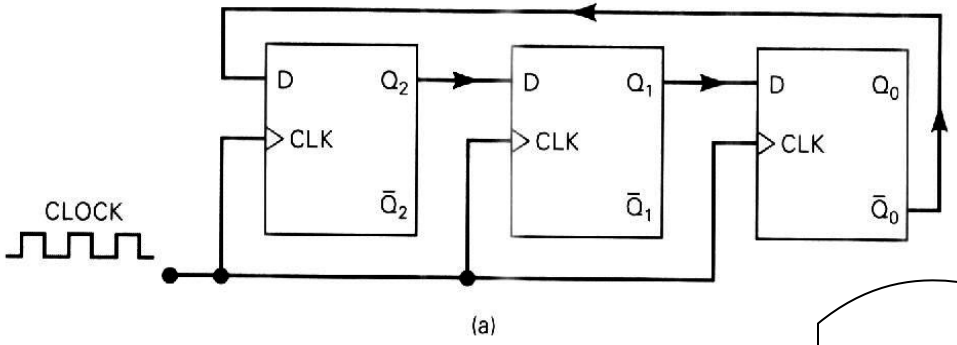


(d)

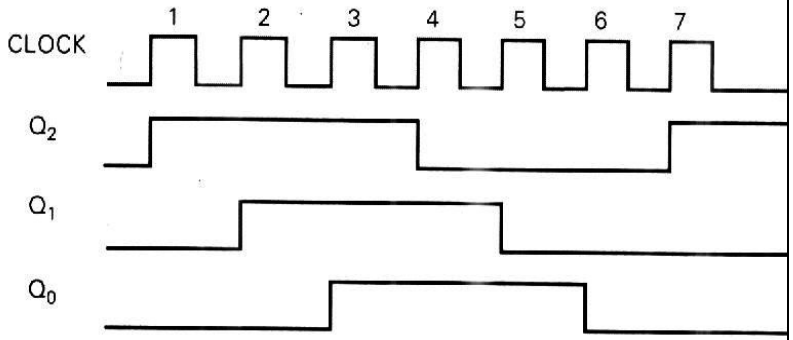
Contador Johnson

Fácil de obtener: basta conectar a entrada D do primero FF-D do contador ao complemento da saída do ultimo FF do contador.

Aplicação ref. Contador Johnson:



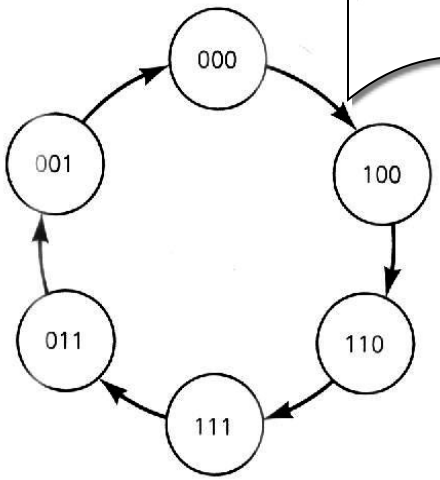
(a)



(b)

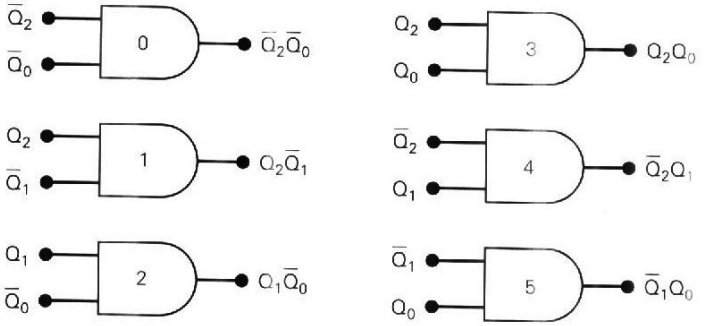
Q_2	Q_1	Q_0	Pulso de CLOCK
0	0	0	0
1	0	0	1
1	1	0	2
1	1	1	3
0	1	1	4
0	0	1	5
0	0	0	6
1	0	0	7
1	1	0	8
.	.	.	.
.	.	.	.
.	.	.	.

(c)



(d)

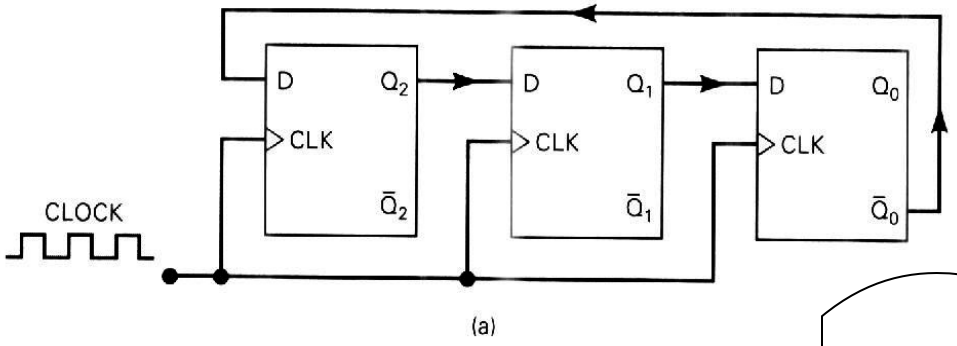
Contador com saídas decodificadas:



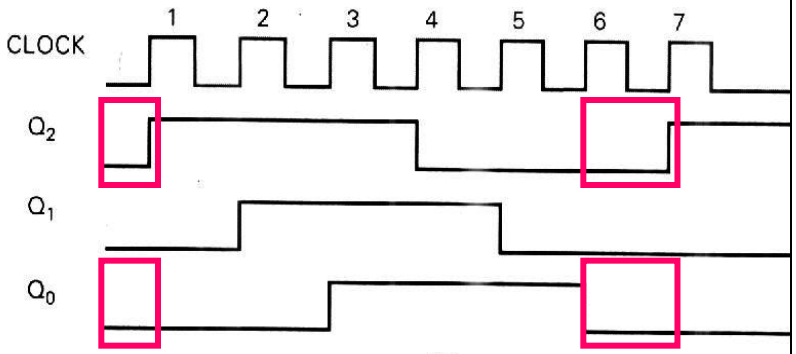
Q_2	Q_1	Q_0	Porta ativa
0	0	0	0
1	0	0	1
1	1	0	2
1	1	1	3
0	1	1	4
0	0	1	5

FIGURA 7.43 Lógica de decodificação para um contador Johnson de módulo 6.

Aplicação ref. Contador Johnson:



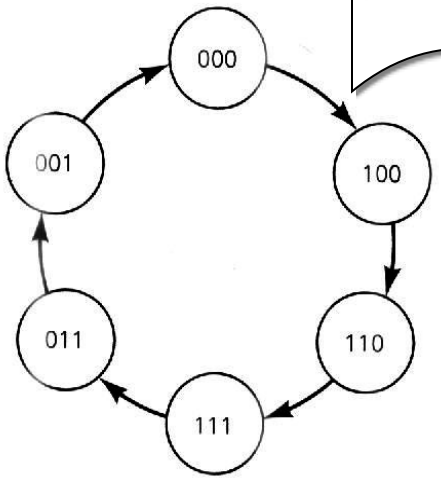
(a)



(b)

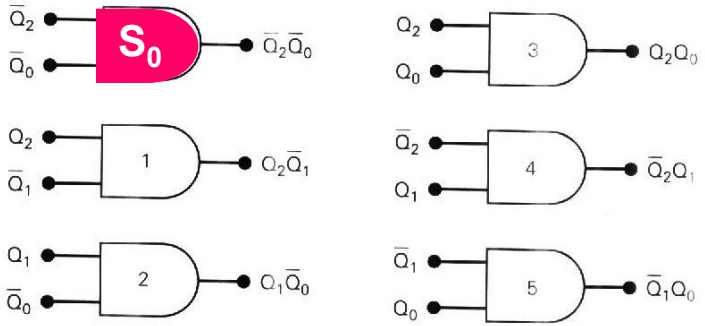
Q_2	Q_1	Q_0	Pulso de CLOCK
0	0	0	0
1	0	0	1
1	1	0	2
1	1	1	3
0	1	1	4
0	0	1	5
0	0	0	6
1	0	0	7
1	1	0	8
.	.	.	.
.	.	.	.
.	.	.	.

(c)



(d)

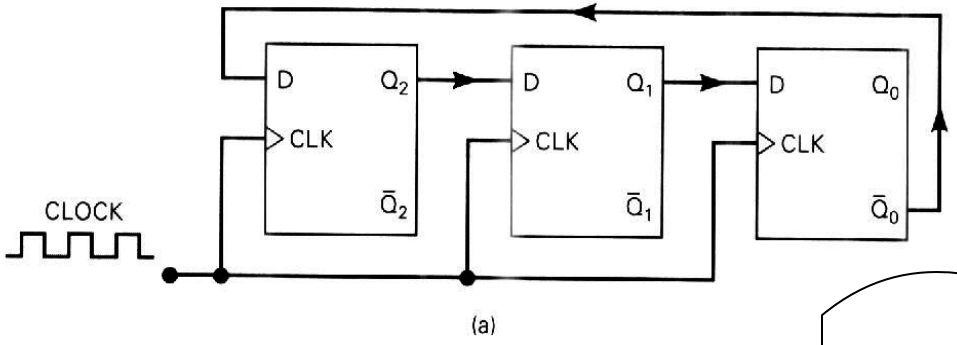
Contador com saídas decodificadas:



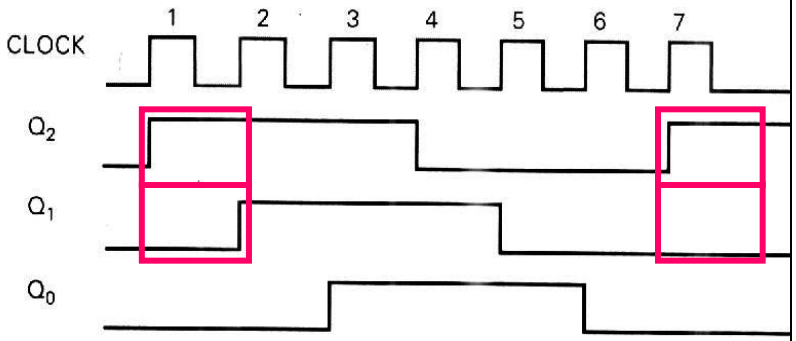
Q_2	Q_1	Q_0	Porta ativa
0	0	0	0
1	0	0	1
1	1	0	2
1	1	1	3
0	1	1	4
0	0	1	5

FIGURA 7.43 Lógica de decodificação para um contador Johnson de módulo 6.

Aplicação ref. Contador Johnson:

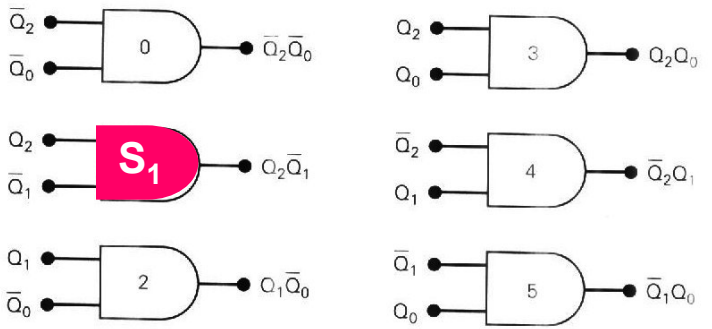


(a)



(b)

Contador com saídas decodificadas:

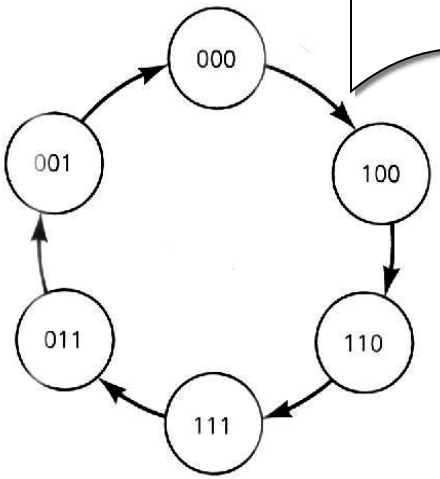


Q_2	Q_1	Q_0	Porta ativa
0	0	0	0
1	0	0	1
1	1	0	2
1	1	1	3
0	1	1	4
0	0	1	5

FIGURA 7.43 Lógica de decodificação para um contador Johnson de módulo 6.

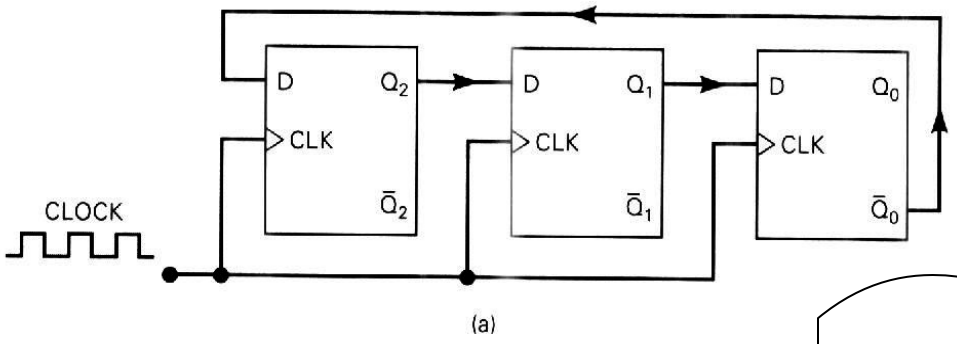
Q_2	Q_1	Q_0	Pulso de CLOCK
0	0	0	0
1	0	0	1
1	1	0	2
1	1	1	3
0	1	1	4
0	0	1	5
0	0	0	6
1	0	0	7
1	1	0	8
.	.	.	.
.	.	.	.
.	.	.	.

(c)

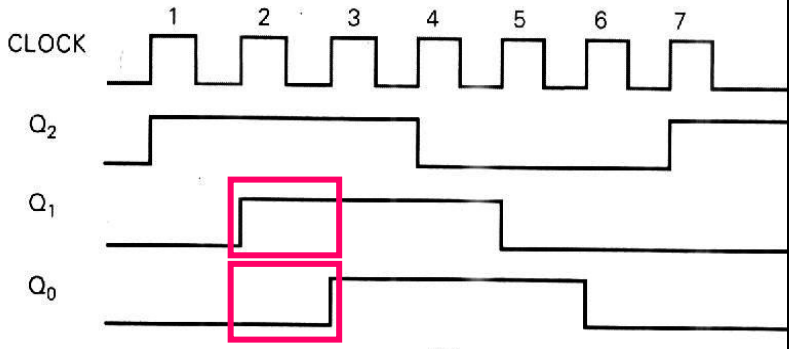


(d)

Aplicação ref. Contador Johnson:



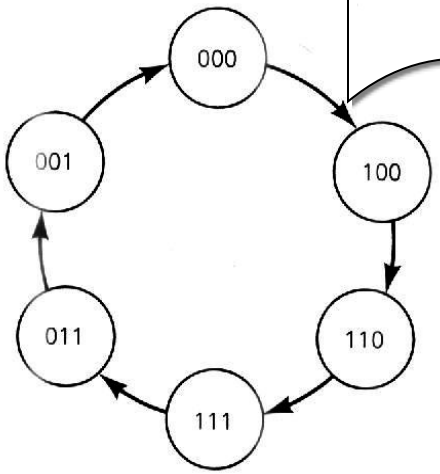
(a)



(b)

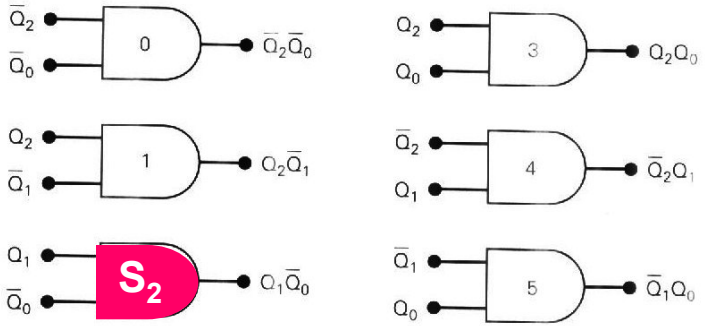
Q_2	Q_1	Q_0	Pulso de CLOCK
0	0	0	0
1	0	0	1
1	1	0	2
1	1	1	3
0	1	1	4
0	0	1	5
0	0	0	6
1	0	0	7
1	1	0	8
.	.	.	.
.	.	.	.
.	.	.	.

(c)



(d)

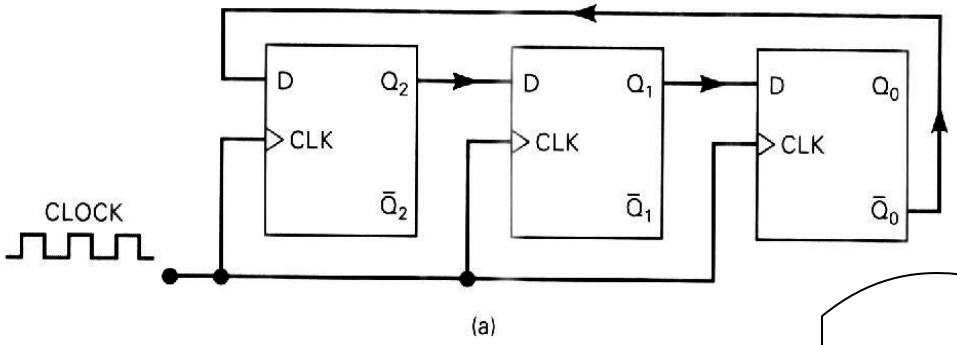
Contador com saídas decodificadas:



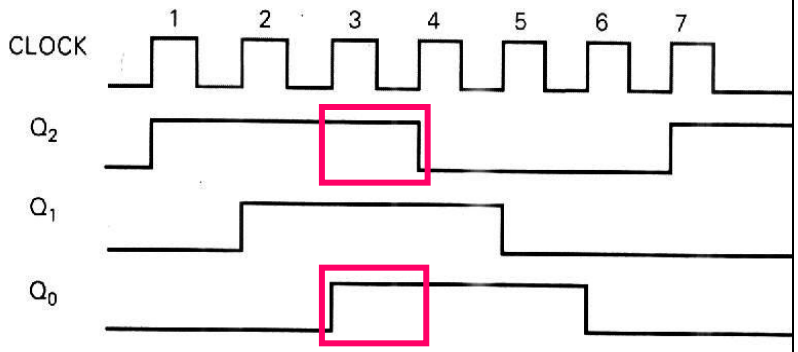
Q_2	Q_1	Q_0	Porta ativa
0	0	0	0
1	0	0	1
1	1	0	2
1	1	1	3
0	1	1	4
0	0	1	5

FIGURA 7.43 Lógica de decodificação para um contador Johnson de módulo 6.

Aplicação ref. Contador Johnson:



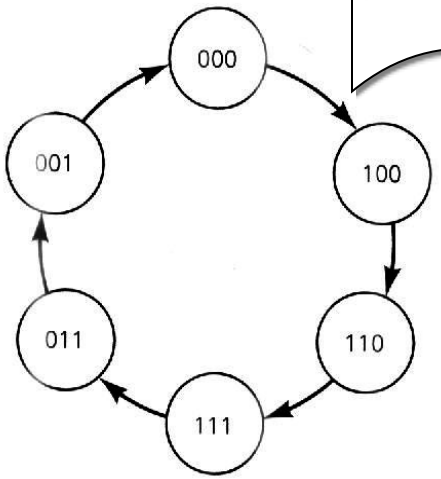
(a)



(b)

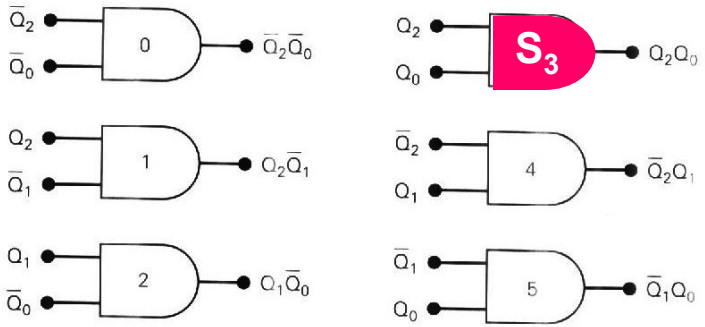
Q_2	Q_1	Q_0	Pulso de CLOCK
0	0	0	0
1	0	0	1
1	1	0	2
1	1	1	3
0	1	1	4
0	0	1	5
0	0	0	6
1	0	0	7
1	0	0	8
.	.	.	.
.	.	.	.
.	.	.	.

(c)



(d)

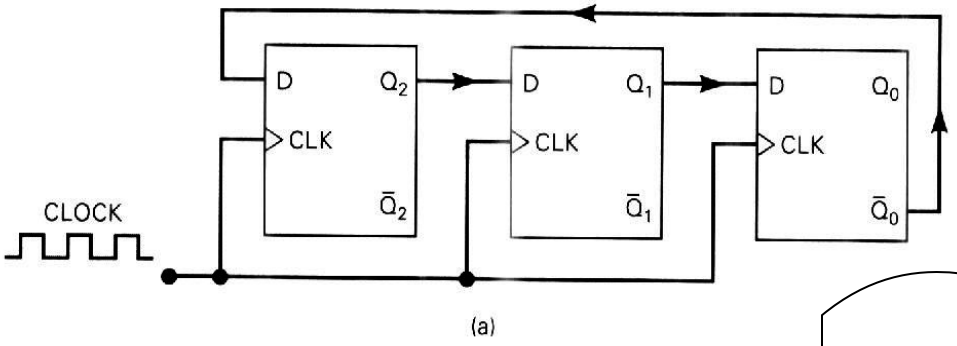
Contador com saídas decodificadas:



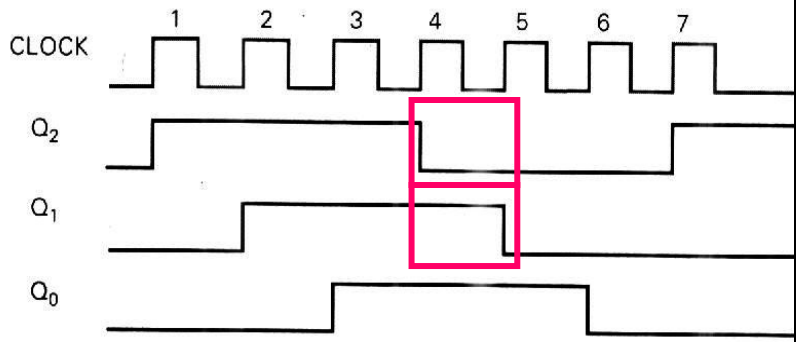
Q_2	Q_1	Q_0	Porta ativa
0	0	0	0
1	0	0	1
1	1	0	2
1	1	1	3
0	1	1	4
0	0	1	5

FIGURA 7.43 Lógica de decodificação para um contador Johnson de módulo 6.

Aplicação ref. Contador Johnson:



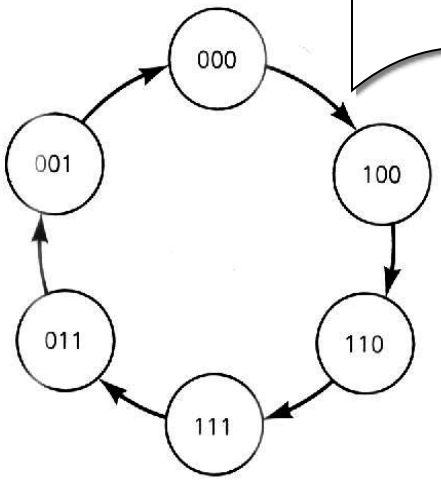
(a)



(b)

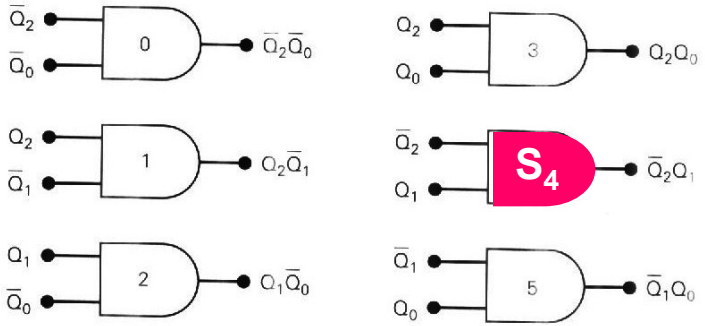
Q_2	Q_1	Q_0	Pulso de CLOCK
0	0	0	0
1	0	0	1
1	1	0	2
1	1	1	3
0	1	1	4
0	0	1	5
0	0	0	6
1	0	0	7
1	1	0	8
.	.	.	.
.	.	.	.
.	.	.	.

(c)



(d)

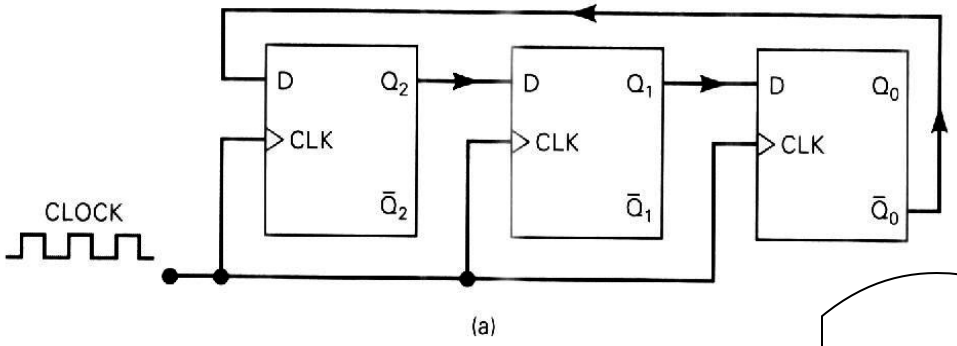
Contador com saídas decodificadas:



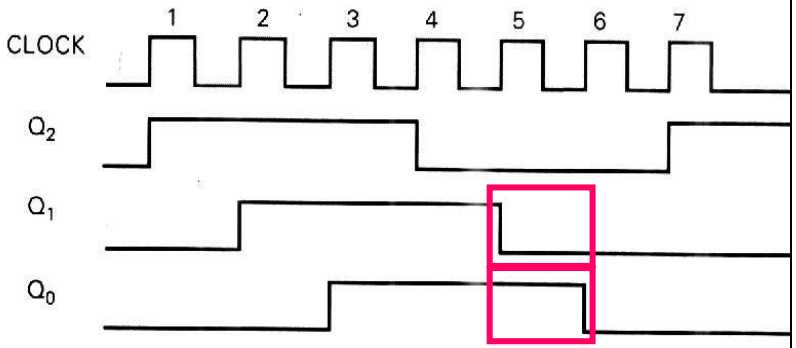
Q_2	Q_1	Q_0	Porta ativa
0	0	0	0
1	0	0	1
1	1	0	2
1	1	1	3
0	1	1	4
0	0	1	5

FIGURA 7.43 Lógica de decodificação para um contador Johnson de módulo 6.

Aplicação ref. Contador Johnson:

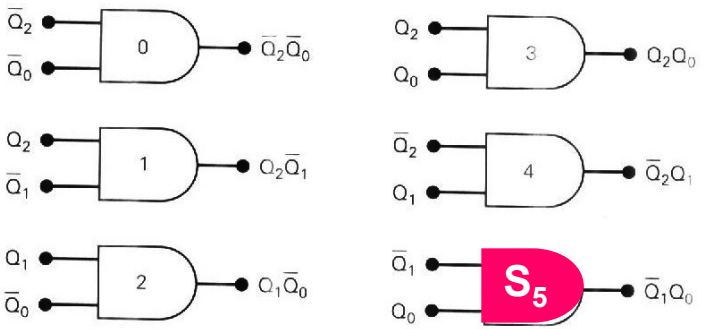


(a)



(b)

Contador com saídas decodificadas:

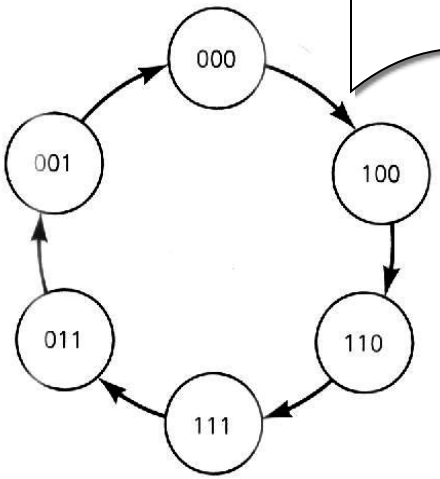


Q_2	Q_1	Q_0	Porta ativa
0	0	0	0
1	0	0	1
1	1	0	2
1	1	1	3
0	1	1	4
0	0	1	5

FIGURA 7.43 Lógica de decodificação para um contador Johnson de módulo 6.

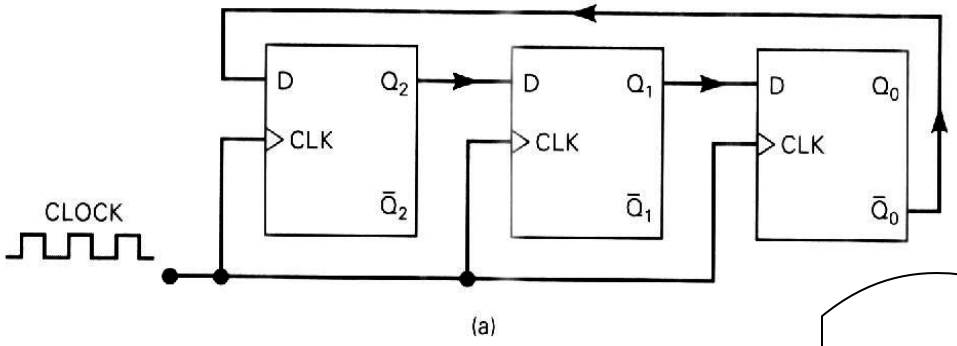
Q_2	Q_1	Q_0	Pulso de CLOCK
0	0	0	0
1	0	0	1
1	1	0	2
1	1	1	3
0	1	1	4
0	0	1	5
0	0	0	6
1	0	0	7
1	1	0	8
.	.	.	.
.	.	.	.
.	.	.	.

(c)

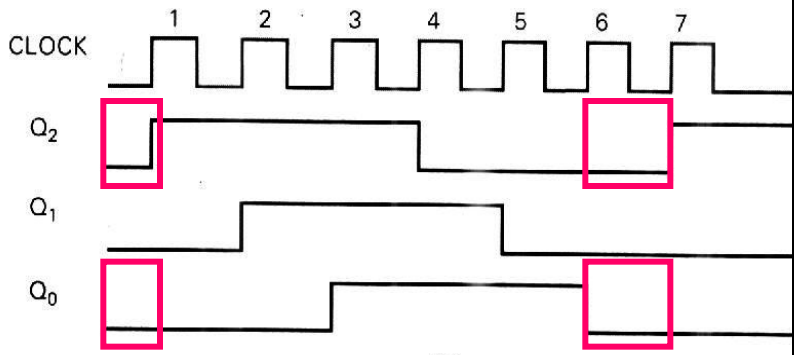


(d)

Aplicação ref. Contador Johnson:



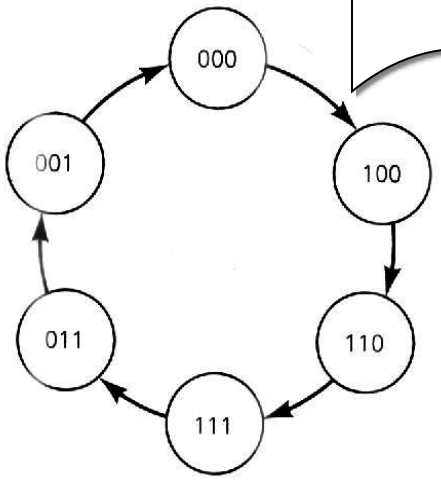
(a)



(b)

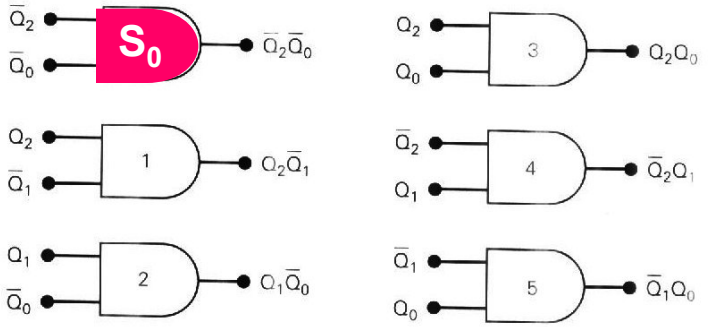
Q_2	Q_1	Q_0	Pulso de CLOCK
0	0	0	0
1	0	0	1
1	1	0	2
1	1	1	3
0	1	1	4
0	0	1	5
0	0	0	6
1	0	0	7
1	1	0	8
.	.	.	.
.	.	.	.
.	.	.	.

(c)



(d)

Contador com saídas decodificadas:

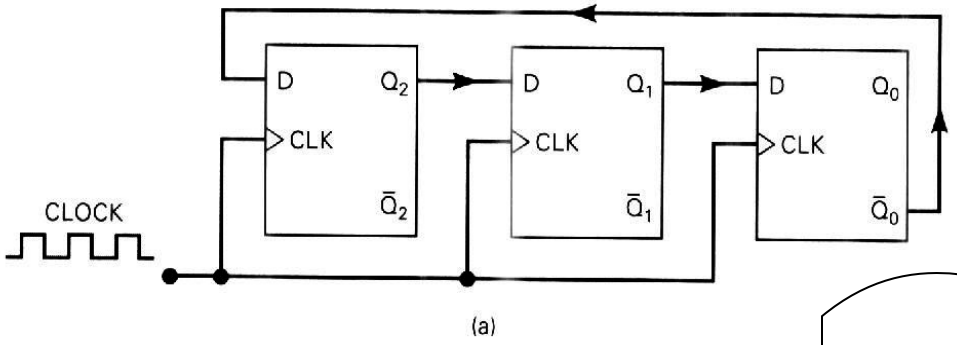


Q_2	Q_1	Q_0	Porta ativa
0	0	0	0
1	0	0	1
1	1	0	2
1	1	1	3
0	1	1	4
0	0	1	5

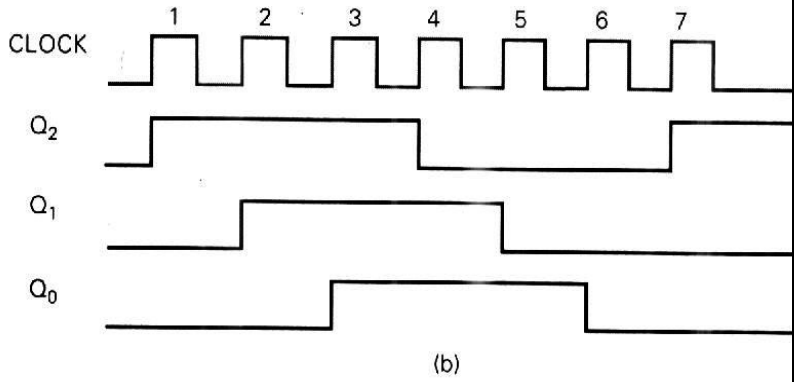
FIGURA 7.43 Lógica de decodificação para um contador Johnson de módulo 6.

Notar que **no importa la cuantidad de estados** del contador Johnson, siempre se puede decodificar sus salidas usando solamente puertas AND de 2 entradas!

Aplicação ref. Contador Johnson:

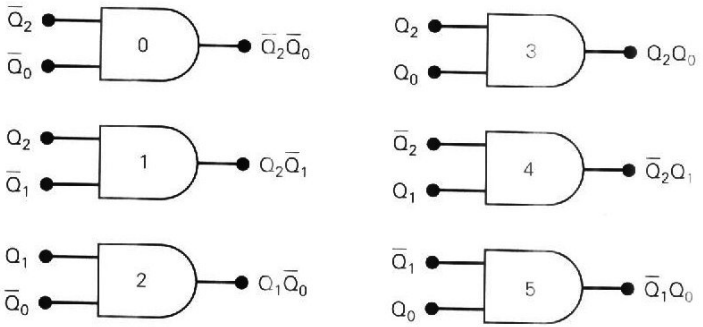


(a)



(b)

Contador com saídas decodificadas:

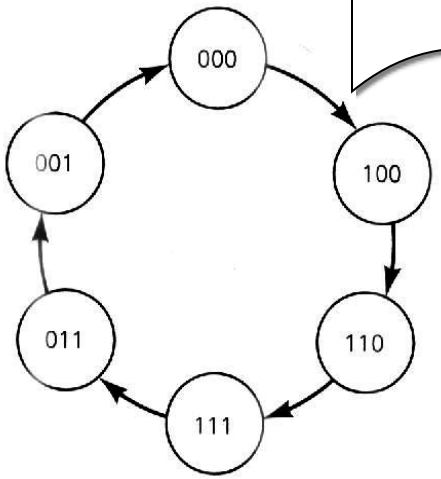


Q_2	Q_1	Q_0	Porta ativa
0	0	0	0
1	0	0	1
1	1	0	2
1	1	1	3
0	1	1	4
0	0	1	5

FIGURA 7.43 Lógica de decodificação para um contador Johnson de módulo 6.

Q_2	Q_1	Q_0	Pulso de CLOCK
0	0	0	0
1	0	0	1
1	1	0	2
1	1	1	3
0	1	1	4
0	0	1	5
0	0	0	6
1	0	0	7
1	1	0	8
.	.	.	.
.	.	.	.
.	.	.	.

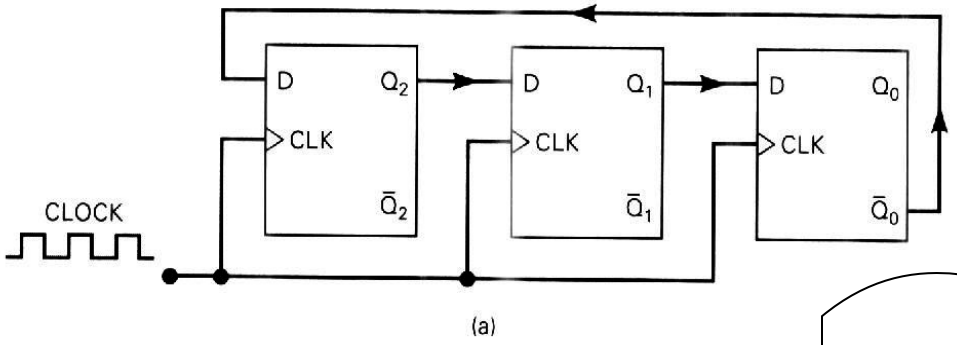
(c)



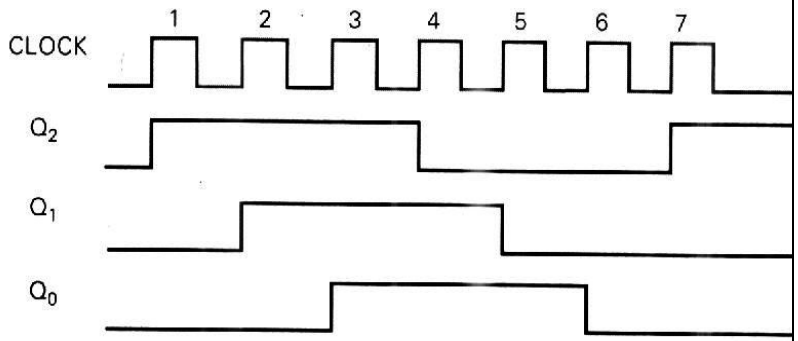
(d)

Vantagens:
Não ocorrem os problemas de *glitches* comun aos contadores asíncronos com saídas decodificadas.

Aplicação ref. Contador Johnson:



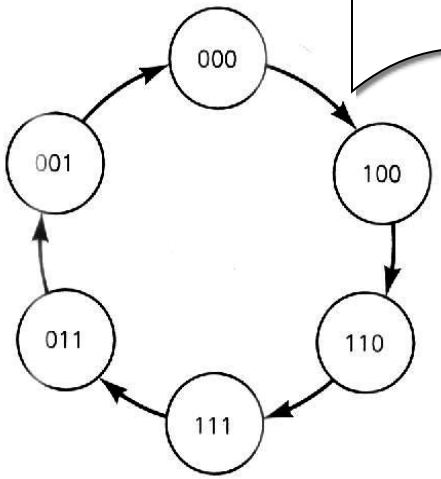
(a)



(b)

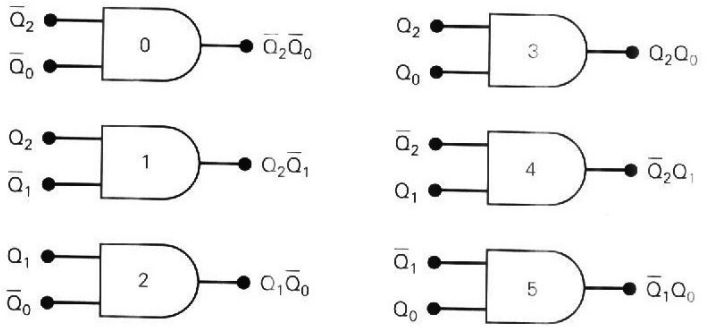
Q_2	Q_1	Q_0	Pulso de CLOCK
0	0	0	0
1	0	0	1
1	1	0	2
1	1	1	3
0	1	1	4
0	0	1	5
0	0	0	6
1	0	0	7
1	1	0	8
.	.	.	.
.	.	.	.
.	.	.	.

(c)



(d)

Contador com saídas decodificadas:



Q_2	Q_1	Q_0	Porta ativa
0	0	0	0
1	0	0	1
1	1	0	2
1	1	1	3
0	1	1	4
0	0	1	5

FIGURA 7.43 Lógica de decodificação para um contador Johnson de módulo 6.

Notar também que ***n* estados** para un contador Johnson implica en **2×*n* FFs**.

CI de contador Jonhson com saídas decodificadas:

FAIRCHILD SEMICONDUCTOR™

October 1987
Revised January 1999

CD4017BC • CD4022BC

Decade Counter/Divider with 10 Decoded Outputs • Divide-by-8 Counter/Divider with 8 Decoded Outputs

General Description

The CD4017BC is a 5-stage divide-by-10 Johnson counter with 10 decoded outputs and a carry out bit.

The CD4022BC is a 4-stage divide-by-8 Johnson counter with 8 decoded outputs and a carry-out bit.

These counters are cleared to their zero count by a logical "1" on their reset line. These counters are advanced on the positive edge of the clock signal when the clock enable signal is in the logical "0" state.

The configuration of the CD4017BC and CD4022BC permits medium speed operation and assures a hazard free counting sequence. The 10/8 decoded outputs are normally in the logical "0" state and go to the logical "1" state only at their respective time slot. Each decoded output remains high for 1 full clock cycle. The carry-out signal completes a full cycle for every 10/8 clock input cycles and is used as a ripple carry signal to any succeeding stages.

Features

- Wide supply voltage range: 3.0V to 15V
- High noise immunity: 0.45 V_{DD} (typ.)
- Low power TTL compatibility: Fan out of 2 driving 74L or 1 driving 74LS
- Medium speed operation: 5.0 MHz (typ.) with 10V V_{DD}
- Low power: 10 µW (typ.)
- Fully static operation

Applications

- Automotive
- Instrumentation
- Medical electronics
- Alarm systems
- Industrial electronics
- Remote metering

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SEMICONDUCTOR™

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CI de contador Jonhson com saídas decodificadas:

General Description

The CD4017BC is a 5-stage divide-by-10 Johnson counter with 10 decoded outputs and a carry out bit.

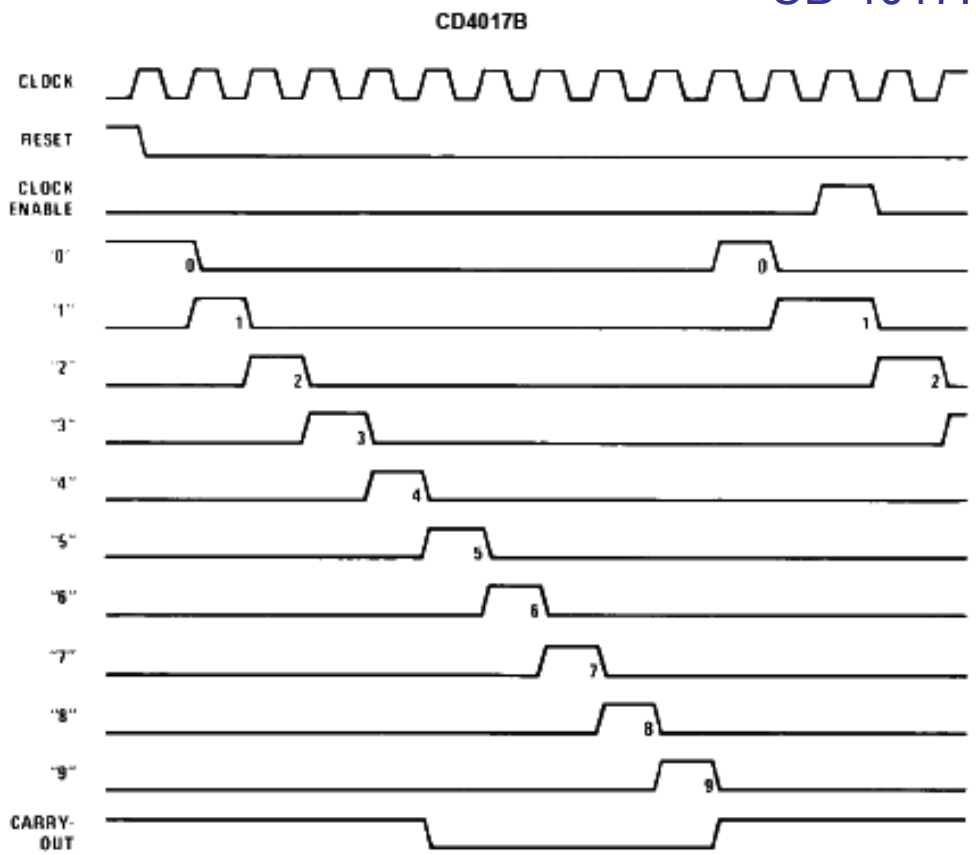
The CD4022BC is a 4-stage divide-by-8 Johnson counter with 8 decoded outputs and a carry-out bit.

These counters are cleared to their zero count by a logical "1" on their reset line. These counters are advanced on the positive edge of the clock signal when the clock enable signal is in the logical "0" state.

The configuration of the CD4017BC and CD4022BC permits medium speed operation and assures a hazard free counting sequence. The 10/8 decoded outputs are normally in the logical "0" state and go to the logical "1" state only at their respective time slot. Each decoded output remains high for 1 full clock cycle. The carry-out signal completes a full cycle for every 10/8 clock input cycles and is used as a ripple carry signal to any succeeding stages.

Timing Diagrams

CD 4017:



FAIRCHILD
SEMICONDUCTOR™

October 1987
Revised January 1999

CD4017BC • CD4022BC

Decade Counter/Divider with 10 Decoded Outputs • Divide-by-8 Counter/Divider with 8 Decoded Outputs

General Description

The CD4017BC is a 5-stage divide-by-10 Johnson counter with 10 decoded outputs and a carry out bit.

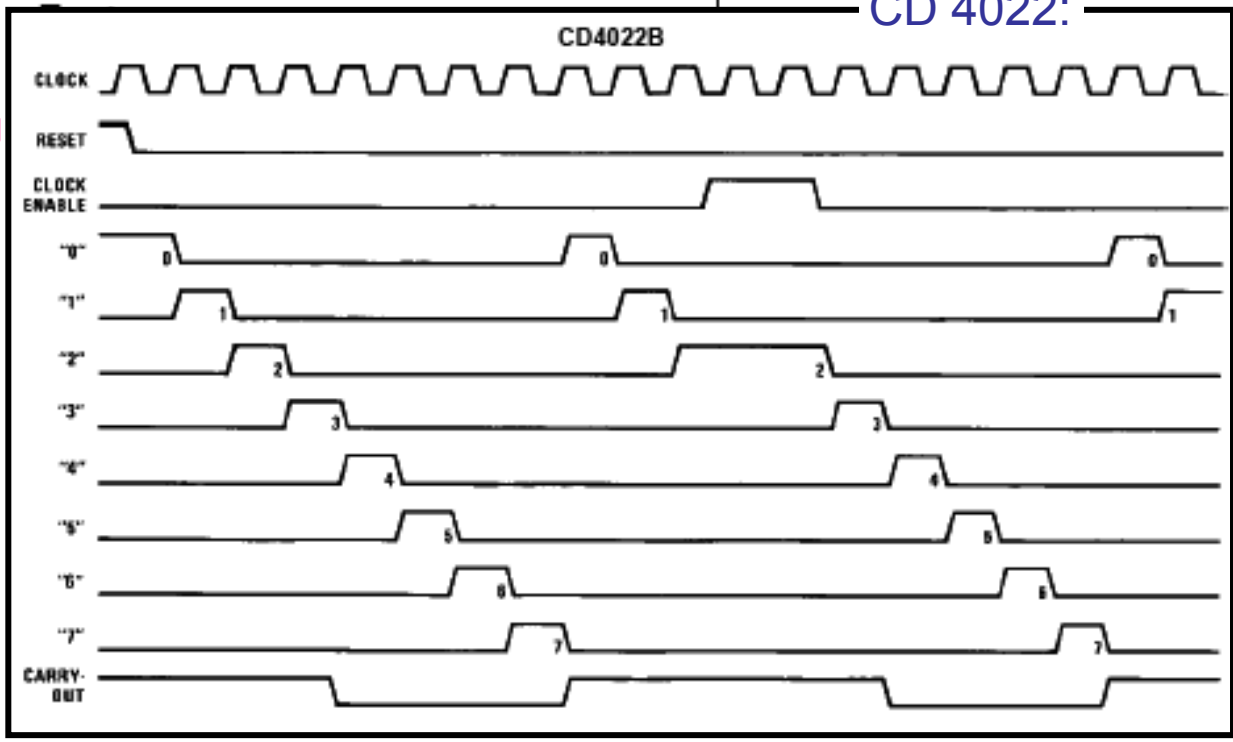
The CD4022BC is a 4-stage divide-by-8 Johnson counter with 8 decoded outputs and a carry-out bit.

These counters are cleared to their zero count by a logical "1" on their reset line. These counters are advanced on the positive edge of the clock signal when the clock enable signal is in the logical "0" state.

The configuration of the CD4017BC and CD4022BC permits medium speed operation and assures a hazard free counting sequence. The 10/8 decoded outputs are normally in the logical "0" state and go to the logical "1" state only at their respective time slot. Each decoded output remains high for 1 full clock cycle. The carry-out signal completes a full cycle for every 10/8 clock input cycles and is used as a ripple carry signal to any succeeding stages.

CI de contador Jonhson com saídas decodificadas:

CD 4022:



Contador (síncrono) com carga paralela de dados: