

# CONVERSION BETWEEN FLIP-FLOPS

ENT262 Digital Logic Design  
2019-Semester 1

- To convert between flip-flops
  - SR to JK
  - SR to D
  - JK to SR
  - JK to D
  - D to SR
  - D to JK

<http://www.circuitstoday.com/flip-flop-conversion>

Conversion Table

	J-K Inputs		Outputs		S-R Inputs	
	J	K	Q <sub>p</sub>	Q <sub>p+1</sub>	S	R
<b>NC</b>	0	0	0	0	0	X
	0	0	1	1	X	0
<b>RESET</b>	0	1	0	0	0	X
	0	1	1	0	0	1
<b>SET</b>	1	0	0	1	1	0
	1	0	1	1	X	0
<b>TOGGLE</b>	1	1	0	1	1	0
	1	1	1	0	0	1

	KQ <sub>p</sub>	00	01	11	10
J	0	0 <sup>0</sup>	X <sup>1</sup>	0 <sup>3</sup>	0 <sup>2</sup>
	1	1 <sup>4</sup>	X <sup>5</sup>	0 <sup>7</sup>	1 <sup>6</sup>

$$S = J\overline{Q}_P$$

	KQ <sub>p</sub>	00	01	11	10
J	0	X <sup>0</sup>	0 <sup>1</sup>	1 <sup>3</sup>	X <sup>2</sup>
	1	0 <sup>4</sup>	0 <sup>5</sup>	1 <sup>7</sup>	0 <sup>6</sup>

$$R = KQ_P$$

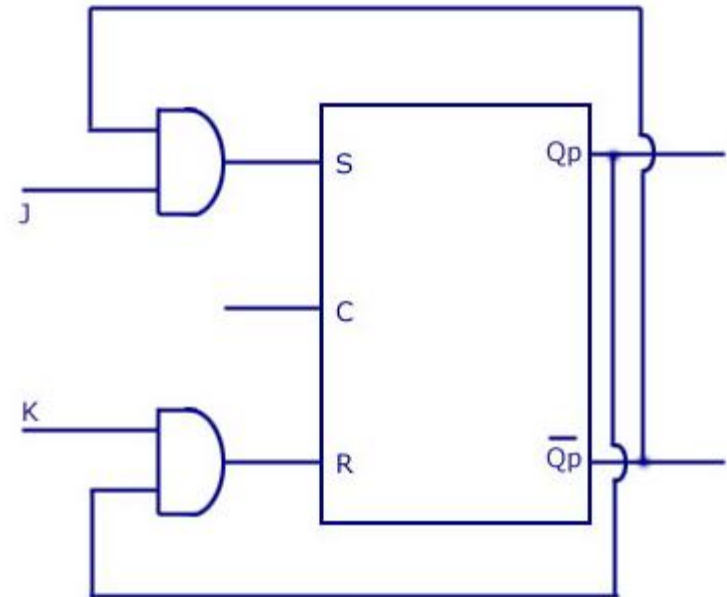
	KQ <sub>P</sub>			
J	00	01	11	10
0	0 <sup>0</sup>	X <sup>1</sup>	0 <sup>3</sup>	0 <sup>2</sup>
1	1 <sup>4</sup>	X <sup>5</sup>	0 <sup>7</sup>	1 <sup>6</sup>

$$S = \overline{J} \overline{Q_P}$$

	KQ <sub>P</sub>			
J	00	01	11	10
0	X <sup>0</sup>	0 <sup>1</sup>	1 <sup>3</sup>	X <sup>2</sup>
1	0 <sup>4</sup>	0 <sup>5</sup>	1 <sup>7</sup>	0 <sup>6</sup>

$$R = KQ_P$$

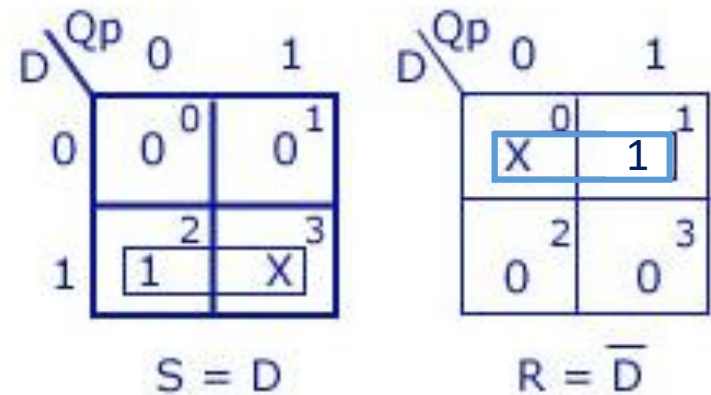
Logic Diagram



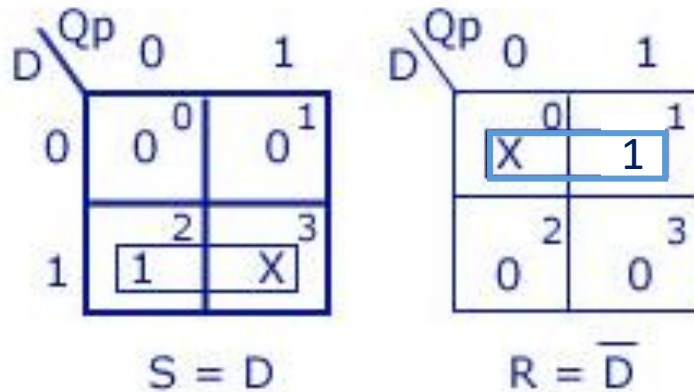
Conversion Table

	D Input	Outputs		S-R Inputs	
		$Q_p$	$Q_{p+1}$	S	R
<b>RESET</b>	0	0	0	0	X
	0	1	0	0	1
<b>SET</b>	1	0	1	1	0
	1	1	1	X	0

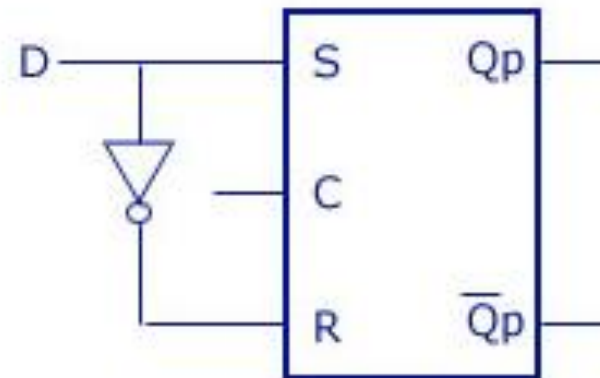
K-maps



K-maps



Logic Diagram



Conversion Table

S-R Inputs		Outputs		J-K Inputs	
S	R	Q <sub>p</sub>	Q <sub>p+1</sub>	J	K
0	0	0	0	0	X
0	0	1	1	X	0
0	1	0	0	0	X
0	1	1	0	X	1
1	0	0	1	1	X
1	0	1	1	X	0
1	1	Invalid		Dont care	
1	1	Invalid		Dont care	

NC

RESET

SET

INVALID

S		RQ <sub>p</sub>		00	01	11	10
		0	1	3	2		
0	0	X	X	0			
1	4	5	7	6			
	1	X	X	X			

J=S

S		RQ <sub>p</sub>		00	01	11	10
		0	1	3	2		
0	X	0	1	X			
1	4	5	7	6			
	X	0	X	X			

K=R

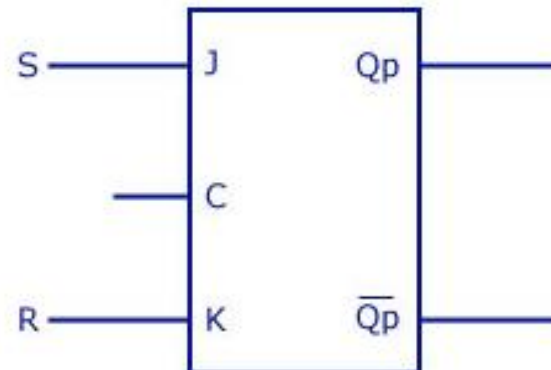
	RQp			
S	00	01	11	10
0	0 <sup>0</sup>	X <sup>1</sup>	X <sup>3</sup>	0 <sup>2</sup>
1	1 <sup>4</sup>	X <sup>5</sup>	X <sup>7</sup>	X <sup>6</sup>

$$J=S$$

	RQp			
S	00	01	11	10
0	X <sup>0</sup>	0 <sup>1</sup>	1 <sup>3</sup>	X <sup>2</sup>
1	X <sup>4</sup>	0 <sup>5</sup>	X <sup>7</sup>	X <sup>6</sup>

$$K=R$$

Logic Diagram





Conversion Table

	S-R Inputs		Outputs		D Input
	S	R	Q <sub>p</sub>	Q <sub>p+1</sub>	
<b>NC</b>	0	0	0	0	0
	0	0	1	1	1
<b>RESET</b>	0	1	0	0	0
	0	1	1	0	0
<b>SET</b>	1	0	0	1	1
	1	0	1	1	1
<b>INVALID</b>	1	1	Invalid		Dont care
	1	1	Invalid		Dont care

K-map

		RQ <sub>p</sub>			
		00	01	11	10
S	0	0	1	0	0
	1	1	1	X	X

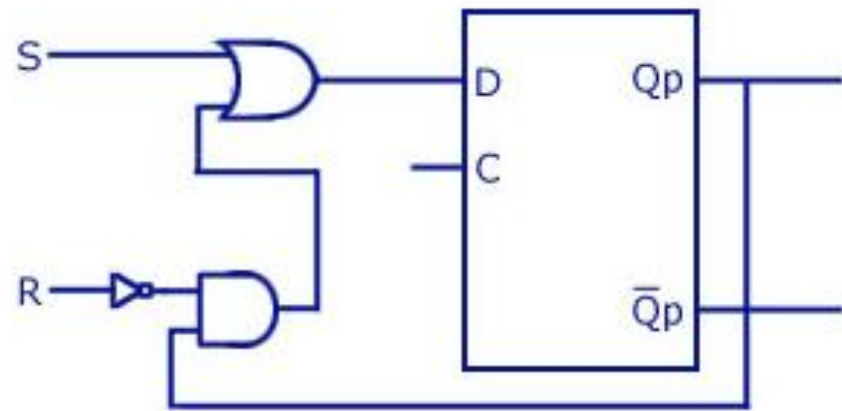
$$D = S + \bar{R}Q_n$$

K-map

	RQp			
	00	01	11	10
S				
0	0	1	0	0
1	1	1	X	X

$$D = S + \bar{R}Q_n$$

Logic Diagram



Conversion Table

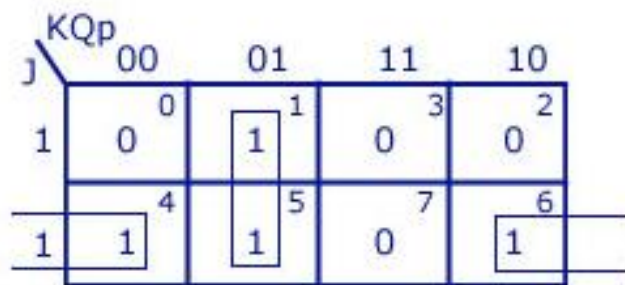
	J-K Input		Outputs		D Input
	J	K	Q <sub>p</sub>	Q <sub>p+1</sub>	
<b>NC</b>	0	0	0	0	0
	0	0	1	1	1
<b>RESET</b>	0	1	0	0	0
	0	1	1	0	0
<b>SET</b>	1	0	0	1	1
	1	0	1	1	1
<b>TOGGLE</b>	1	1	0	1	1
	1	1	1	0	0

K-map

		KQ <sub>p</sub>			
		00	01	11	10
J	1	0 <sup>0</sup>	1 <sup>1</sup>	0 <sup>3</sup>	0 <sup>2</sup>
	1	1 <sup>4</sup>	1 <sup>5</sup>	0 <sup>7</sup>	1 <sup>6</sup>

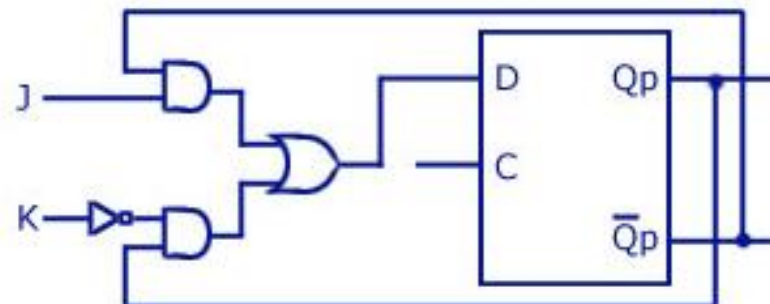
$$D = J\bar{Q}_p + \bar{K}Q_p$$

K-map

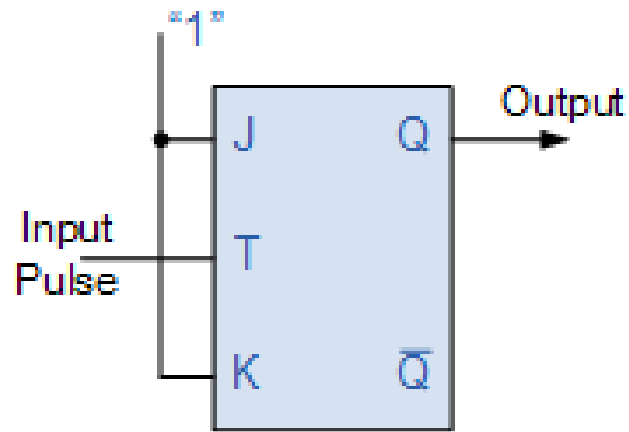


$$D = J\bar{Q}_p + \bar{K}Q_p$$

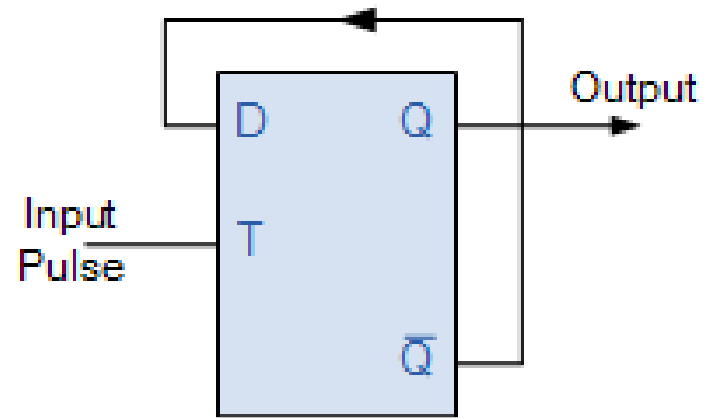
Logic Diagram



## Toggle Flip-Flop



JK Flip-flop  
Conversion



D-type Flip-flop  
Conversion