



Digital teknik

Lkaa

2008



Tal systemer

- 10 talssystemet
 - 0,1,2,3,4,5,6,7,8,9 (ti tal!)

Position	6	5	4	3	2	1	0
Tal:	2	4	3	7	1	9	6
	10^6	10^5	10^4	10^3	10^2	10^1	10^0



Binære tal

- Digitalteknik:
 - Binære talsystem eks: 1001B
 - Oktale talsystem eks: 162
 - Hexadecimale talsystem eks 10AH
- 4 bit = nibble
- 8 bit = byte
- 16 bit = word



Binære tal

Position	6	5	4	3	2	1	0
Tal:	1	0	1	1	0	1	0
	2^6	2^5	2^4	2^3	2^2	2^1	2^0
I alt: $90_{(10)}$	64	0(32)	16	8	0(4)	2	0(1)



Oktal talsystem

Binært	Oktalt	Decimalt
000	0	0
001	1	1
010	2	2
011	3	3
100	4	4
101	5	5
110	6	6
111	7	7
1000	10	8



Hexadecimal

- Tallene: 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F benyttes til Hex tal!

Position			4	3	2	1	0
Tal: 2F4AH				2	F	4	A
			16^4	16^3	16^2	16^1	16^0
			65536	4096	256	16	1
I alt: $12106_{(10)}$				8192	3840	64	10



Omsætning mellem talsystemer

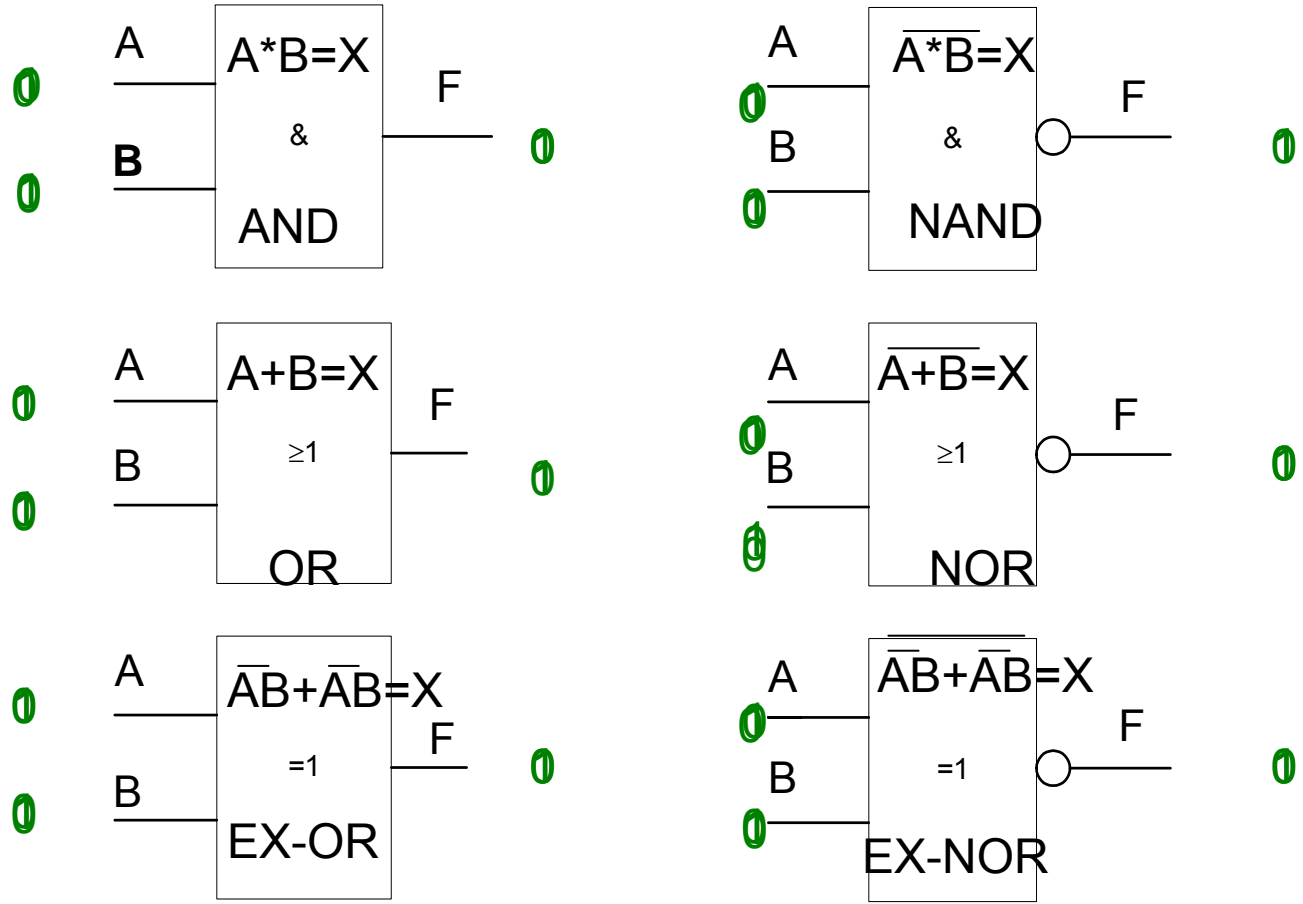
- Omsæt 27_{10} til binærtal

1 1 0 1 1
MSB
LSB

	27
-	16
rest	11
-	8
rest	3
	4
rest	3
-	2
rest	1
	1
	0

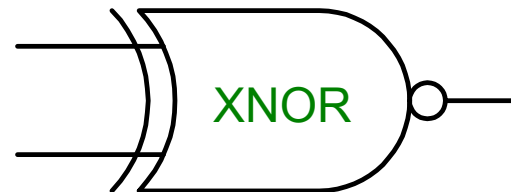
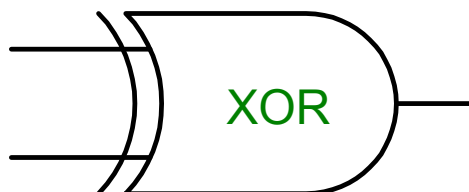
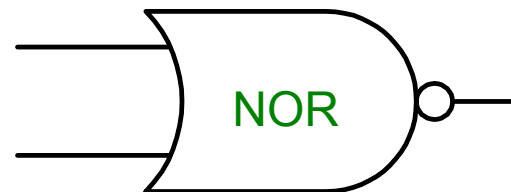
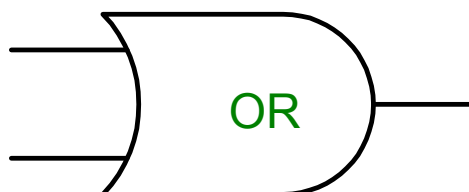
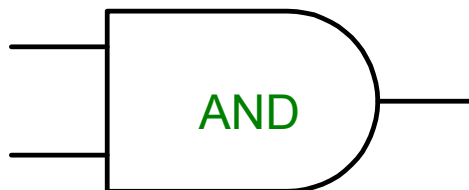


Logiske gates



Logiske gates

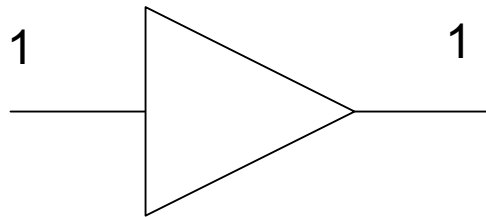
Amerikanske symboler



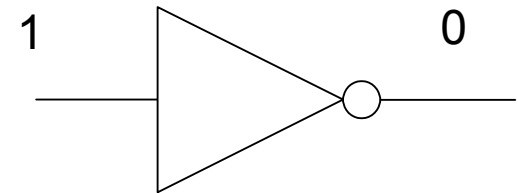


Buffer & inverter

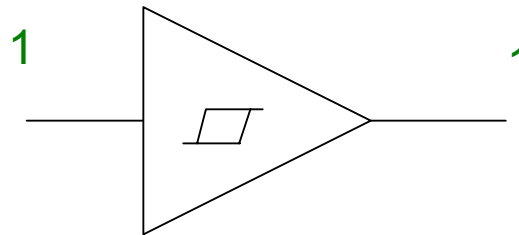
Buffer



Inverter



Schmitt-trigger



Retter flanker op!



Flip-flop

- Flip-flop ændre ikke tilstand på udgangen, selvom indgangs signalet ”fjernes”
- FF husker sit udgangs tilstand!!!
- Gates følger indgangs signalerne



Flip-flop

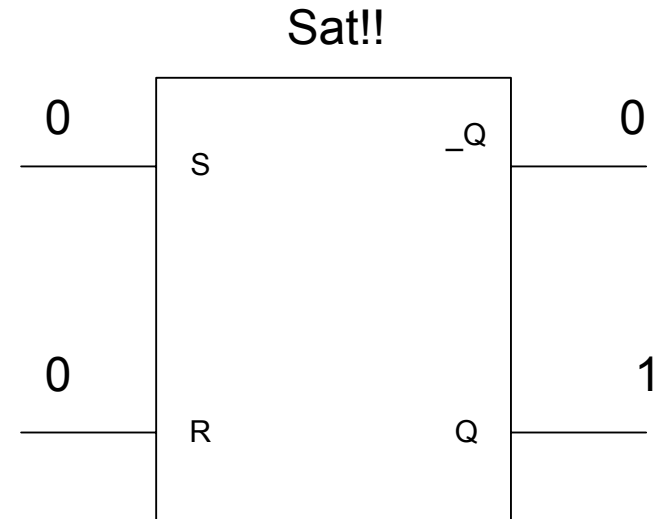
- FF udgang: Q og \overline{Q}
- \overline{Q} er negeret i forhold til Q

Indg	Udg. Q	Udg. \overline{Q}
1	1	0
0	0	1



RS Flip-flop

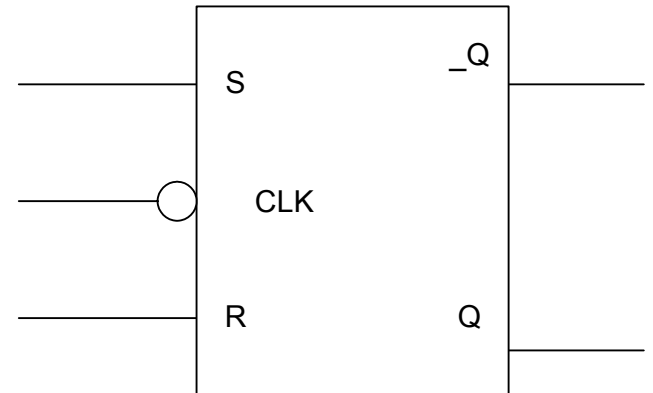
R	S	Q	\overline{Q}	
0	1	0	1	
1	0	1	0	
0	0	Q_n	$\overline{Q_n}$	Låst
1	1	1	1	Udef.



Implus styret RS-FF



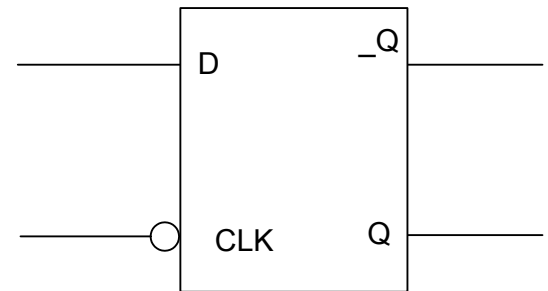
S	R	C	Q	\overline{Q}	
X	X	0	Q_n	Q_n	Låst
0	0	1	Q_n	Q_n	Låst
0	1	1	0	1	
1	0	1	1	0	
1	1	1	1	1	Udef.





D-FF

D	C	Q	\overline{Q}	
X	0	Q_n	Q_n	Låst
0	1	0	1	
1	1	1	0	

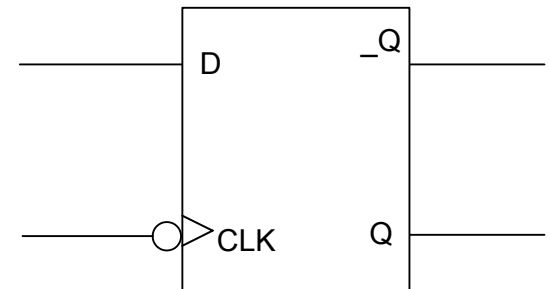




D-FF positiv flanke

- Skiftet sker når C går op

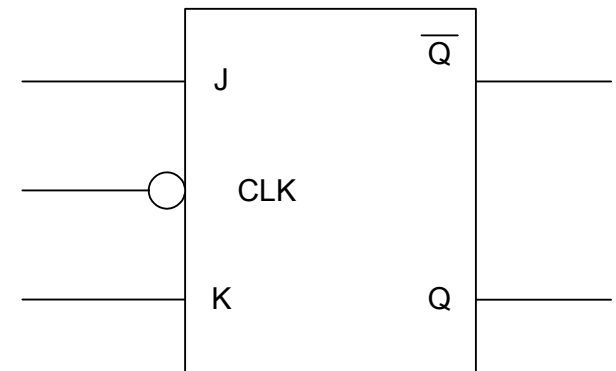
D	C	Q	\overline{Q}	
X	0	Q_n	Q_n	Låst
0	↑	0	1	
1	↑	1	0	





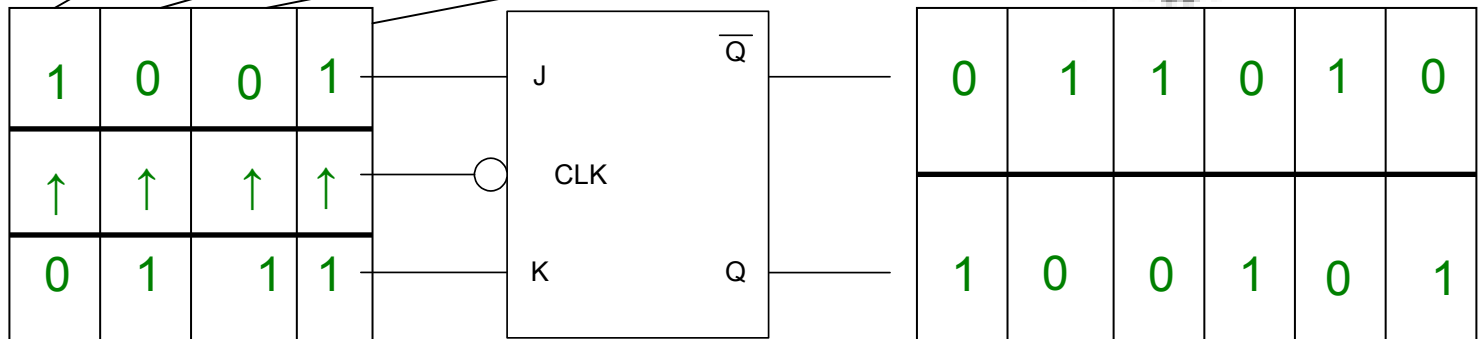
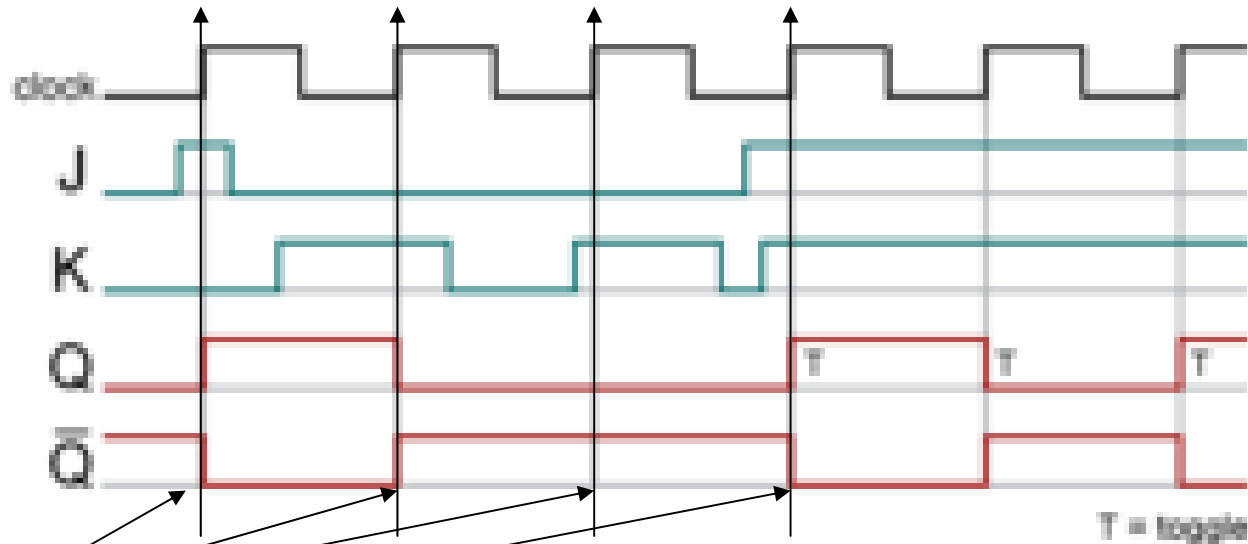
JK(Jack Killy)-FF

J	K	C	Q	\overline{Q}	
X	X	0	Q_n	$\overline{Q_n}$	låst
0	0	↑	Q_n	$\overline{Q_n}$	låst
0	1	↑	0	1	
1	0	↑	1	0	
1	1	↑	toggle		



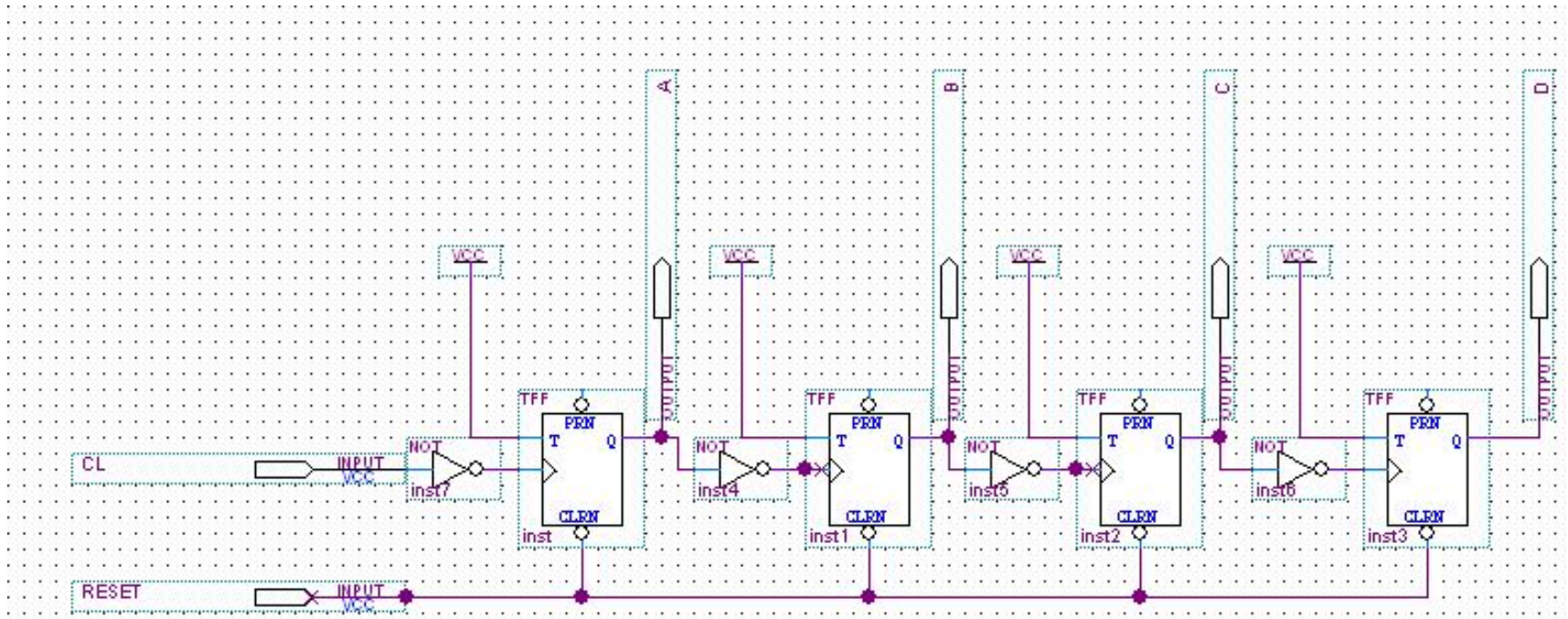


JK-FF



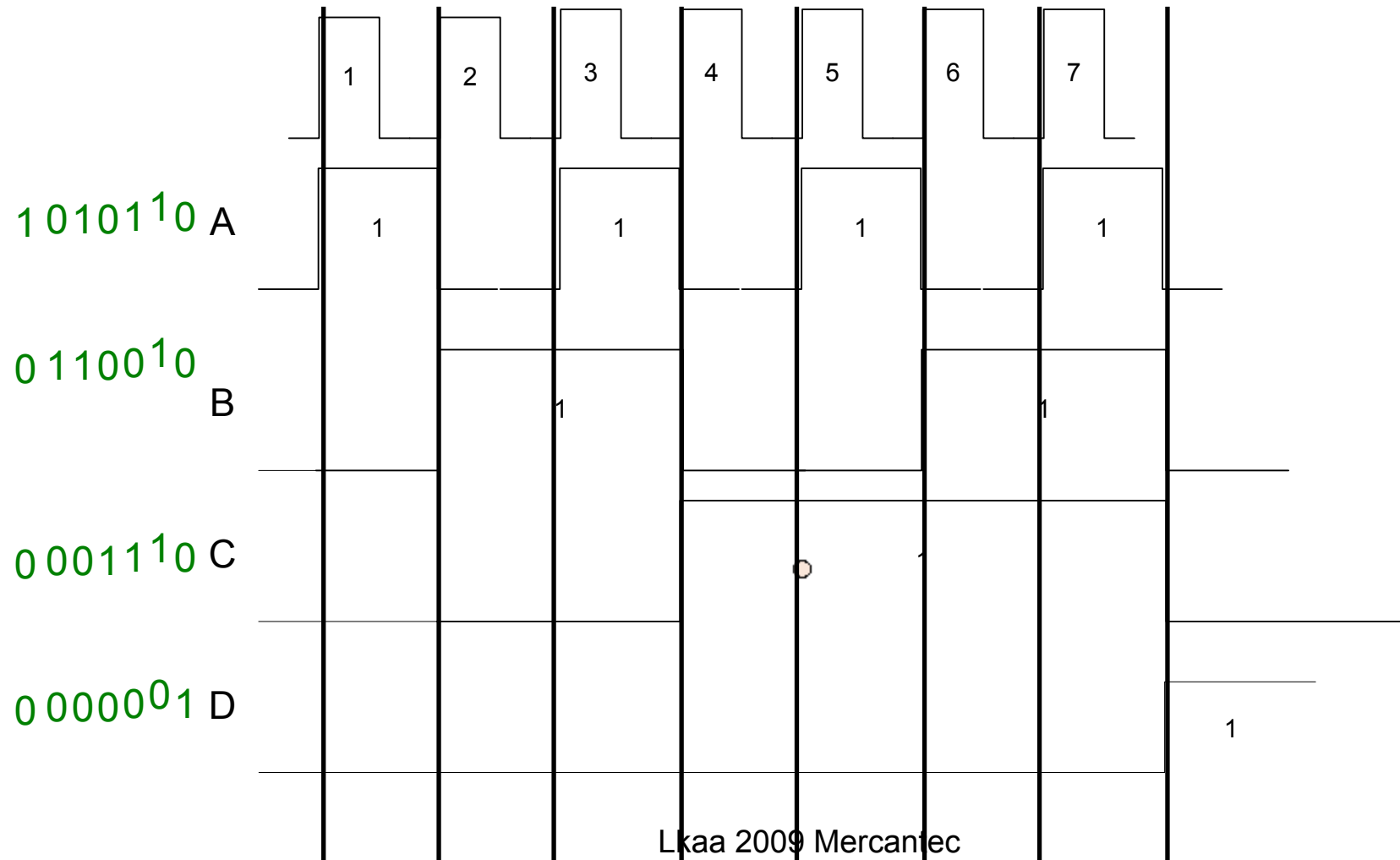


Asynkron tæller





Timer diagram for asynkrontæller



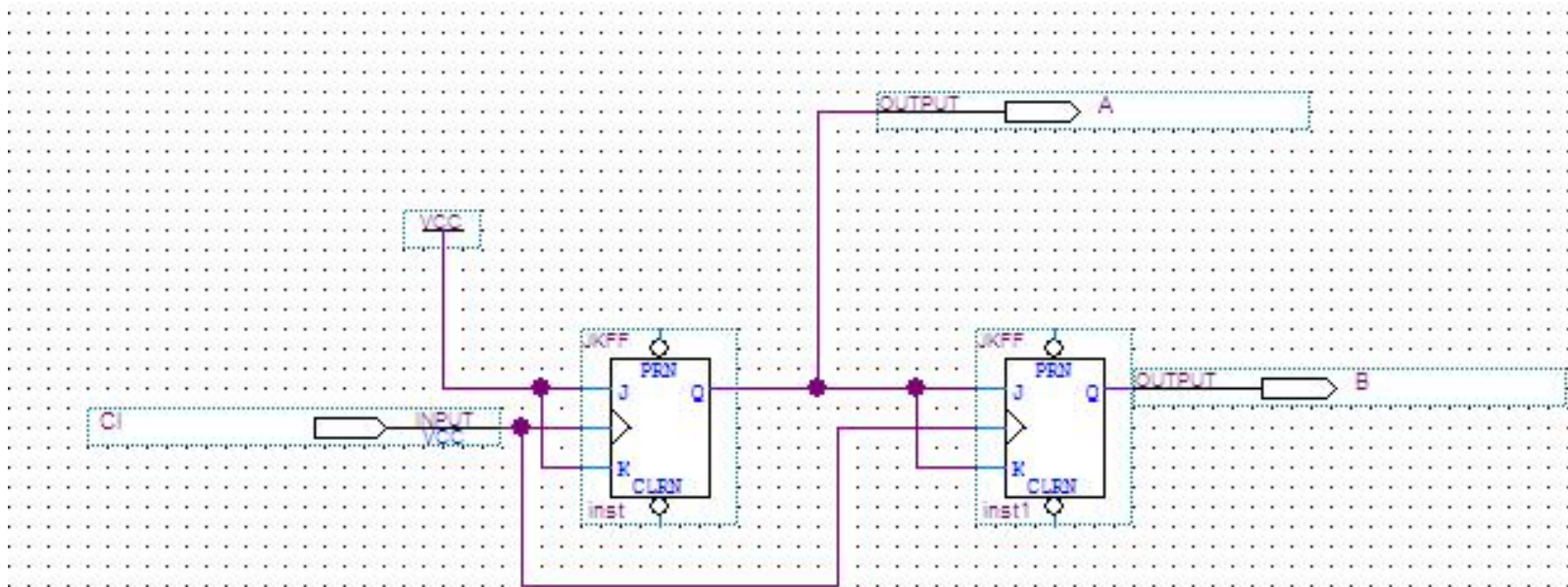


Synkron tæller?

- Asynkron ulempe: "Delay" mellem hver skifte
- Synkron: Samme Delay på udgangene!!
- For det meste benyttes JK-FF



Synkron tæller?



Asynkron tæller opgave



- Konstruerer med en asynkron tæller en reaktions måler
- Tæller max til 0.89 sek, tiden stopper!!
- Kan resettes med en knap (Key[])!
- Start og stop med en knap (Key[])!
- 7490 kan benyttes i stedet for FF!
- BCD til 7-seg decoder i VHDL