



Digitalna tehnika

5. poglavje:

Sekvenčna vezja



Sekvenčna vezja sestavljajo poleg kombinacijskih vezij tudi spominski elementi. Ti si zapomnijo stanje iz zgodovine in lahko z njim vplivamo na izhode v nekem trenutku poleg aktualnih vhodov.

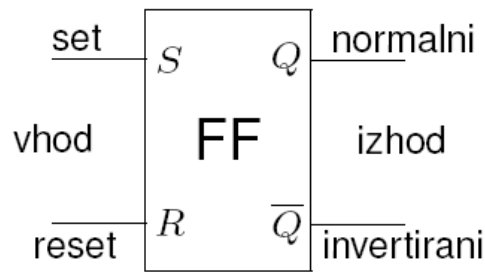
Vrste:

- *sinhronska*: stanje vezja se spremeni ob točno določenih diskretnih časovnih trenutkih. Njihovo delovanje je sinhronizirano s skupnim taktom - uro.
- *asinhronska*: obnašanje vezij je določeno z zaporedjem prihoda vhodnih signalov v poljubnih časovnih trenutkih; vezja med seboj niso posebej sinhronizirana s skupnim taktom.

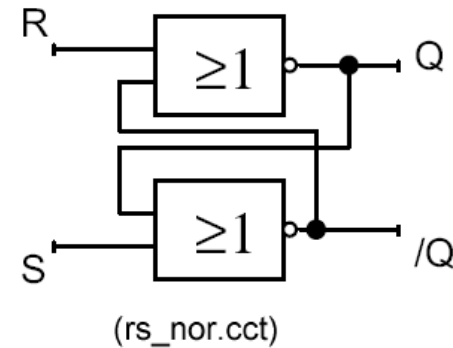


RS flip flop

simbol RS flip-flopa
z neinvertiranimi vhodi



izvedba RS flip-flopa
z NOR vrati



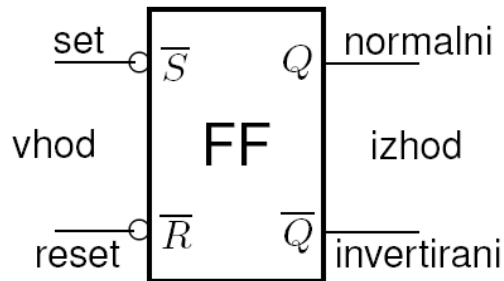
karakteristična tabela

<i>akcija</i>	<i>S</i>	<i>R</i>	<i>Q</i>	<i>Q̄</i>
<i>hold</i>	0	0	<i>ni</i>	<i>sprem.</i>
<i>reset</i>	0	1	0	1
<i>set</i>	1	0	1	0
<i>prepov.</i>	1	1	1	1

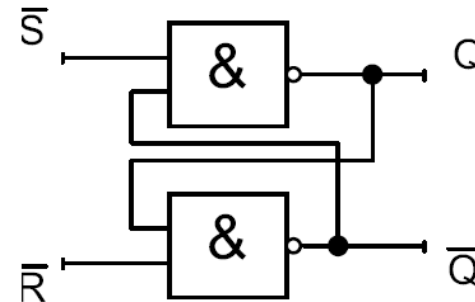


RS flip flop

simbol RS flip-flopa
z invertiranimi vhodi



izvedba RS flip-flopa
z NAND vrati



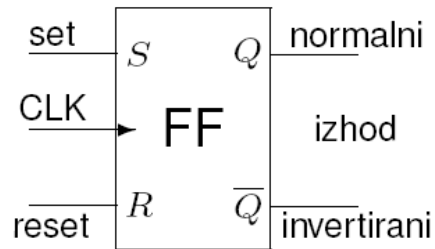
karakteristična tabela

<i>akcija</i>	\overline{S}	\overline{R}	Q	\overline{Q}
<i>prepov.</i>	0	0	1	1
<i>set</i>	0	1	1	0
<i>reset</i>	1	0	0	1
<i>hold</i>	1	1	<i>ni</i>	<i>sprem.</i>

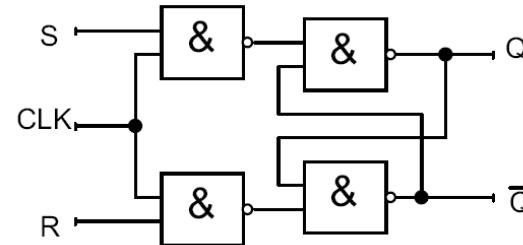


Sinhroni RS flip flop

simbol sinhroniziranega
RS flip-flopa



izvedba sinhroniziranega
RS flip-flopa z NAND vrati

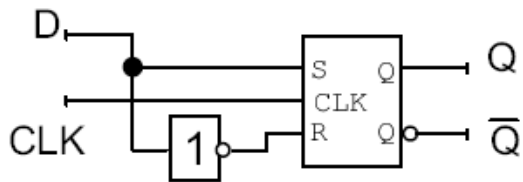
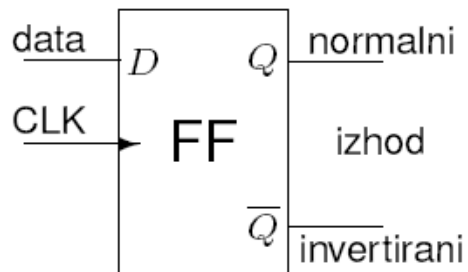


karakteristična tabela

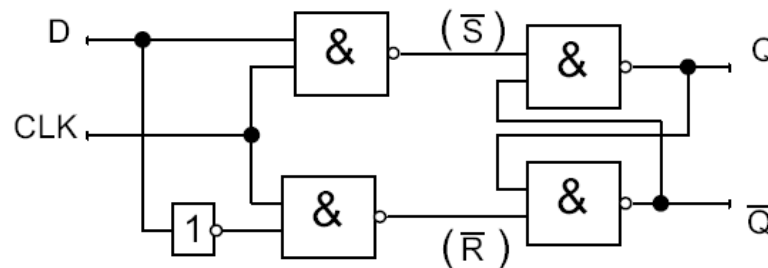
<i>akcija</i>	$Q_{(n)}$	$S_{(n)}$	$R_{(n)}$	$Q_{(n+1)}$
<i>hold</i>	0	0	0	0
<i>reset</i>	0	0	1	0
<i>set</i>	0	1	0	1
<i>prepov.</i>	0	1	1	<i>nedef.</i>
<i>hold</i>	1	0	0	1
<i>reset</i>	1	0	1	0
<i>set</i>	1	1	0	1
<i>prepov.</i>	1	1	1	<i>nedef.</i>



D flip flop



izvedba D flip-flopa

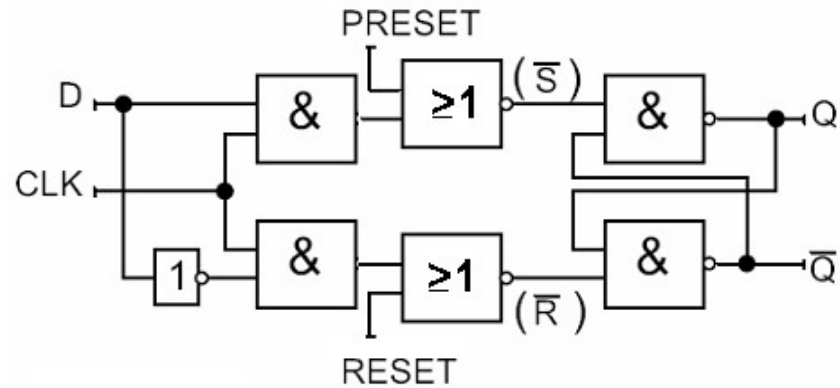
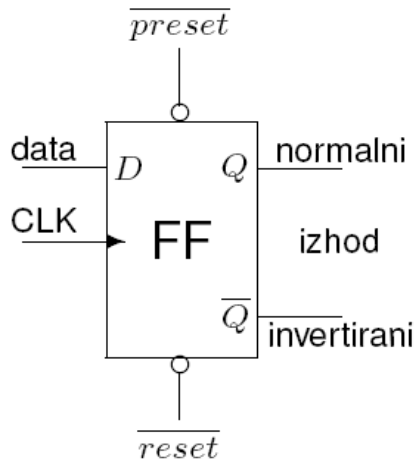


karakteristična tabela

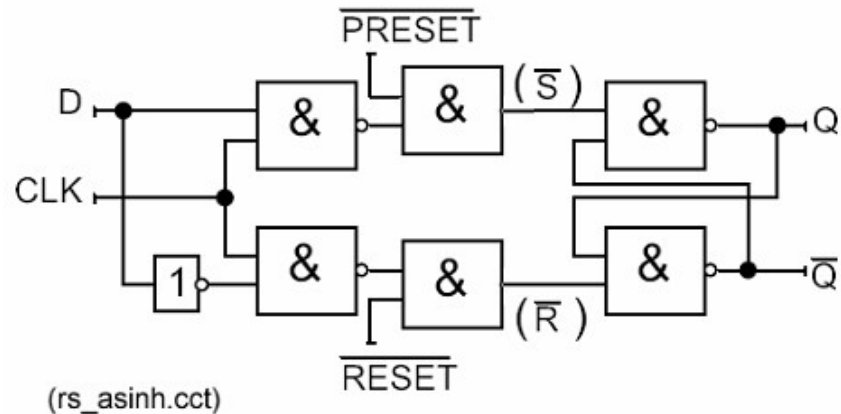
$Q_{(n)}$	$D_{(n)}$	$Q_{(n+1)}$
0	0	0
0	1	1
1	0	0
1	1	1



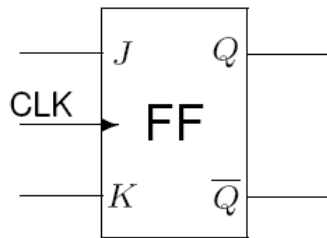
D flip flop z asinhronimi vhodi



akcija	$Q_{(n)}$	$\overline{preset}_{(n)}$	$\overline{reset}_{(n)}$	$Q_{(n+1)}$
prepov.	0	0	0	ndef.
set	0	0	1	1
reset	0	1	0	0
normalno	0	1	1	0
prepov.	1	0	0	ndef.
set	1	0	1	1
reset	1	1	0	0
normalno	1	1	1	1



D flip flop z asinhronimi vhodi

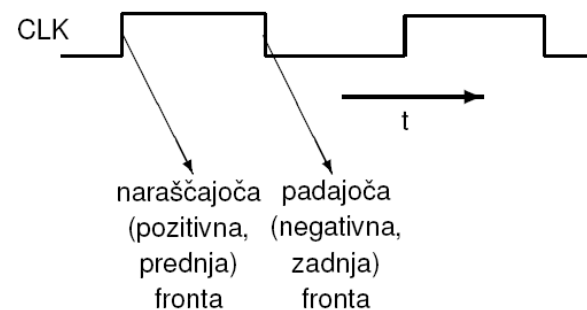


Kadar sta J in K = 1, se stanje spremeni, kadar sta 0, pa se zadrži. Kadar sta različna, delujeta kot R in S vhoda RS flip-flopa.

karakteristična tabela

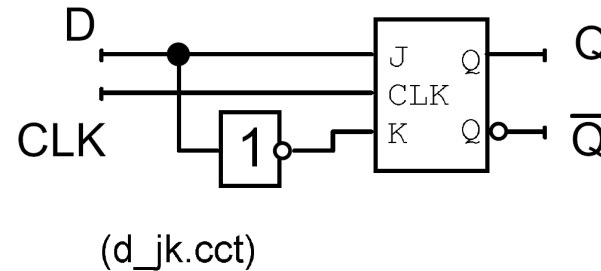
<i>stanje</i>	$Q_{(n)}$	$J_{(n)}$	$K_{(n)}$	$Q_{(n+1)}$
<i>hold</i>	0	0	0	0
<i>reset</i>	0	0	1	0
<i>set</i>	0	1	0	1
<i>change</i>	0	1	1	1
<i>hold</i>	1	0	0	1
<i>reset</i>	1	0	1	0
<i>set</i>	1	1	0	1
<i>change</i>	1	1	1	0

Proženje JK FF s fronto in ne z nivojem:



D in T flip flop realizirana z JK FF

D flip flop:



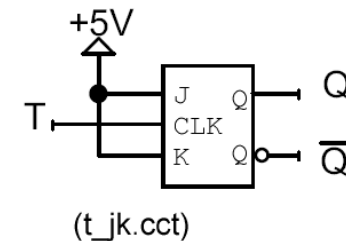
T flip flop:

karakteristična tabela

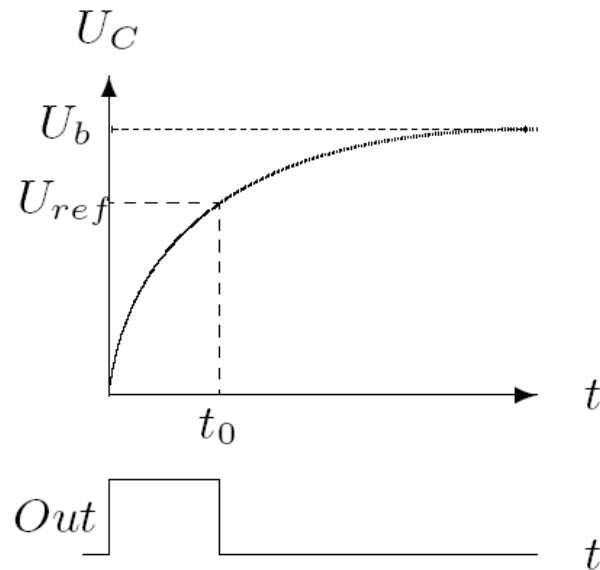
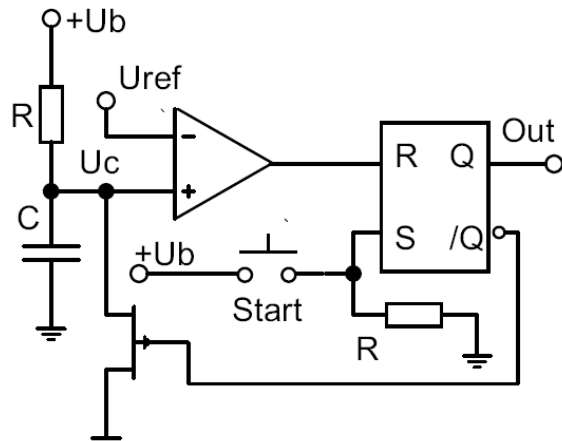
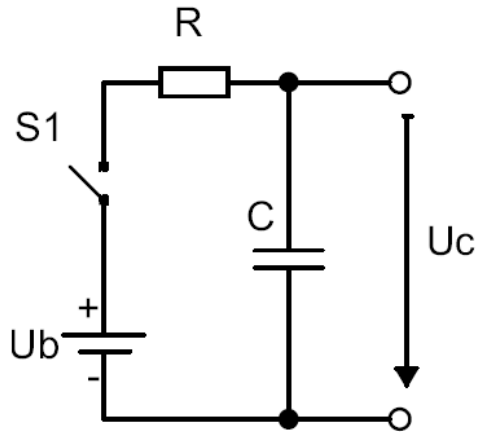
$Q_{(n)}$	$T_{(n)}$	$Q_{(n+1)}$
0	0	0
0	↓	1
1	0	1
1	↓	0

$T_{(n)} = \downarrow$ v tabeli pomeni
aktivni prehod fronte

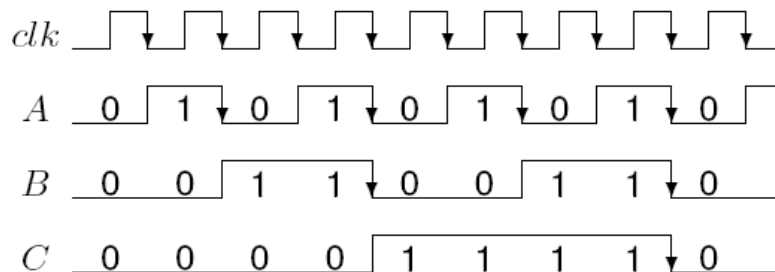
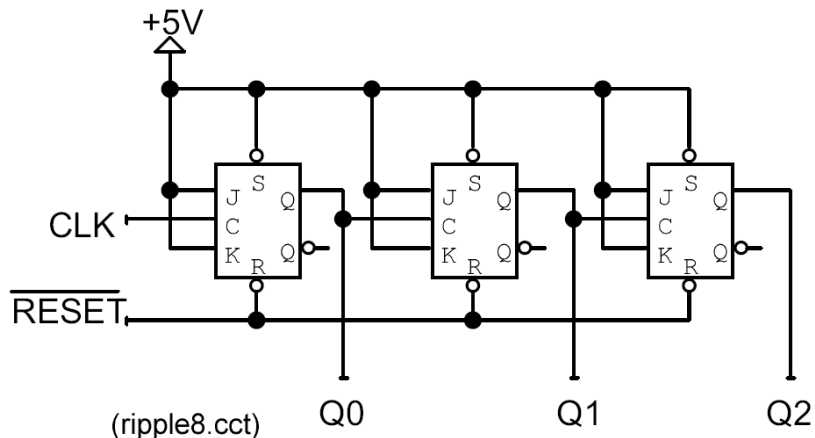
izvedba T flip-flopa z JK



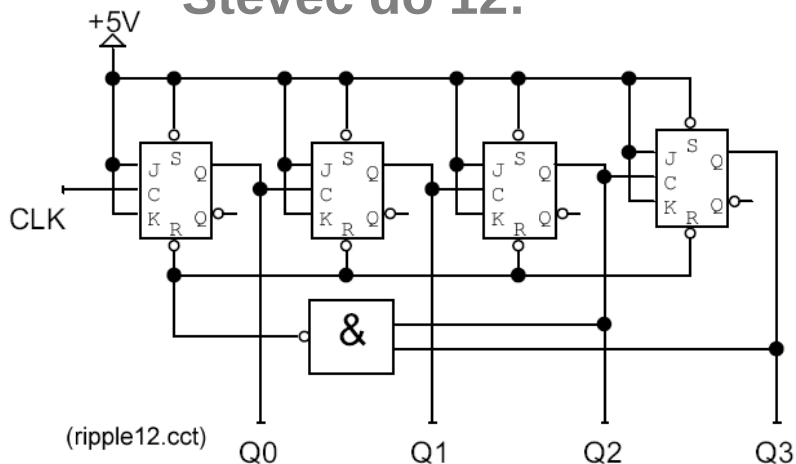
Mono- in astabilni FF



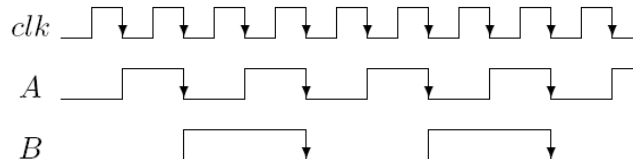
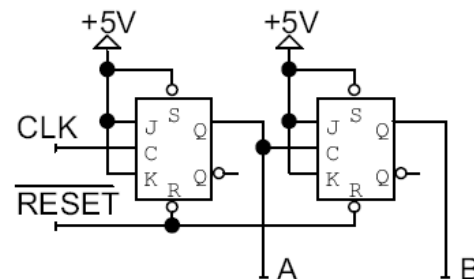
Binarni serijski (ripple) števec



Števec do 12:



Števec kot delilec frekvence:



Registri

