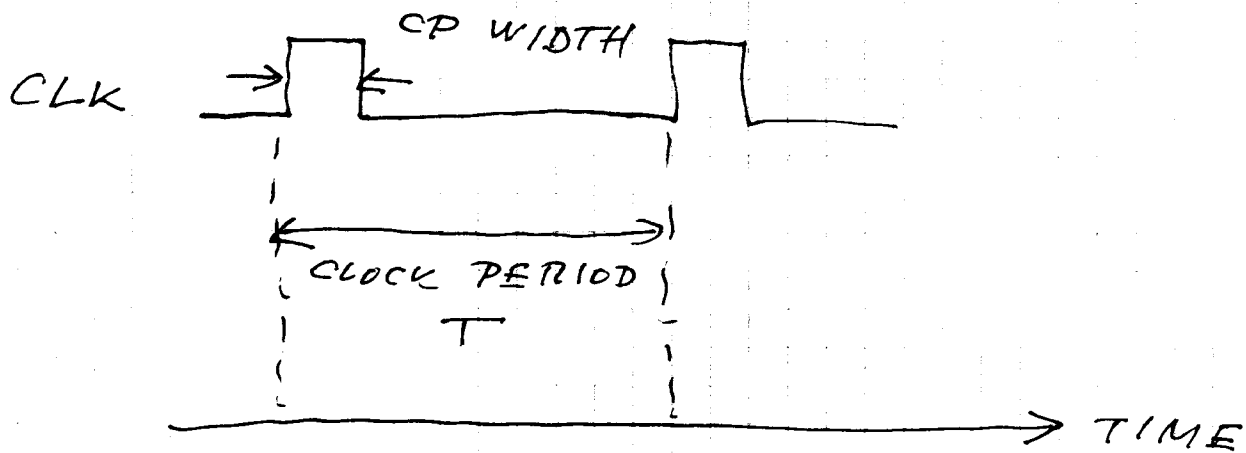


GATED LATCH

CLOCK:



CLOCK FREQUENCY: $f = \frac{1}{T}$
 HERTZ (HZ): 1 CHANGE
 PER SECOND

(AC HAS FR. OF 60HZ)

f

$$1 \text{ MHz} = 10^6 \text{ Hz}$$

$$1000 \text{ MHz} = 10^9 \text{ Hz} = 1 \text{ GHz}$$

$$1000 \text{ GHz} = 10^{12} \text{ Hz}$$

$T = 1/f$

$$10^{-6} \text{ sec} = 1 \mu\text{sec} \quad (\text{MICROSECOND})$$

$$10^{-9} \text{ sec} = 1 \text{ nsec} \quad (\text{NANOSECOND})$$

$$10^{-12} \text{ sec} = 1 \text{ psec} \quad (\text{PICOSECOND})$$

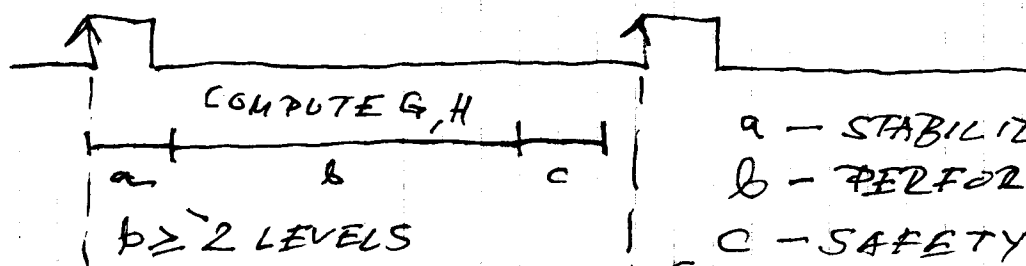
$$1 \mu\text{s} = 1000 \text{ ns}$$

$$1 \text{ ns} = 1000 \text{ ps}$$

$$2 \text{ GHz} \rightarrow 0.5 \mu\text{s} = 500 \text{ ns}$$

$$4 \text{ GHz} \rightarrow 0.25 \mu\text{s} = 250 \text{ ns}$$

$$10 \text{ GHz} \rightarrow 0.1 \mu\text{s} = 100 \text{ ns}$$



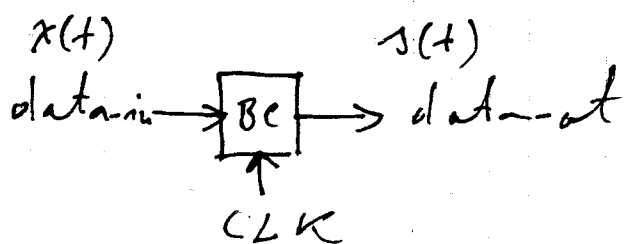
a - STABILIZE STATE

b - PERFORM COMPUT.

c - SAFETY MARGIN

(VAR IN DELAY)

BASIC BINARY CELL — FUNCTION DESIRED



$y(t)$ DOES NOT CHANGE BETWEEN CLOCK PULSES

BEFORE CLOCK:

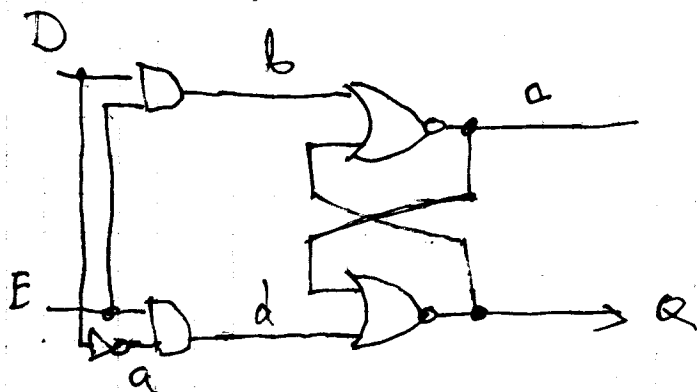
$x(t)$ 0 0 1 1

$y(t)$ 0 1 0 1

AFTER CLOCK: $y(t+1) = f(y(t)) = f(x(t))$

$y(t)$ 0 0 1 1

GATED LATCH



NOR

x	y	z
0	0	1
0	1	0
1	0	0
1	1	0

$$b = D \cdot E \quad a = D'$$

$$d = D' \cdot E$$

$E=1 \quad \begin{cases} b=D, a=D' \\ d=D' \end{cases}$

$D=1 \Rightarrow \begin{matrix} b=1 \\ d=0 \end{matrix} \Rightarrow \begin{matrix} c=0 \\ \Rightarrow Q=1 \end{matrix} \Rightarrow \text{LOOP} \therefore Q=D$

$D=0 \Rightarrow \begin{matrix} b=0 \\ d=1 \end{matrix} \Rightarrow \begin{matrix} Q=0 \\ \Rightarrow c=1 \end{matrix} \Rightarrow \text{LOOP} \therefore Q=D$

So, WHEN $E=1$, $Q=D$
 OUTPUT: INPUT LEVEL SENSITIVE
 CHANGE $E \rightarrow 0$, KEEP D UNCHANGED
 UNTIL $E=0$.

$E=0$

$b=0 \quad d=0$

IF $C=0$ THEN $Q=1 \Rightarrow C=0$
 STABLE

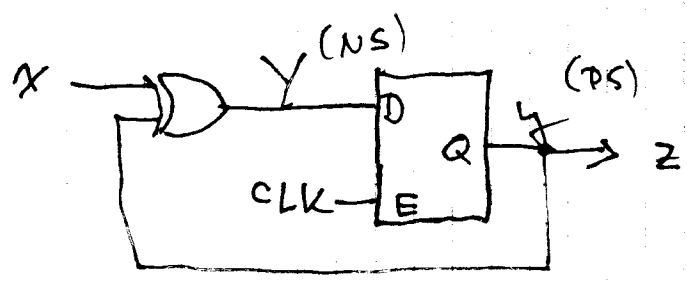
IF $C=1$ THEN $Q=0 \Rightarrow C=1$
 STABLE

— STABLE STATE AS LONG AS $E=0$

$\rightarrow Q(t+t_p) = D(t) \cdot E(t) + Q(t) \cdot E'(t)$

LIMITATIONS WITH GATED LATCH

CONSIDER A SIMPLE FSM:

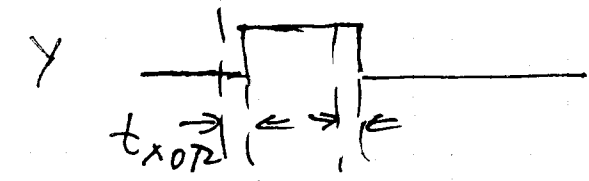
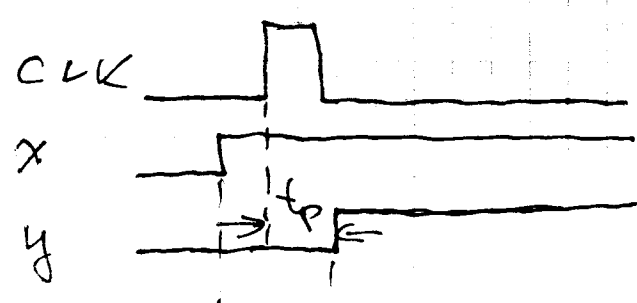


y \ x	0	1
0	0	1
1	1	0

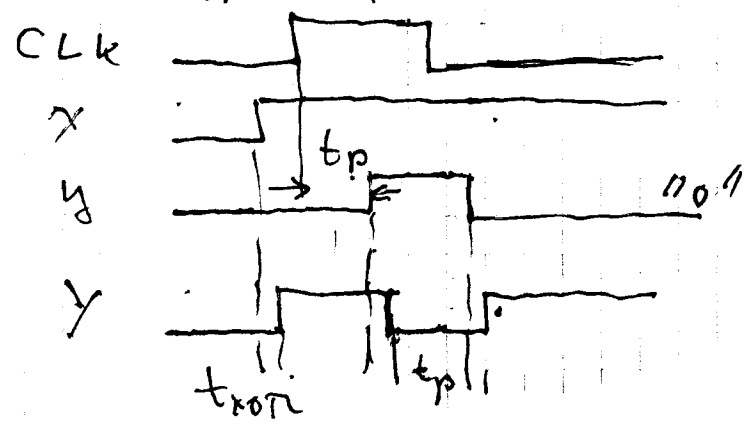
y

GOAL $y: 0 \rightarrow 1$

(2) a) ✓



(2) b) ✗



$y: 0 \rightarrow 1 \rightarrow 0$