1) Decade Counter

7-seg. LED display $D C B A$	7-seg. LED display $D C B A$	7-seg. LED display $D C B A$	7-seg. LED display $D C B A$

0-15

0-9

A
B
C
D

7490 Decade

clock pulses

thousands digit   hundreds digit   tens digit   ones digit

$0-1 \quad - \quad 1 \ o/p \quad 2^1$

$0-3 \quad - \quad 2 \ o/p \quad 2^2$

$0-7 \quad - \quad 3 \ o/p \quad 2^3$

$0-15 \quad - \quad 4 \ o/p \quad 2^4$

Decade counter (contd)

Table 6.10 7490 decade counter BCD coding

Decimal Count	BCD Output			
	D	C	B	A
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
0	0	0	0	0

$$2^B + 2^A = 2^1 + 2^0 = 3$$

Display

a
f   b
g
e   c
d
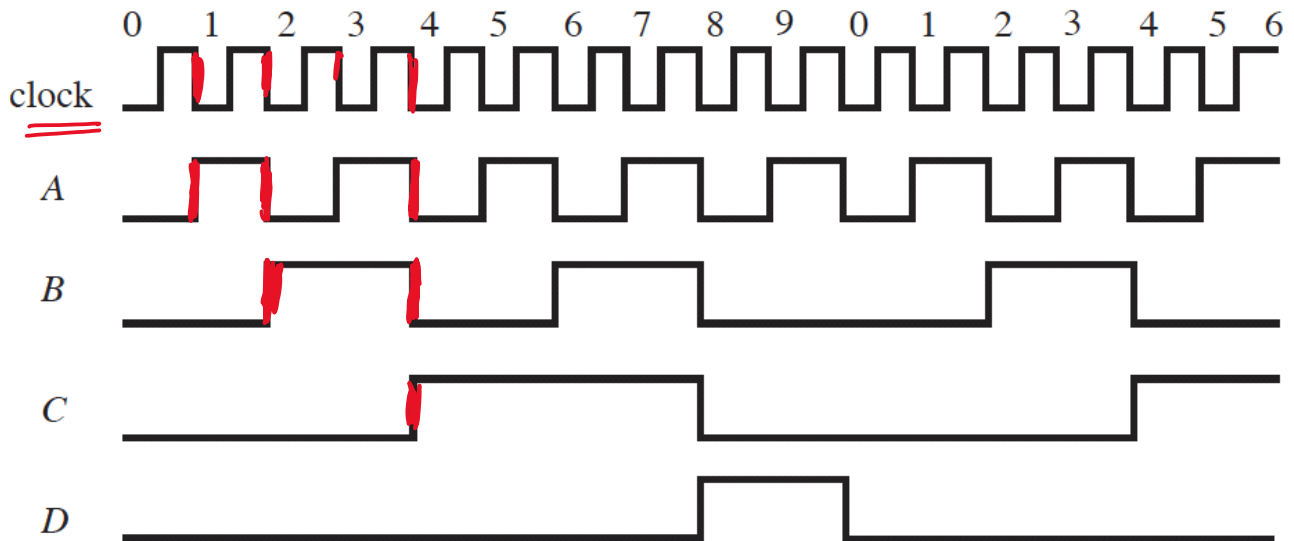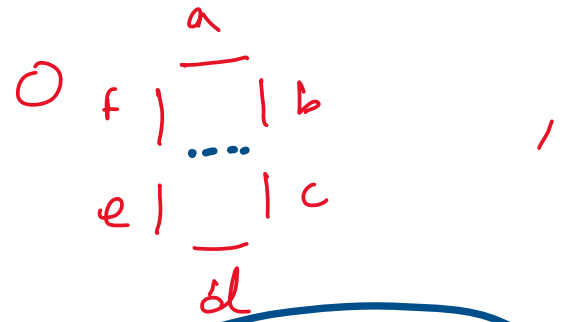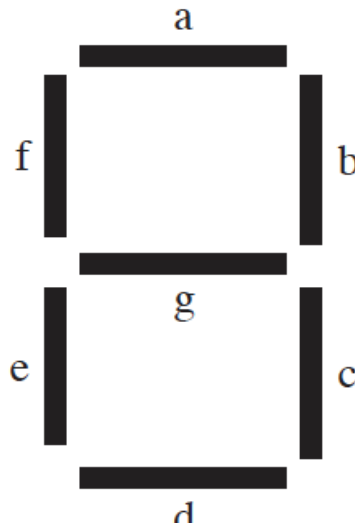
Table 6.11 7447 BCD to seven-segment decoder

Decimal digit	Input				Output						
	D	C	B	A	$\bar{a}$	$\bar{b}$	$\bar{c}$	$\bar{d}$	$\bar{e}$	$\bar{f}$	$\bar{g}$
0	0	0	0	0	0	0	0	0	0	0	1
1	0	0	0	1	1	0	0	1	1	1	1
2	0	0	1	0	0	0	1	0	0	1	0
3	0	0	1	1	0	0	0	0	1	1	0
4	0	1	0	0	1	0	0	1	1	0	0
5	0	1	0	1	0	1	0	0	1	0	0
6	0	1	1	0	1	1	0	0	0	0	0
7	0	1	1	1	0	0	0	1	1	1	1
8	1	0	0	0	0	0	0	0	0	0	0
9	1	0	0	1	0	0	0	0	1	0	0

$a, b, c, d, e, f = 1$
$g = 0$

$0 - 9$

$\bar{a}, \bar{b}, \bar{c}, \bar{d}, \bar{e}, \bar{f} = 0$
$\bar{g} = 1$
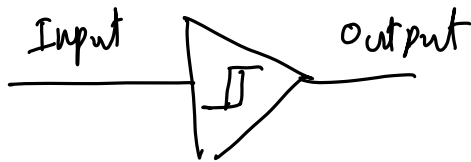
② Schmitt Trigger

Used for switch debouncing

Example

5V

R

switch V_A

0 0

transient

open switch

switch closed

V_A

5V

0

t
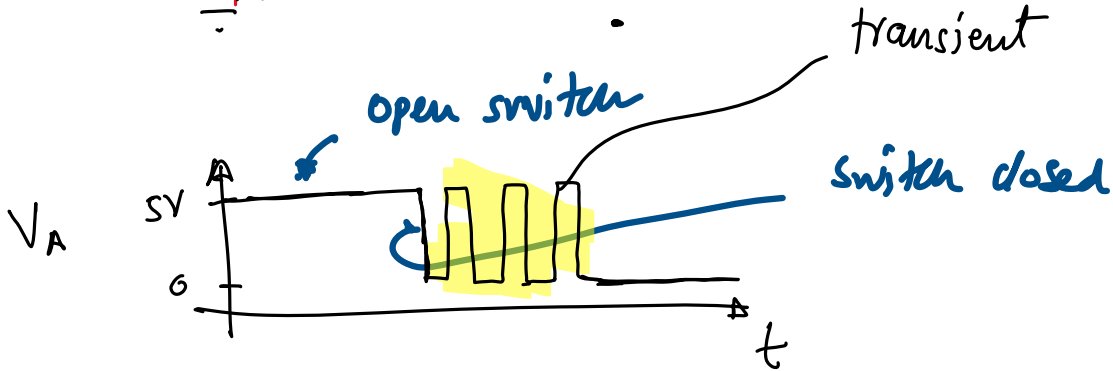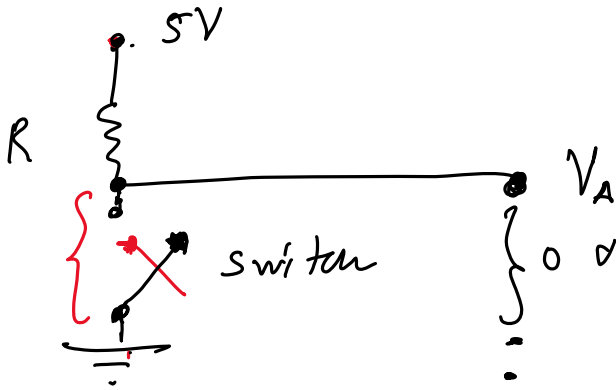
Schmitt trigger prevents this debouncing

Input ———▷𝕵—— output

Input

High Threshold

Low threshold
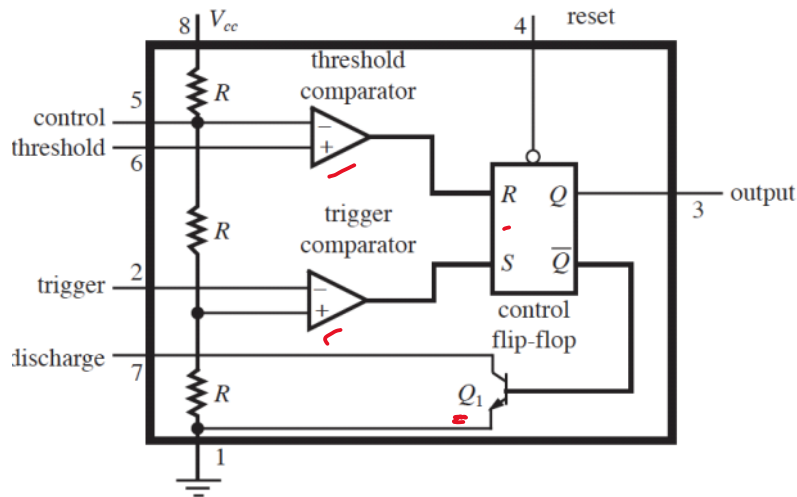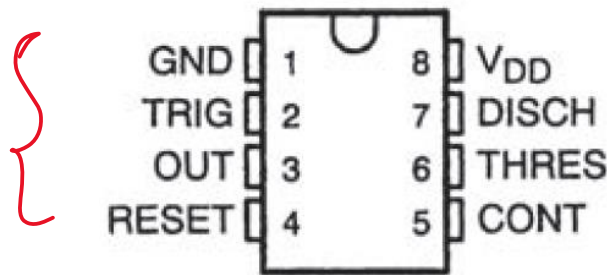
Output

t

$5V$

R

V_A
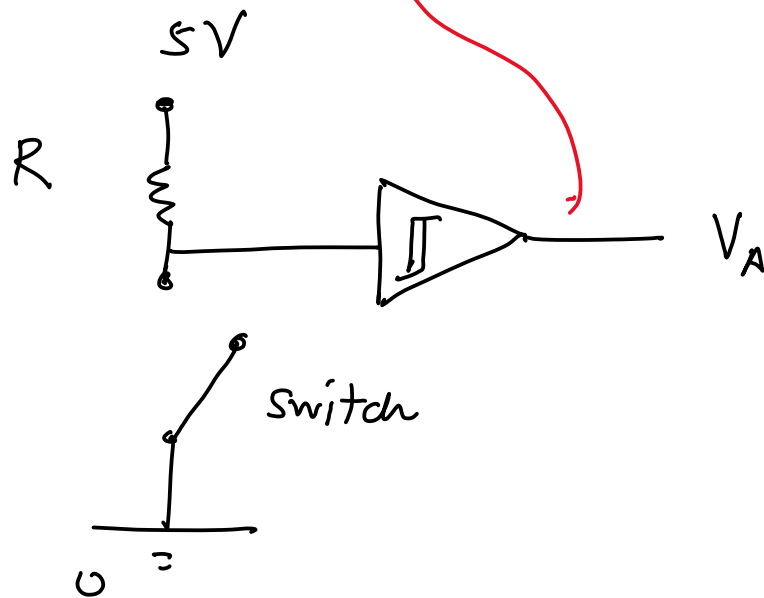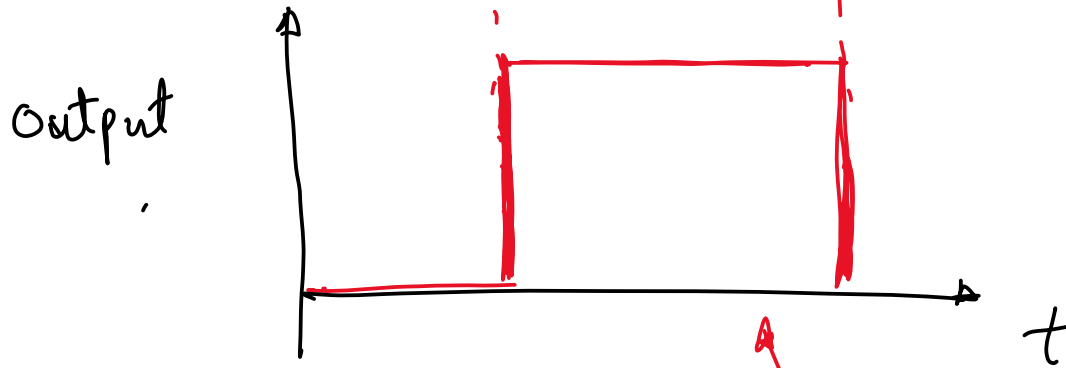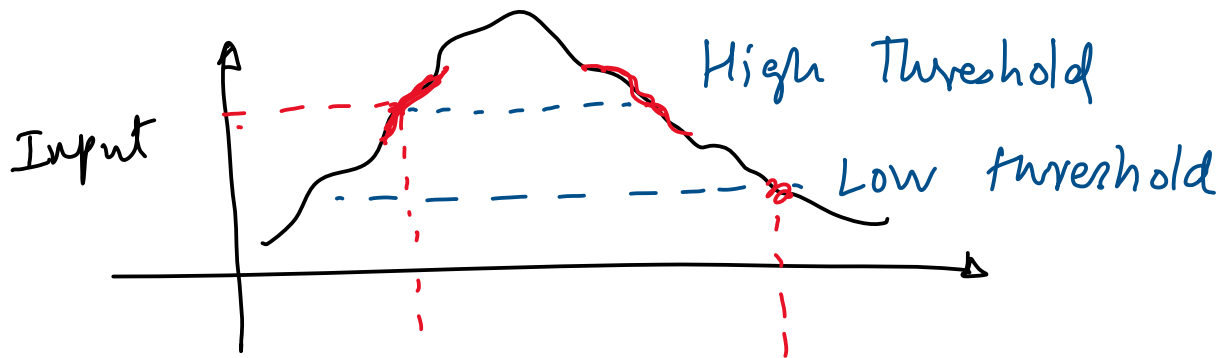
switch

Timer 555

Used for time keeping like a stopwatch.
Applications: bounce free switches, cascaded timers,
frequency dividers, oscillators, LED flashes.

2 op-amps
1 R-S Flip Flop
1 BJT

2 modes of operation

① Monostable vibrator
② Astable vibrator.

Monostable Vibrator (timer)

S	R	Q	$\bar{Q}$
0	0	Q_0	$\bar{Q}_0$
1	0	1	0
0	1	0	1

Working

① Reset is pressed

$R = S = 0$ $Q = 0 ; \bar{Q} = 1$

This turns the BJT ON
& drains the capacitor of charge.

② $S = 1$ $R = 0$

$Q = 1$ $\bar{Q} = 0$

→ Thus output = $Q = 1$

③ when $V > \frac{1}{3} V_{cc}$

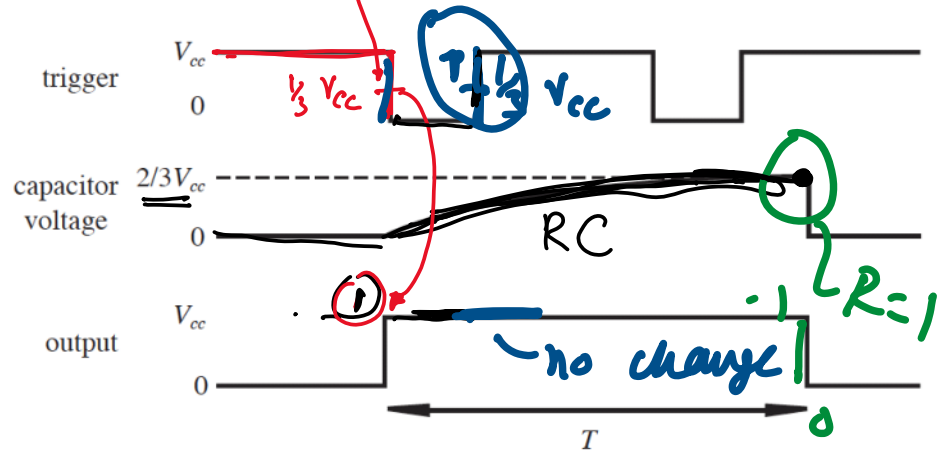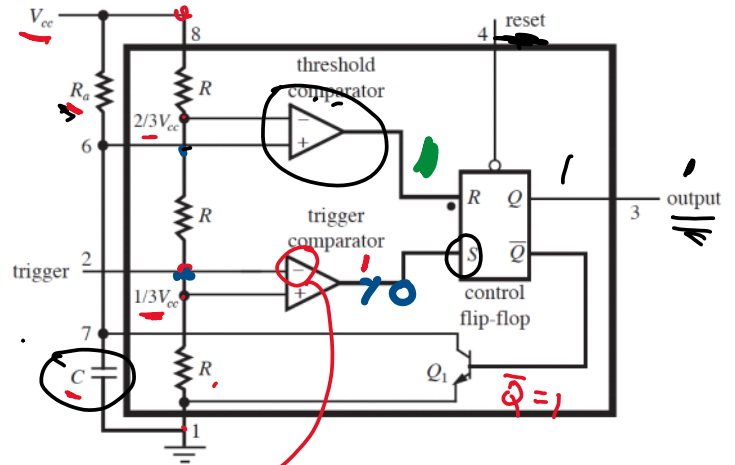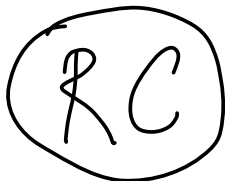$S = 0$ $R = 0$

$\bar{Q} = Q_8 = 1$
$\bar{Q} = \bar{Q}_0 = 0$ } No change in output

④ When capacitor charges to $\frac{2}{3} V_{cc}$,

$R = 1$ $S = 0$
$Q = 0$ $\bar{Q} = 1$

→ output = $Q = 0$

RC

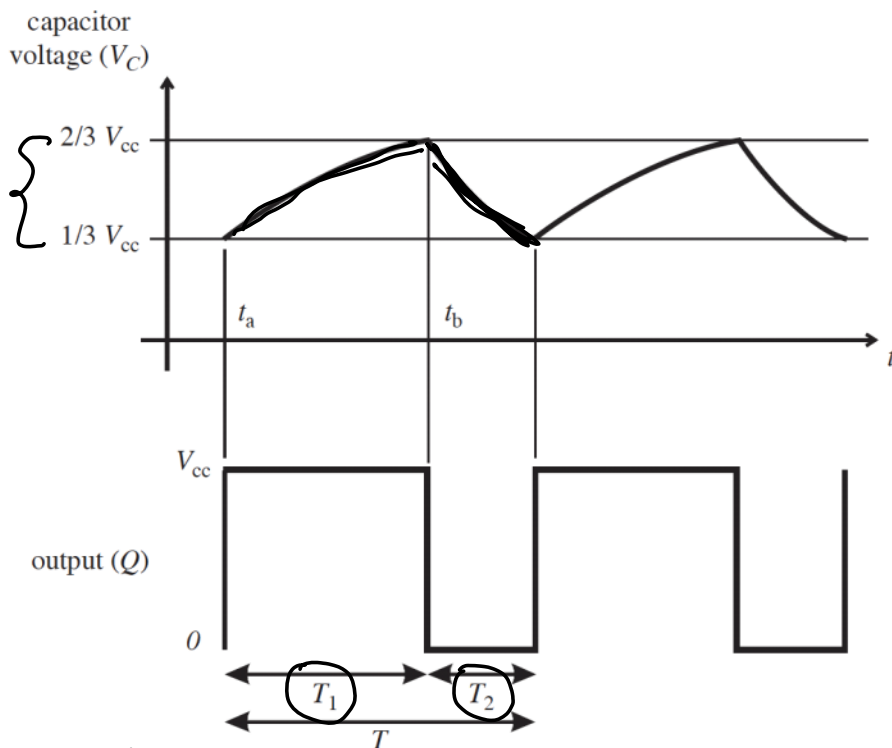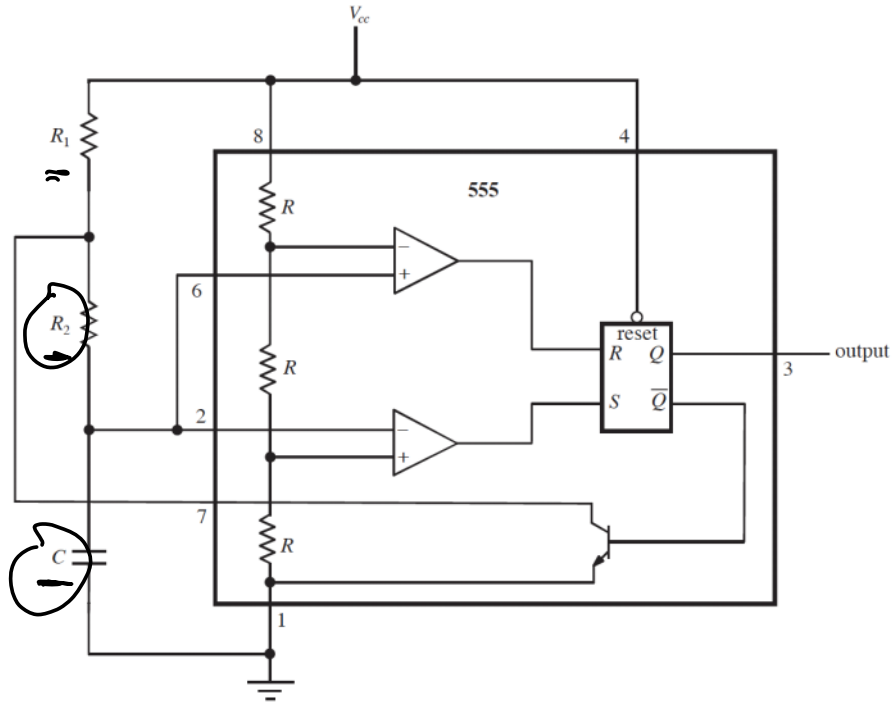Ⓐ Output is HIGH
trigger comparator

Ⓑ Output is LOW
(i) Capacitor charges
(ii) Threshold comparator

RC $\longrightarrow$ (i) Capacitor charges

(ii) Threshold comparators

Astable multivibrator (timer)

$$T_1 = (R_1 + R_2)C \qquad T_2 = R_2C$$