SAGAR INSTITUTE OF RESEARCH AND TECHNOLOGY, Bhopal

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Designation: AP

Department: Electronics & Communication

Subject: Analog Circuits EC 405

IC 555 timer

→ The most versatile linear integrated circuits is the 555 timer.

→ IC is a monolithic timing circuit that can produce accurate and highly stable time delays or oscillations

→ First introduced as the SE/NE 555 in early 1970.

⇒ It is reliable, easy to use and cheaper in cost.

⇒ It is used for industrial (welding moulding etc) and household (setting TV, AC, washing machine) applications

→ Precise time interval is important

→ It gives proper and stable o/p signal

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Applications

1. Monostable and astable multivibrator.
2. DC-DC converters
3. Waveform generators
4. Analog frequency meters
5. Tacho meters
6. Temperature measurement and control devices
7. Voltage regulators etc.
8. Specifically used for time based applications or counting process

Features

1. It operates on +5V to +18V supply voltage in both free running (astable) and one shot (monostable) modes
2. High current o/p
3. Timing it from microseconds through hours
4. Adjustable duty cycle

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IC 555 timer is available as an 8 pin metal can, an 8-pin mini DIP (Dual in package) or a 14 Pin DIP

Pin 1 - Ground - All voltages are measured w.r.t to this terminal

Pin 2 - Trigger

Inverting i/p to a comparator

Pin 3 - o/p is available

Normally off load:- The load can be connected to pin 3 and ground pin

Normally on load: The load connected bet^n pin 3 and supply pin

Pin 4 Reset terminal

Negative pulse is applied.

Pin 5 Control voltage terminal

To control the threshold and trigger levels

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Pin 6 Threshold terminal

Non-inverting input terminal of comparator 1.

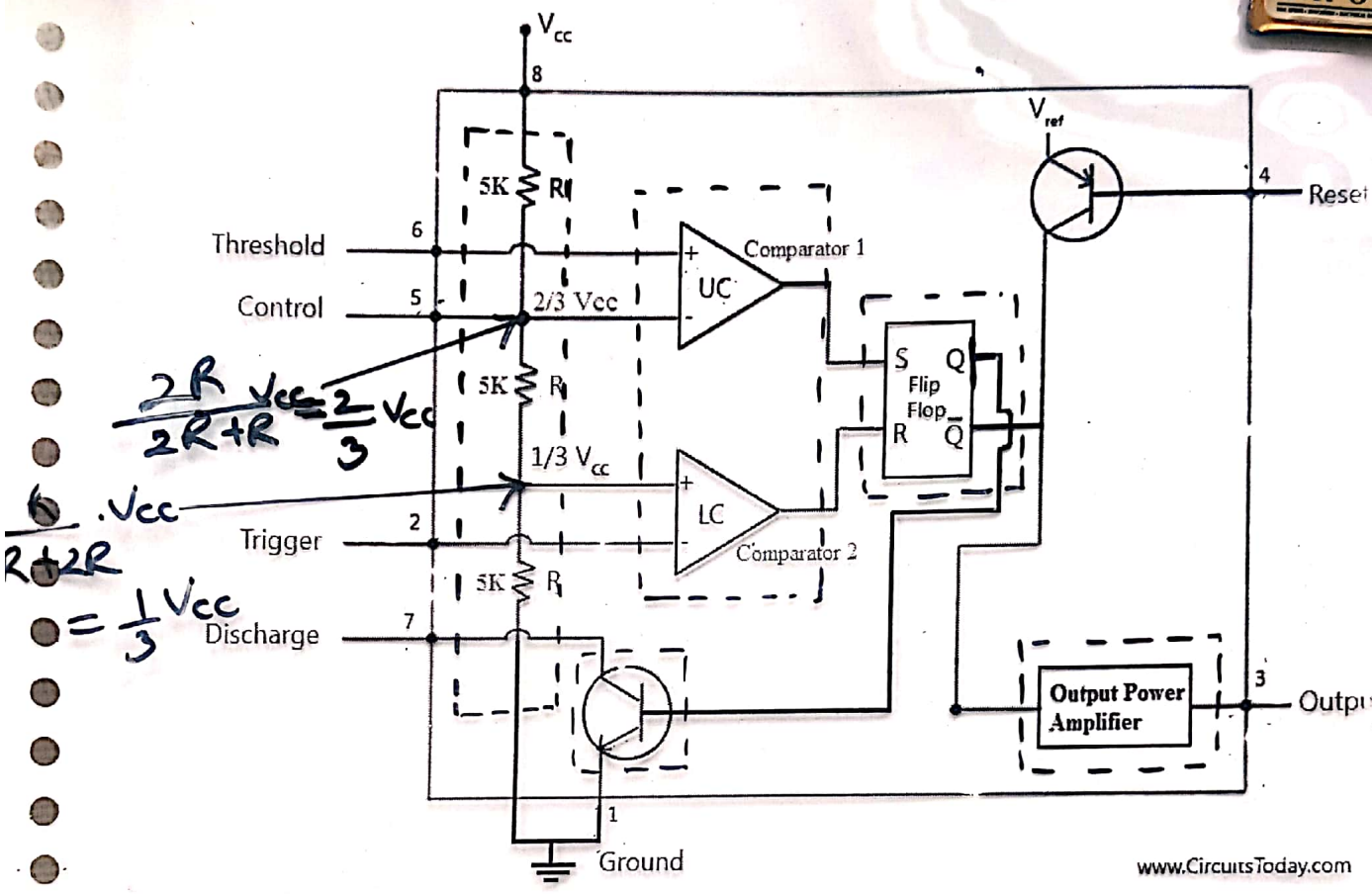
Pin 7 Discharge terminal

Connected internally to the collector of transistor

Pin 8 Supply terminal

A supply voltage of +5V to +18V is applied to this terminal w.r.t ground.

555 IC Timer Block Diagram



Block Diagram – 555 Timer IC

$\frac{2R}{2R+R} V_{cc} = \frac{2}{3} V_{cc}$

$\frac{R}{R+2R} \cdot V_{cc} = \frac{1}{3} V_{cc}$

Timer consists of 5 blocks

1) Resistive network or voltage divider circuit

3 equal 5kΩ resistors and acts as a voltage divider circuits. Hence known as 555 timer.

2) Comparator 3) SR flip flop

4) Discharge circuit

5) output circuit

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Upper Comparator

The voltage on the threshold input must be $> +\frac{2}{3} V_{cc}$

↓

Transistor on

↓

Capacitor discharged

↓

o/p Low

Lower Comparator

The voltage on the trigger input must be $< +\frac{1}{3} V_{cc}$

↓

Transistor off

↓

Capacitor charged

↓

output high

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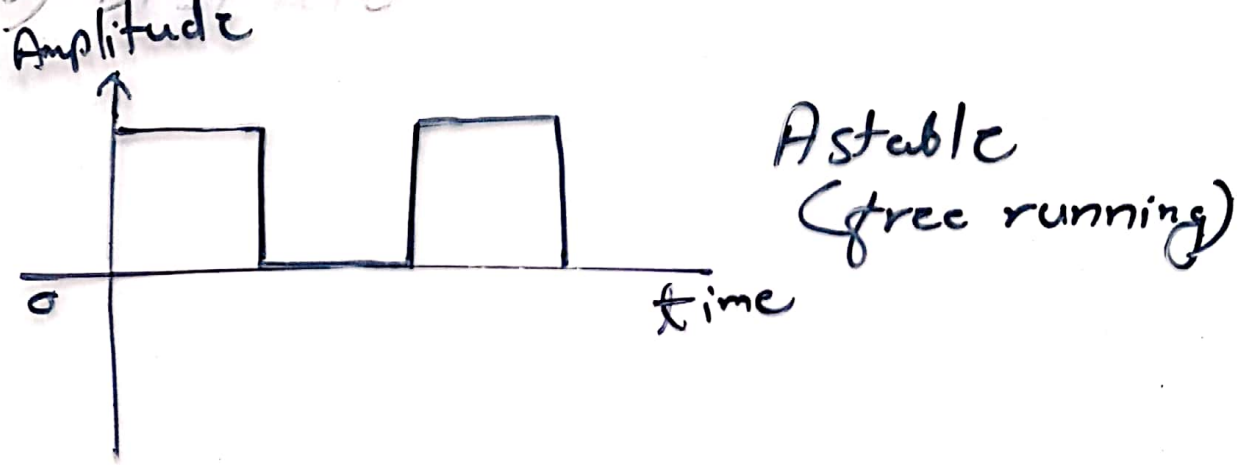
Multivibrators

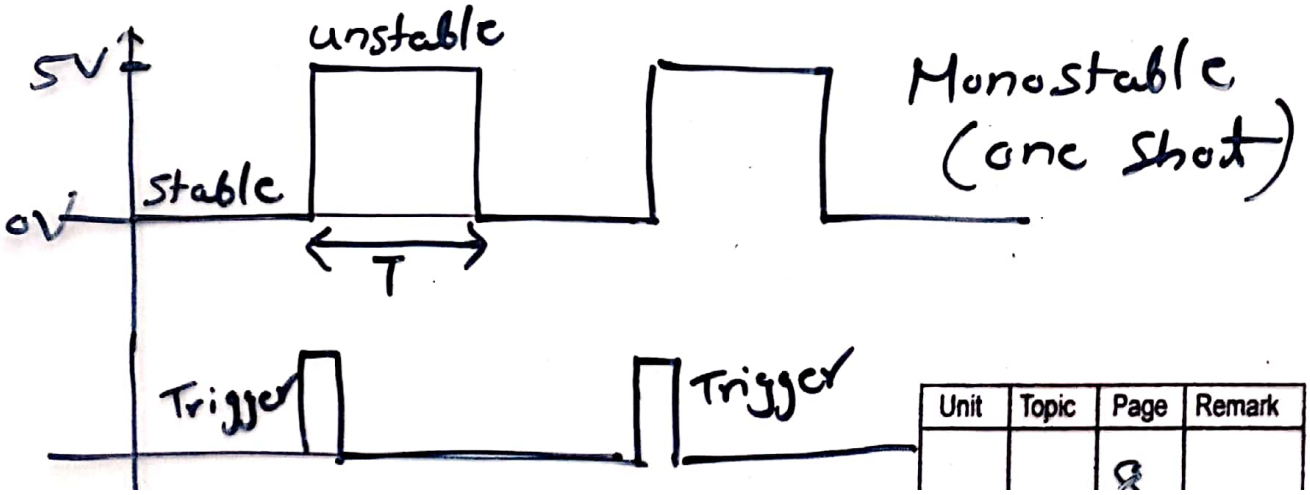
It is the electronic circuit which is used to implement two stated devices like oscillator, timer and flip flop.

Two states — High (1)
low (0)

Two types of multivibrator

1) Astable
2) Monostable
3) ~~Bistable~~





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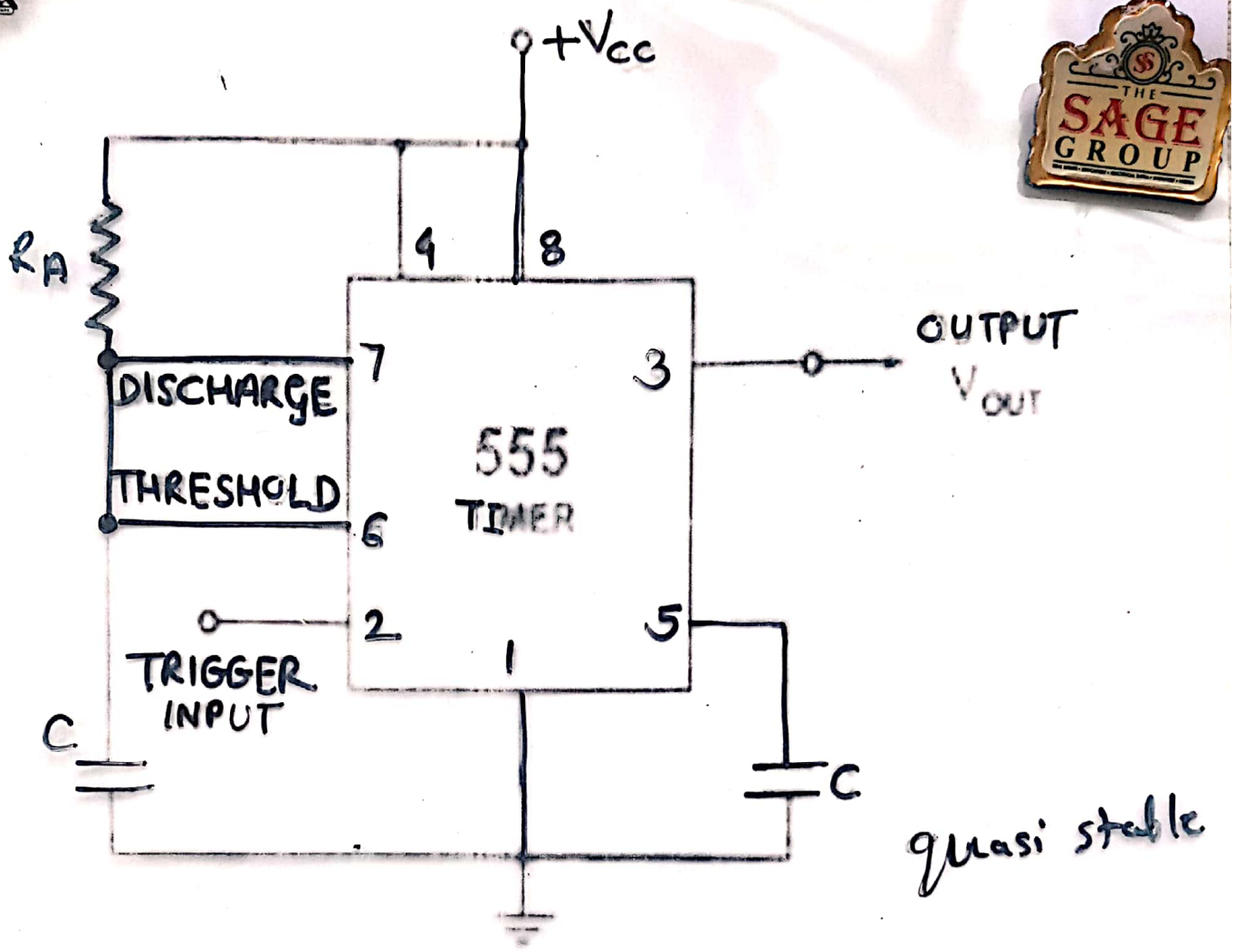

Circuit of the Timer 555 as monostable multivibrator

- Monostable multivibrator is also known as one shot multivibrator
- It has one stable state and it switches to unstable state for a predetermined time period T when it is triggered.
- The time period T is determined by the RC network connected externally

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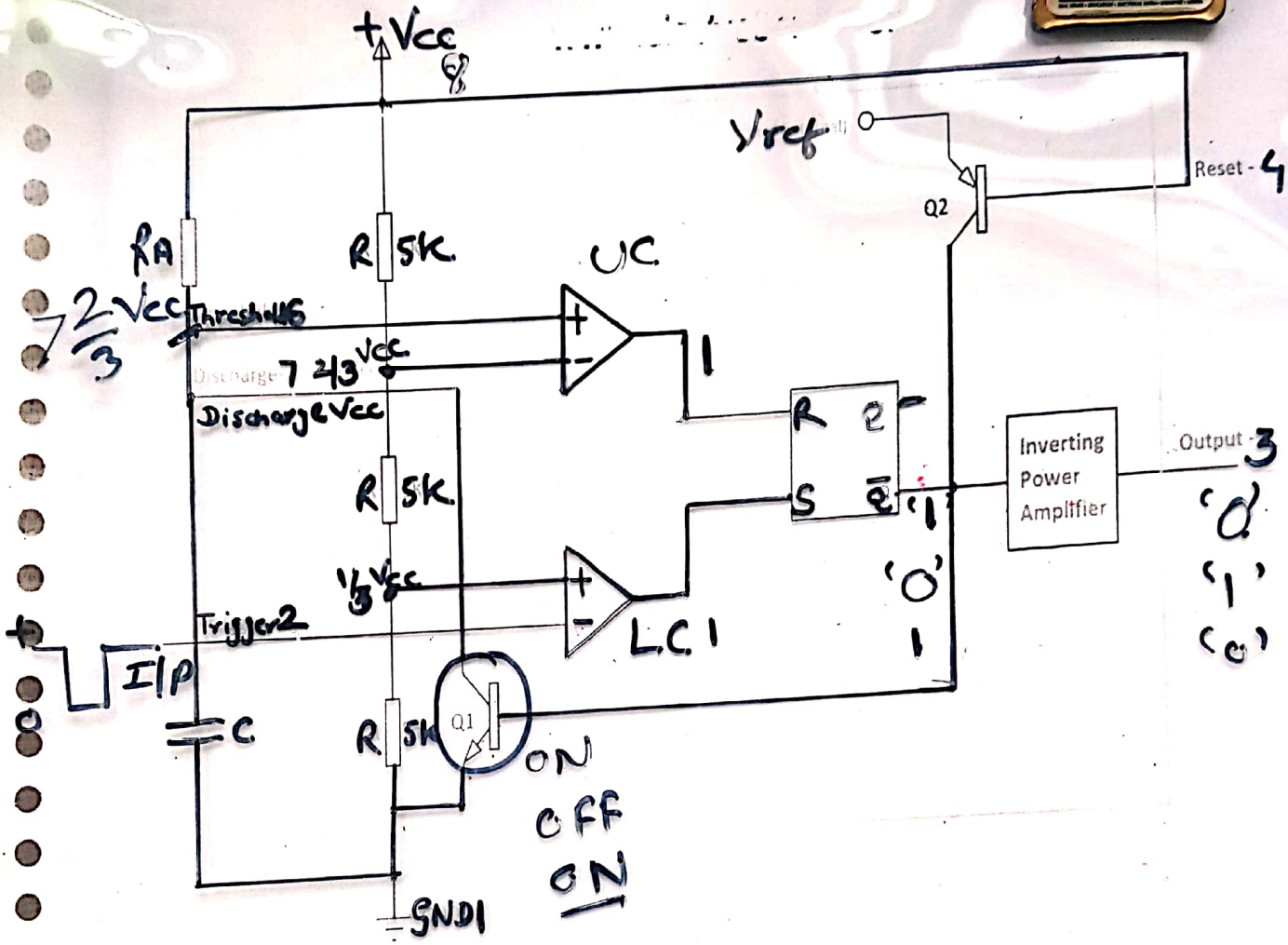
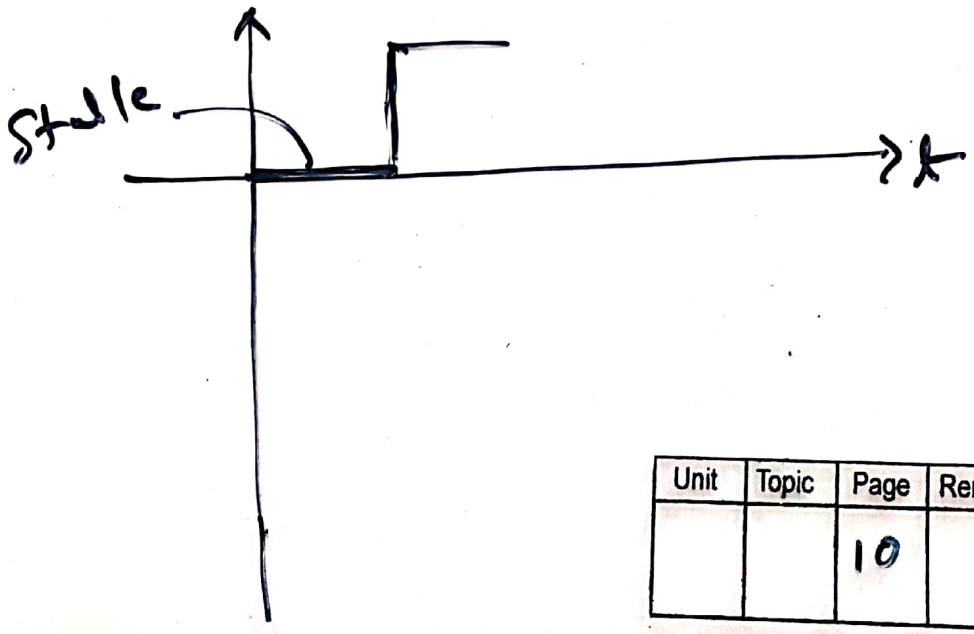


555 connected as a monostable multivibrator



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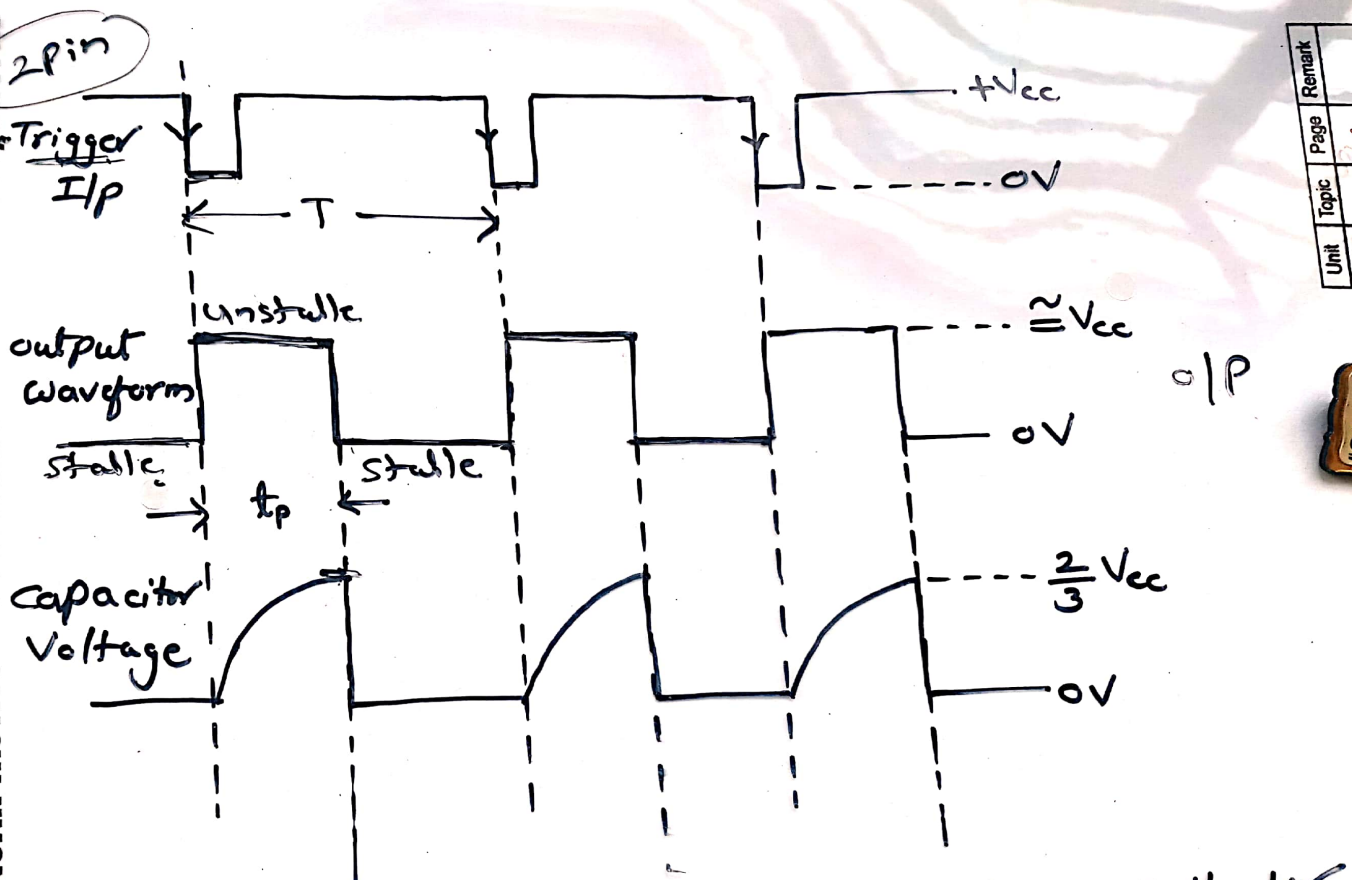

555 connected as a monostable multivibrator
Input and output waveform

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The 555 as an Astable multivibrator

- Free running multivibrator
- Rectangular wave generating circuit
- It does not require an external trigger to change the state of the output
- The time during which the output is either high or low is determined by the two resistors and a capacitor, which are externally connected to the 555 timer.

- Applications

1) Square wave oscillator
2) Free running ramp generator

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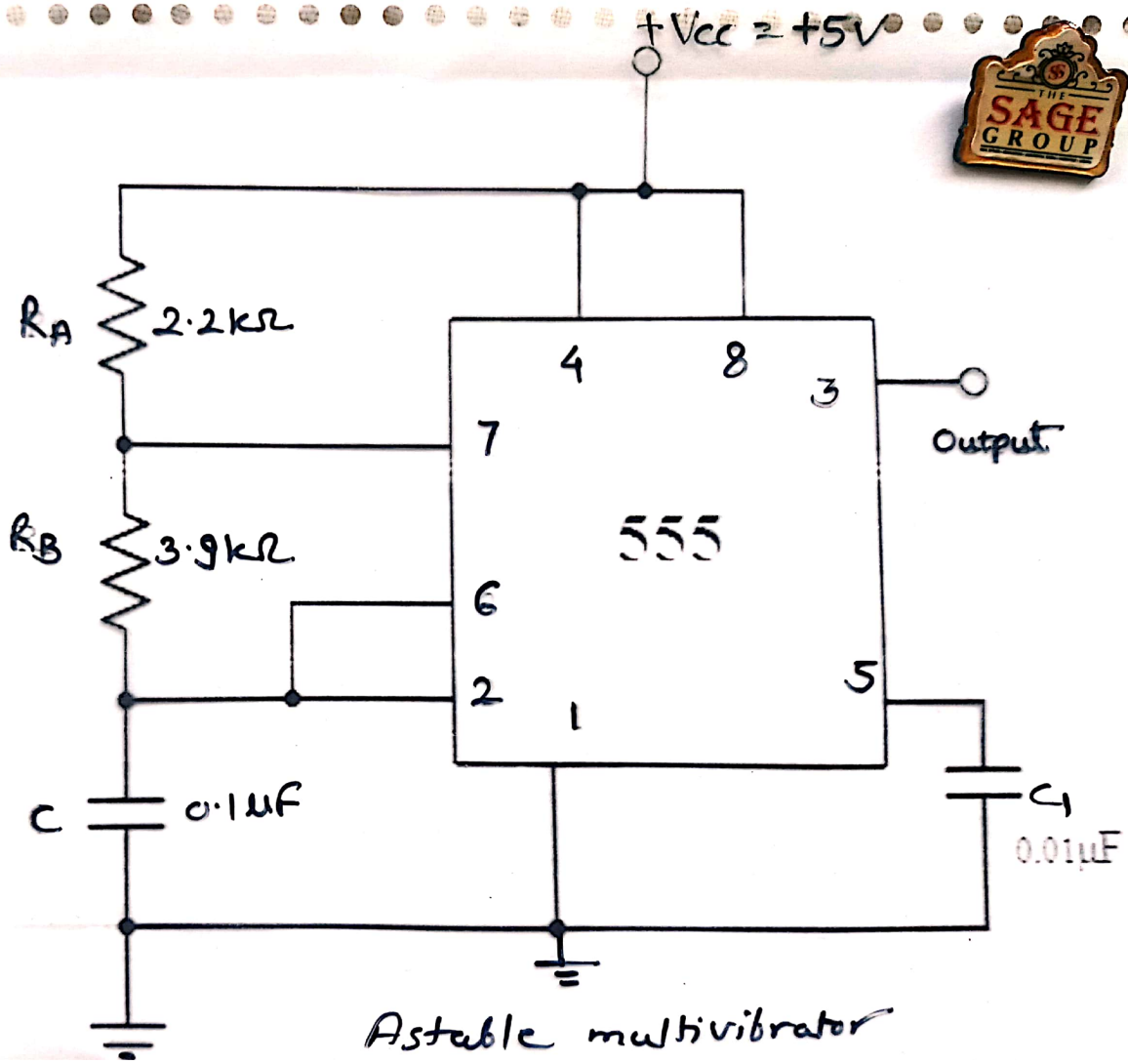

Astable multivibrator

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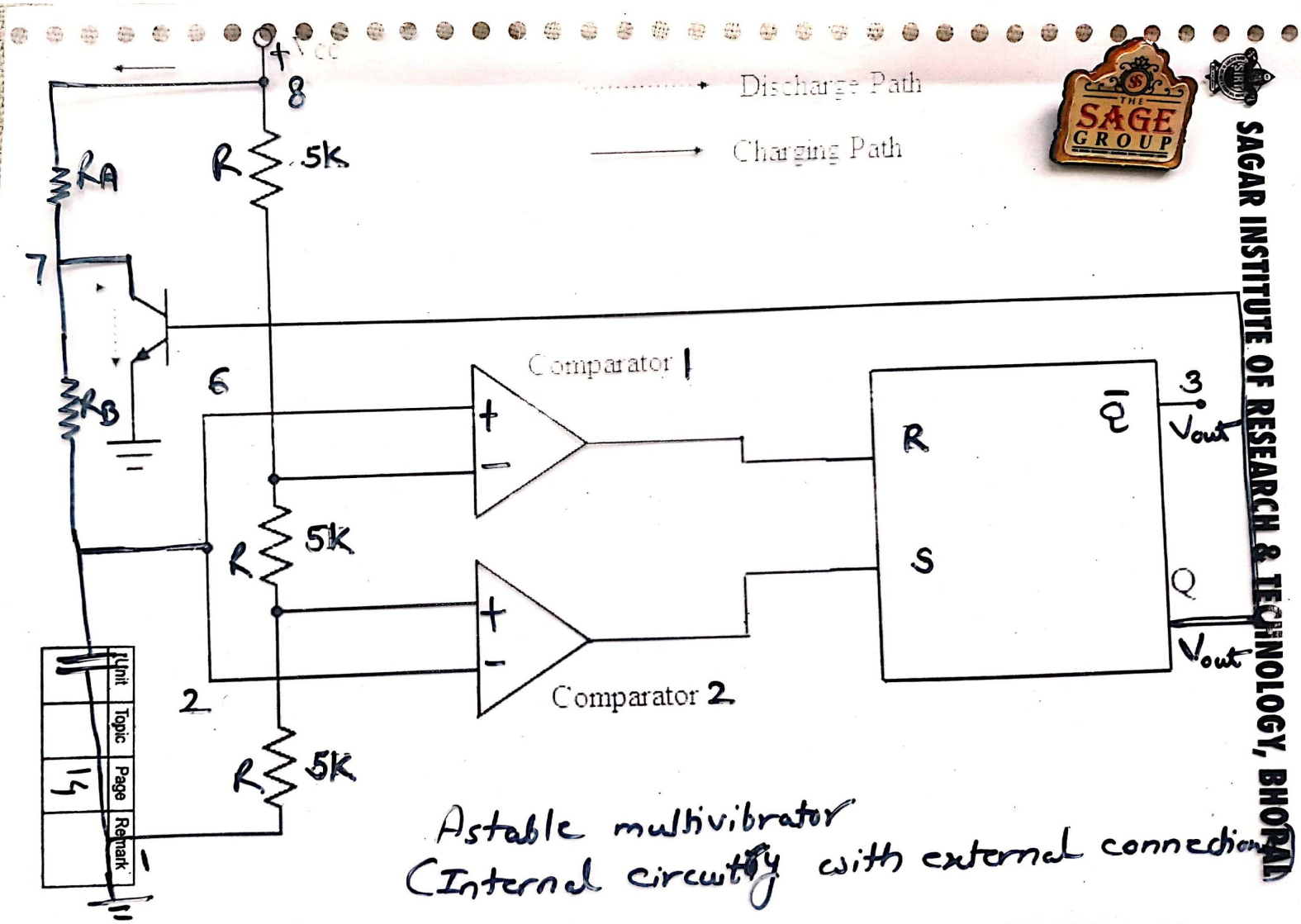

Astable multivibrator
CInternal circuitry with external connection

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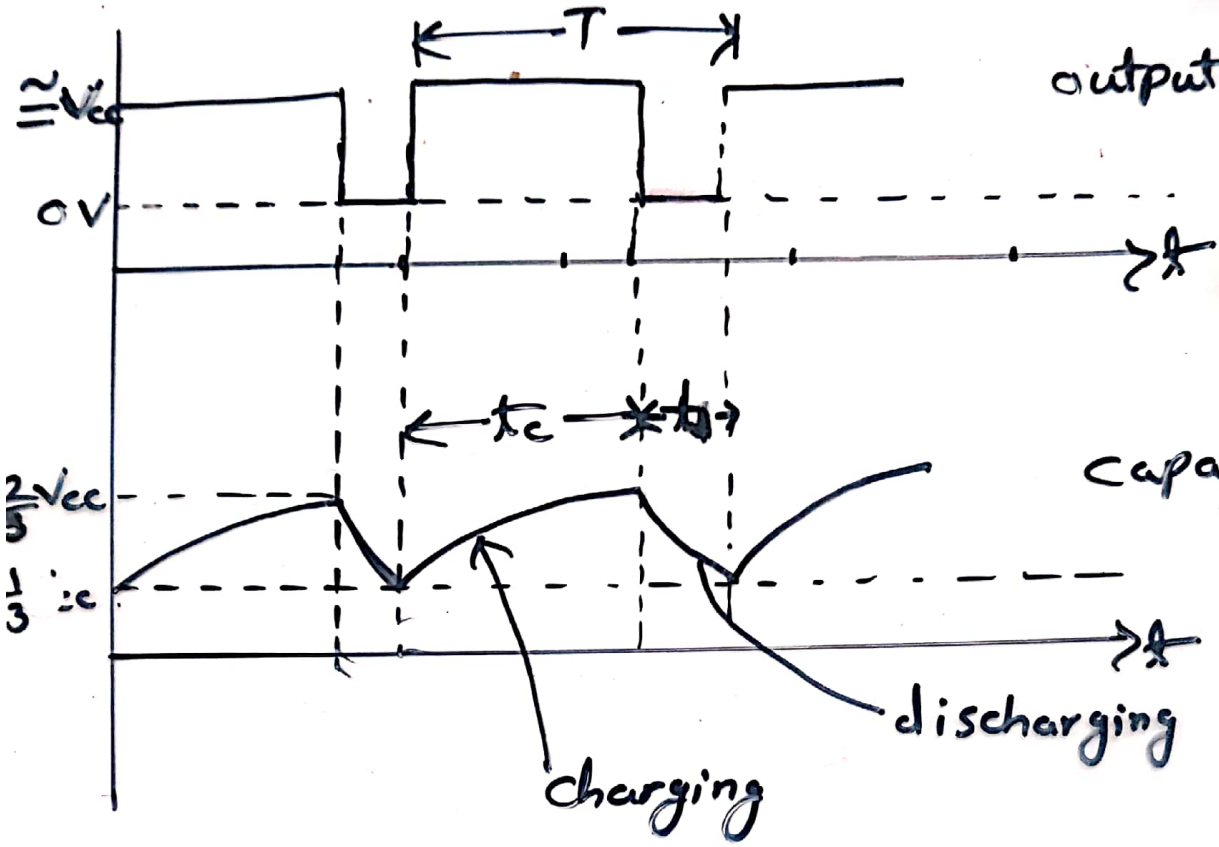

- The capacitor is periodically charged and discharged between $\frac{2}{3}V_{cc}$ and $\frac{1}{3}V_{cc}$ respectively.
- The time during which the capacitor charges from $\frac{1}{3}V_{cc}$ to $\frac{2}{3}V_{cc}$ is equal to the time the output is high and is given by

$$t_c = 0.693(R_A + R_B)C \quad \text{—(1)}$$

- The time during which the capacitor discharges from $\frac{2}{3}V_{cc}$ to $\frac{1}{3}V_{cc}$ is equal to the time the output is low

$$t_d = 0.693(R_B)C \quad \text{—(2)}$$

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The total period of the output waveform is

$$T = t_c + t_d = 0.69(R_A + 2R_B)C \quad \text{— (3)}$$

frequency of oscillation

$$f_o = \frac{1}{T} = \frac{1.45}{(R_A + 2R_B)C} \quad \text{— (4)}$$

$$\% \text{ duty cycle} = \frac{t_c}{T} \times 100$$

$$= \frac{R_A + R_B}{R_A + 2R_B}(100)$$

— (5)

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