SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECB202 – LINEAR AND DIGITAL CIRCUITS

II YEAR/ III SEMESTER

UNIT 2 – **COMPARATORS AND SPECIAL FUNCTION IC's**

TOPIC 3 **– TIMER IC 555 APPLICATIONS**

APPLICATIONS IN MONOSTABLE MODE

1. Missing Pulse Detector
2. Linear Ramp Generator
3. Frequency Divider
4. Pulse Width Modulation

1.MISSING PULSE DETECTOR

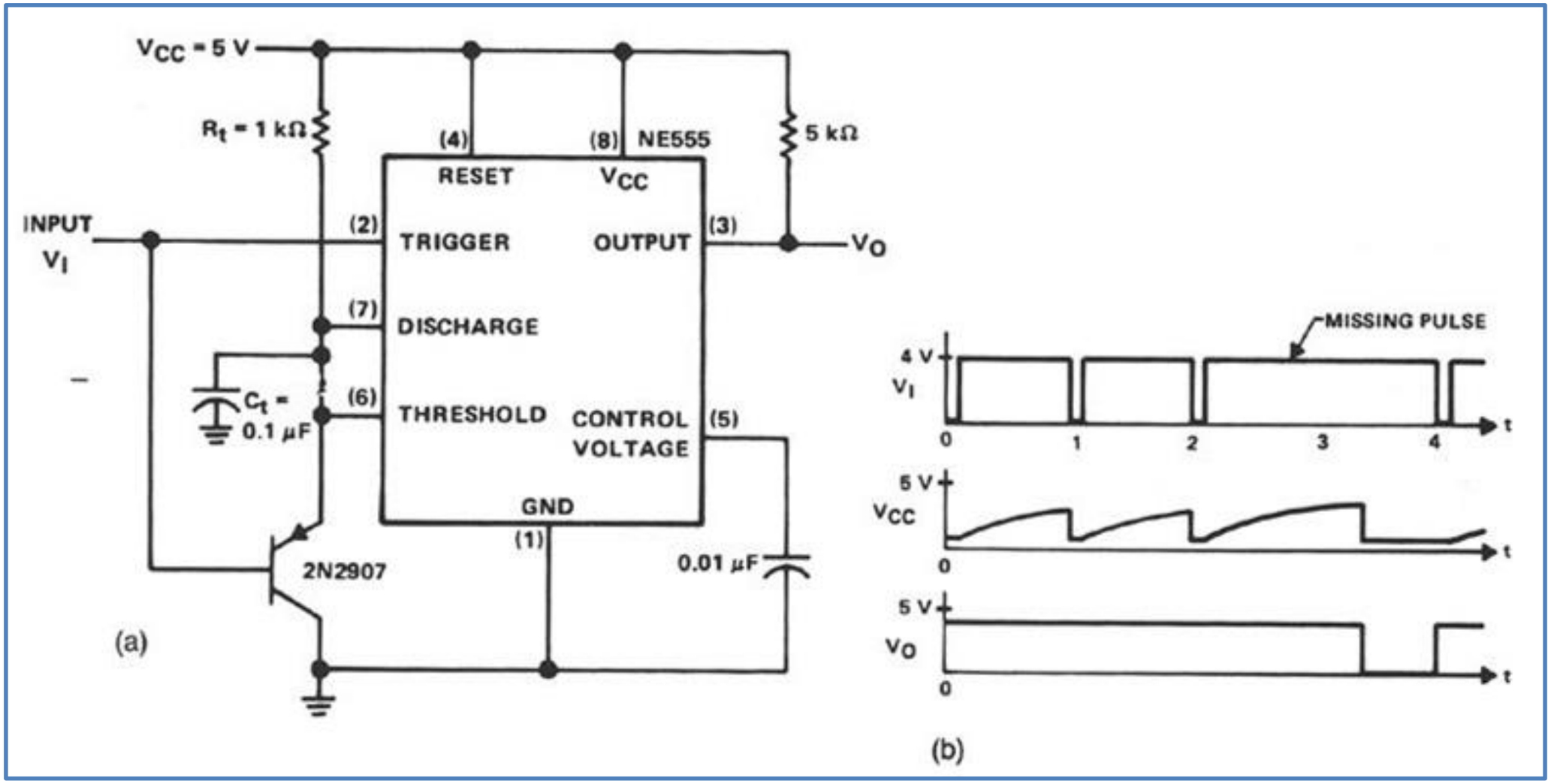


Fig (a) : A missing Pulse Detector Monostable Circuit
Fig (b) : Output of Missing Pulse Detector

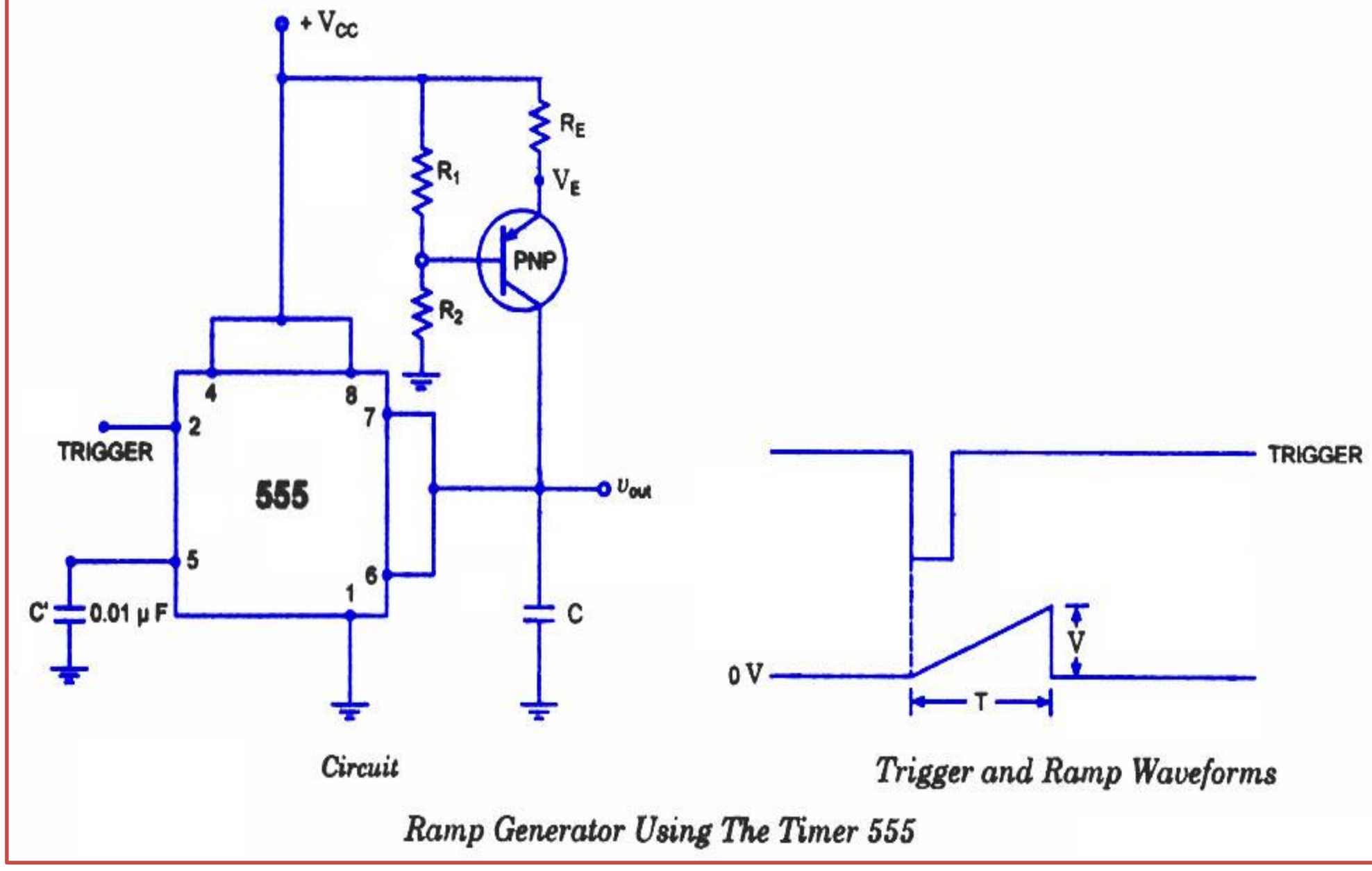
MISSING PULSE DETECTOR

- When input trigger is Low,

  Emitter-base diode of Q is forwarded biased capacitor is clamped to 0.7v(of diode), output of timer is HIGH width of T o/p of timer > trigger pulse width

- T=1.1RC , select R & C such that T > trigger pulse
- Output will be high during successive coming of input trigger pulse
- If one of the input trigger pulse missing trigger i/p is HIGH, Q is cut off, timer acts as normal monostable state
- It can be used for speed control and measurement

2.LINEAR RAMP GENERATOR



Circuit

Trigger and Ramp Waveforms

Ramp Generator Using The Timer 555

WORKING PRINCIPLE

- If a capacitor is charged from a voltage source through a resistor, an exponential waveform is produced
- while charging of a capacitor from a constant current source produces a ramp
- Here the resistor of previous circuits is replaced by a PNP transistor that produces a constant charging current

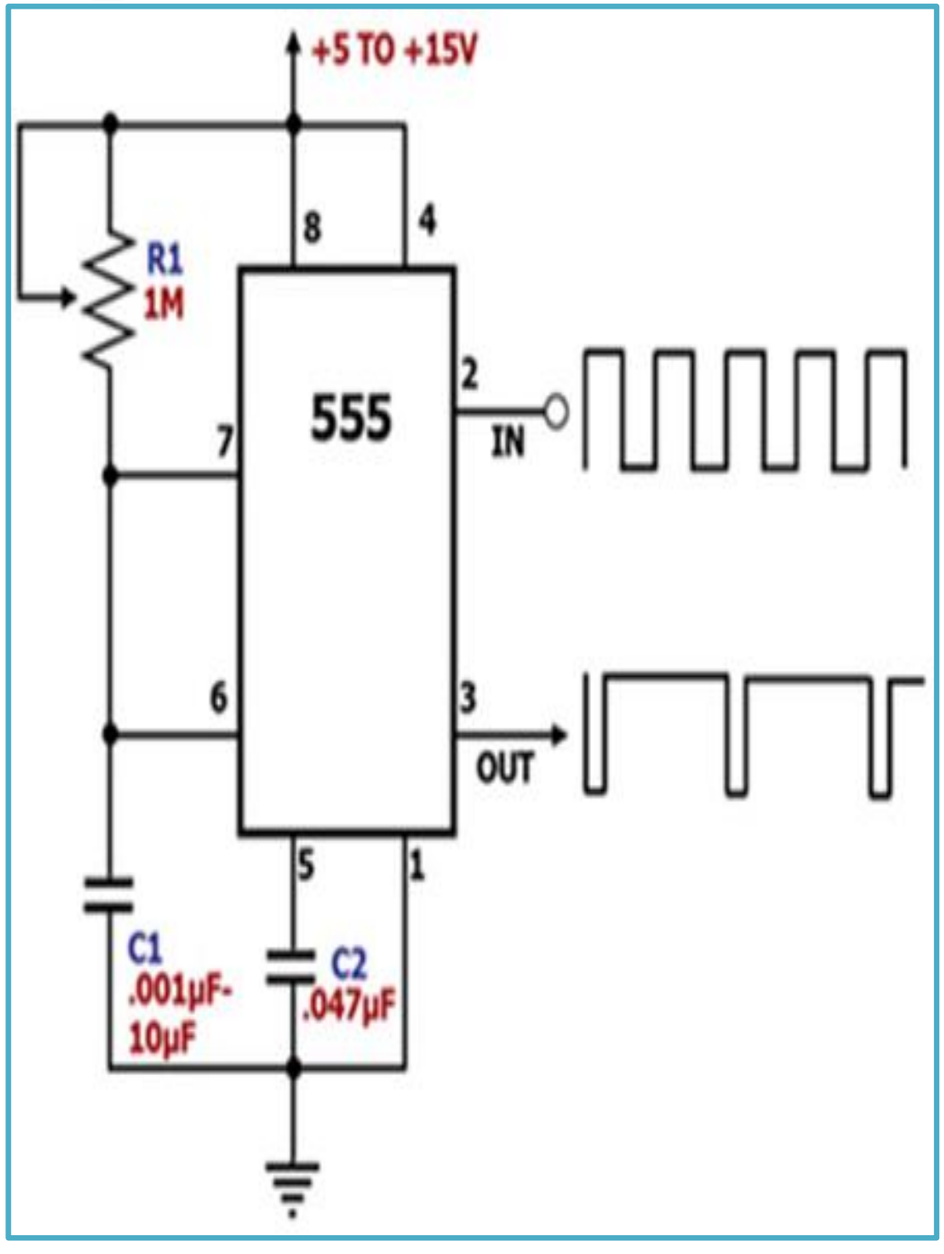
Charging current produced by PNP constant current source is

$$iC = Vcc\text{-}V_E / R_E$$

where $V_E = R_2 / (R_1 + R_2) * VCC + V_{BE}$

- When a trigger starts the PNP current source forces a constant charging into the capacitor C.
- The voltage across the capacitor is a ramp. The slope of the ramp is given as ,Slope, s = I/C

3.FREQUENCY DIVIDER



Description:

- A continuously triggered monostable circuit , when triggered by a square wave generator can be used as a frequency divider
- The monostable multivibrator will be triggered by the first negative going edge of the square wave input
- The output will remain HIGH(because of greater timing interval) for next negative going edge of the input square wave as shown fig

4.PULSE WIDTH MODULATION

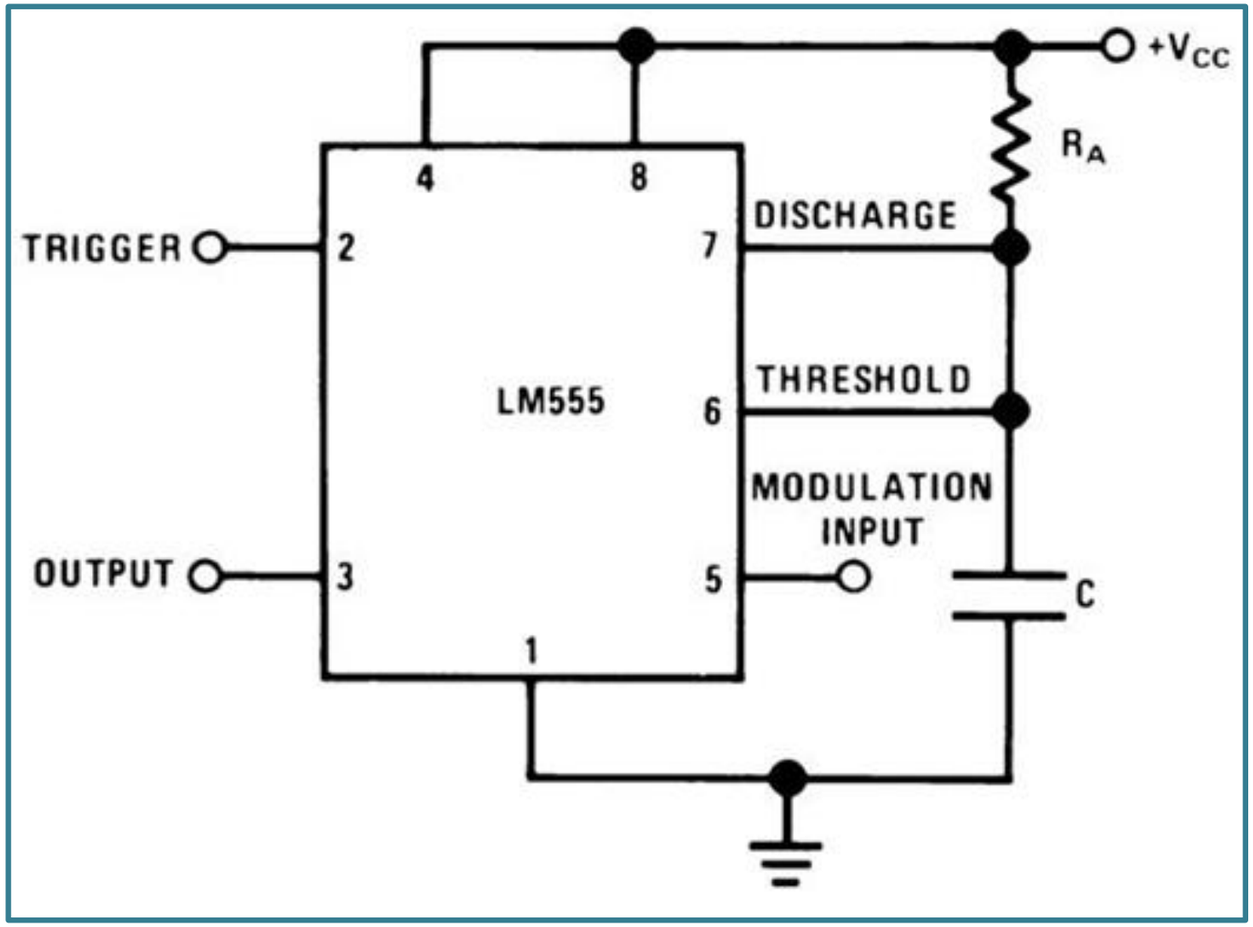


Fig a: Pulse Width Modulation

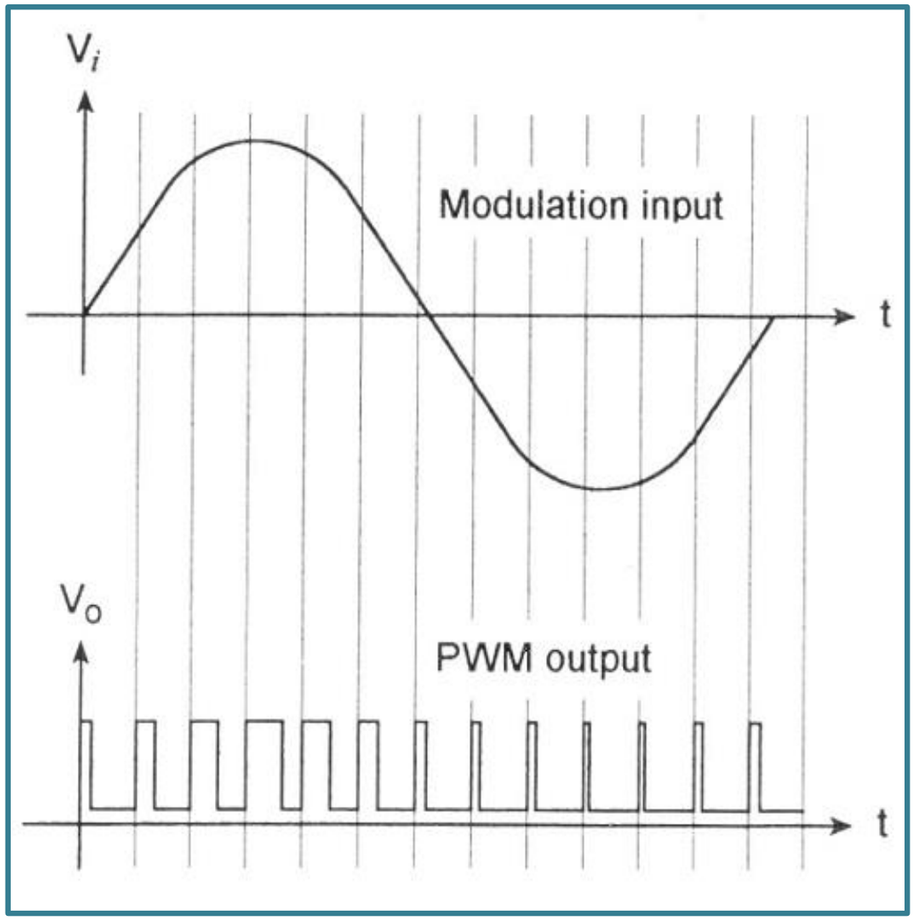


Fig b: PWM Wave Forms

4.PULSE WIDTH MODULATION

- The charging time of capacitor is entirely depend upon 2V**cc**/3.
- When capacitor voltage just reaches about 2V**cc**/3 output of the timer is coming from HIGH to Low level.
- Control this charging time of the capacitor by adding continuously varying signal at the pin-5 of the 555 timer which is denoted as control voltage point

4.PULSE WIDTH MODULATION

- Now each time the capacitor voltage is compared control voltage according to the o/p pulse width change
- So o/p pulse width is changing according to the signal applied to control voltage point. So the output is pulse width modulated form

USES OF 555 TIMER

Practical Representation

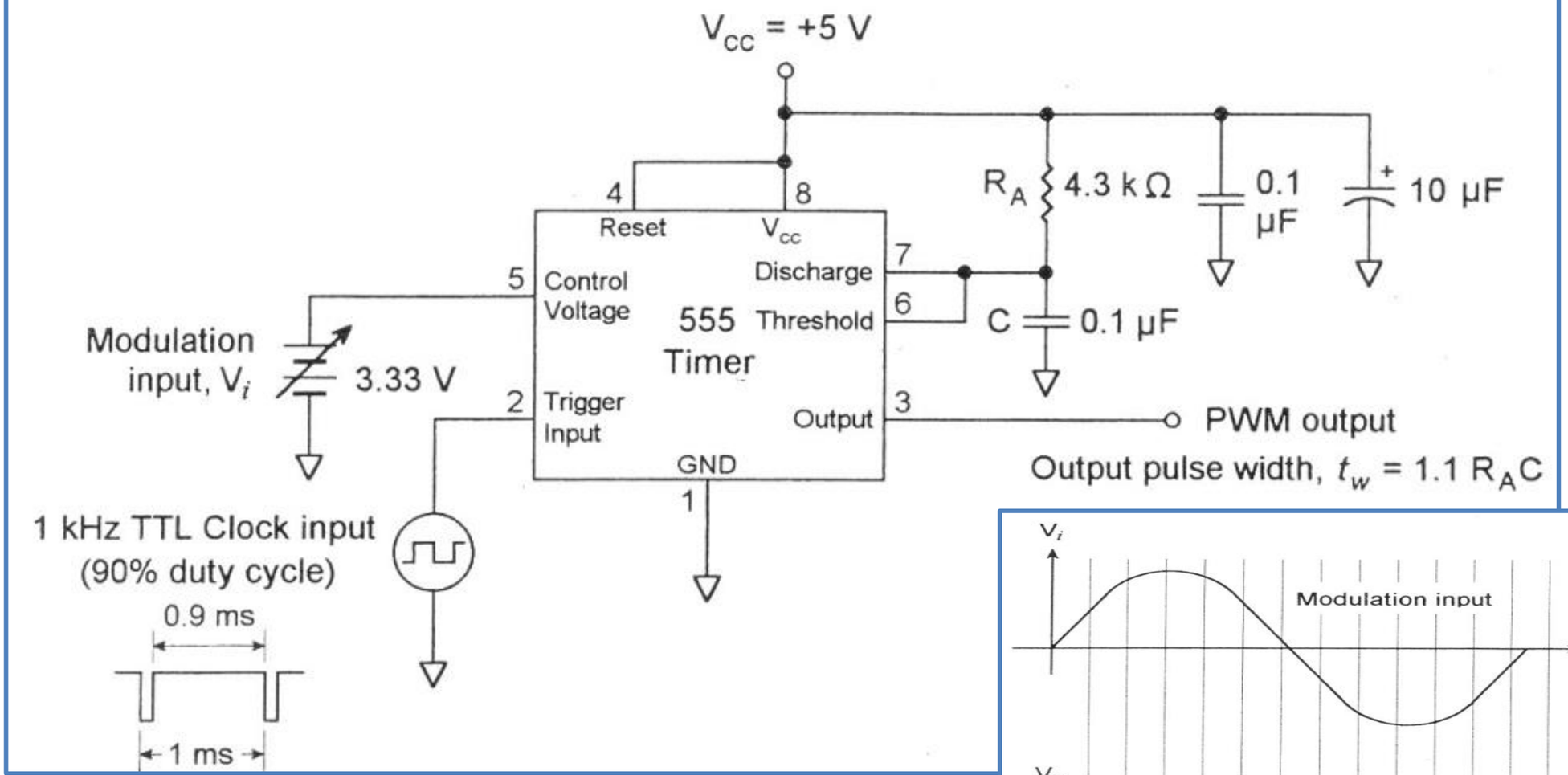
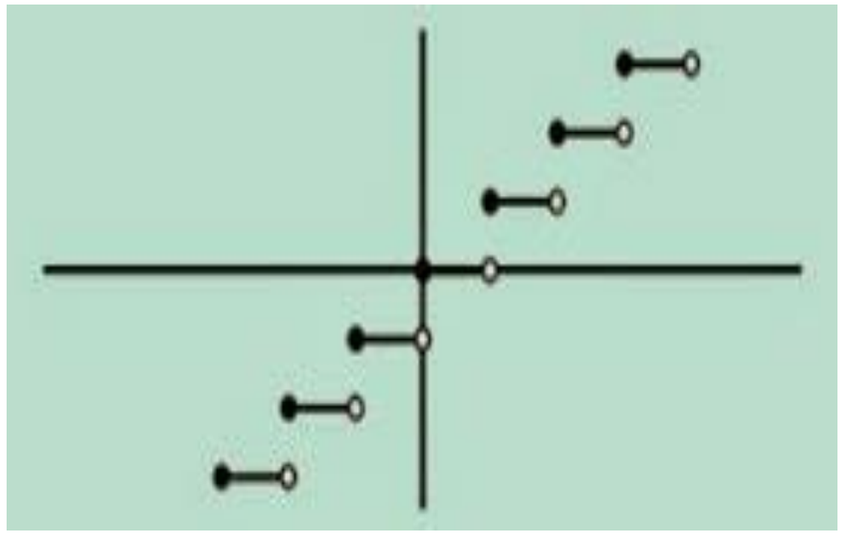


Fig: PWM & Wave forms

Activity

1.Find the name of the movie for the below picture

9.80665 m/s²



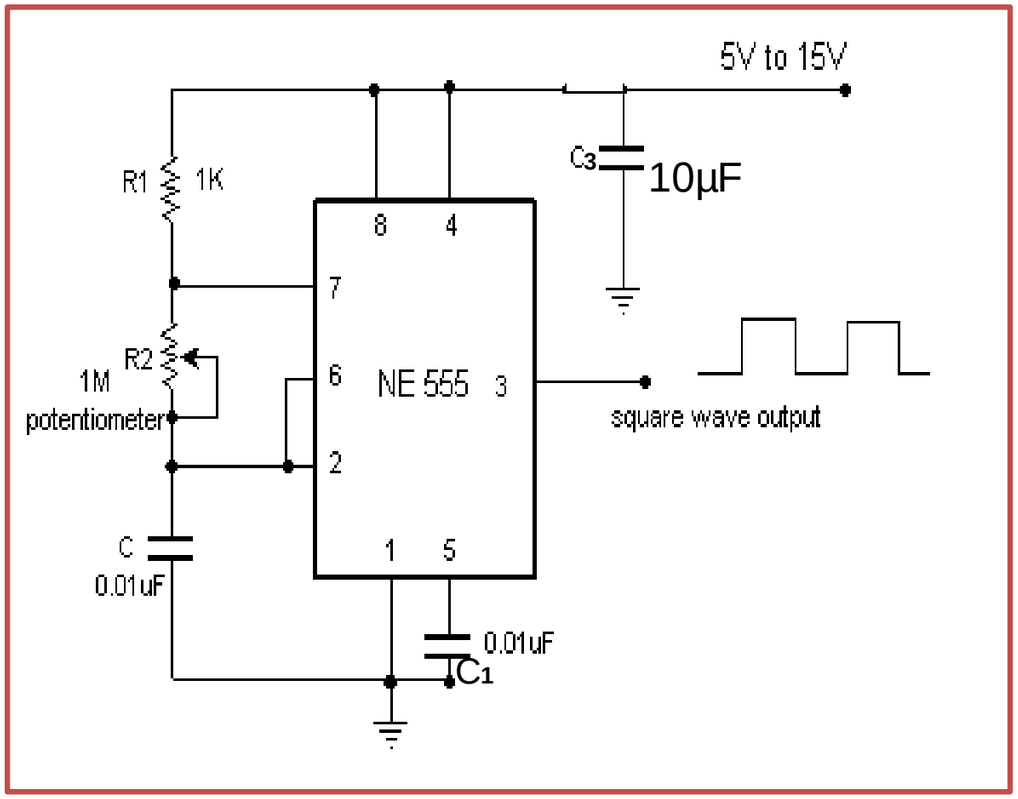
APPLICATIONS IN ASTABLE MODE

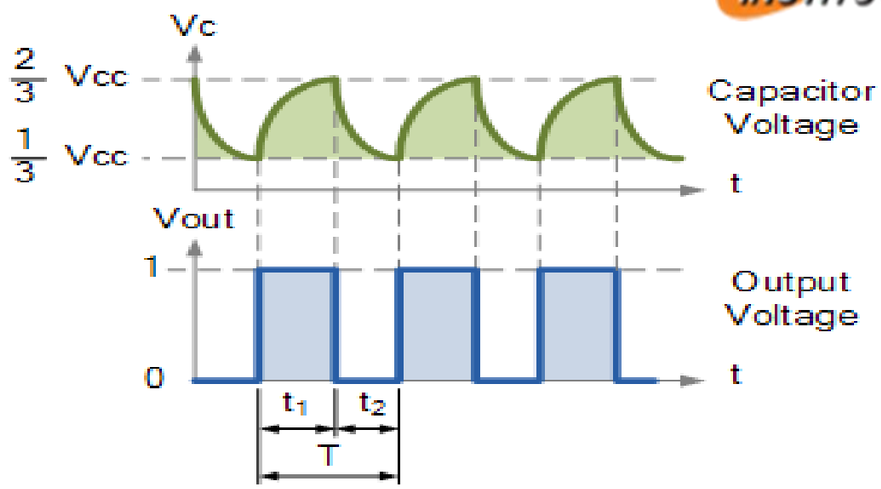
1.Square Generator

2.FSK Generator

3.Pulse Position Modulator

1.SQUARE GENERATOR





$$DutyCycle = \frac{(R_1 + R_2)}{(R_1 + 2R_2)} X100 = 50\%$$

$$Here\ R_1 = 0$$

- To avoid excessive discharge current through Q**1** when R**1**=0 connect a diode across R**2**, place a variable R in place of R**1**.
- Charging path R**1** & D; Discharging path R**2** & pin 7.

1.SQUARE GENERATOR

- Then the capacitor charges up to 2/3Vcc which is determined by the 0.693(R1+R2)C combination
- Discharges itself down to 1/3Vcc determined by the 0.693(R2*C) combination.
- This results in an output waveform whose voltage level is approximately equal to Vcc – 1.5V and output “ON” and “OFF” time periods are determined by the capacitor and resistors combinations.

Astable 555 Oscillator Charge and Discharge Times

$$t_1 = 0.693(R_1 + R_2).C$$

and

$$t_2 = 0.693 \times R_2 \times C$$

Where, R is in Ω and C in Farads.

2. FSK GENERATOR

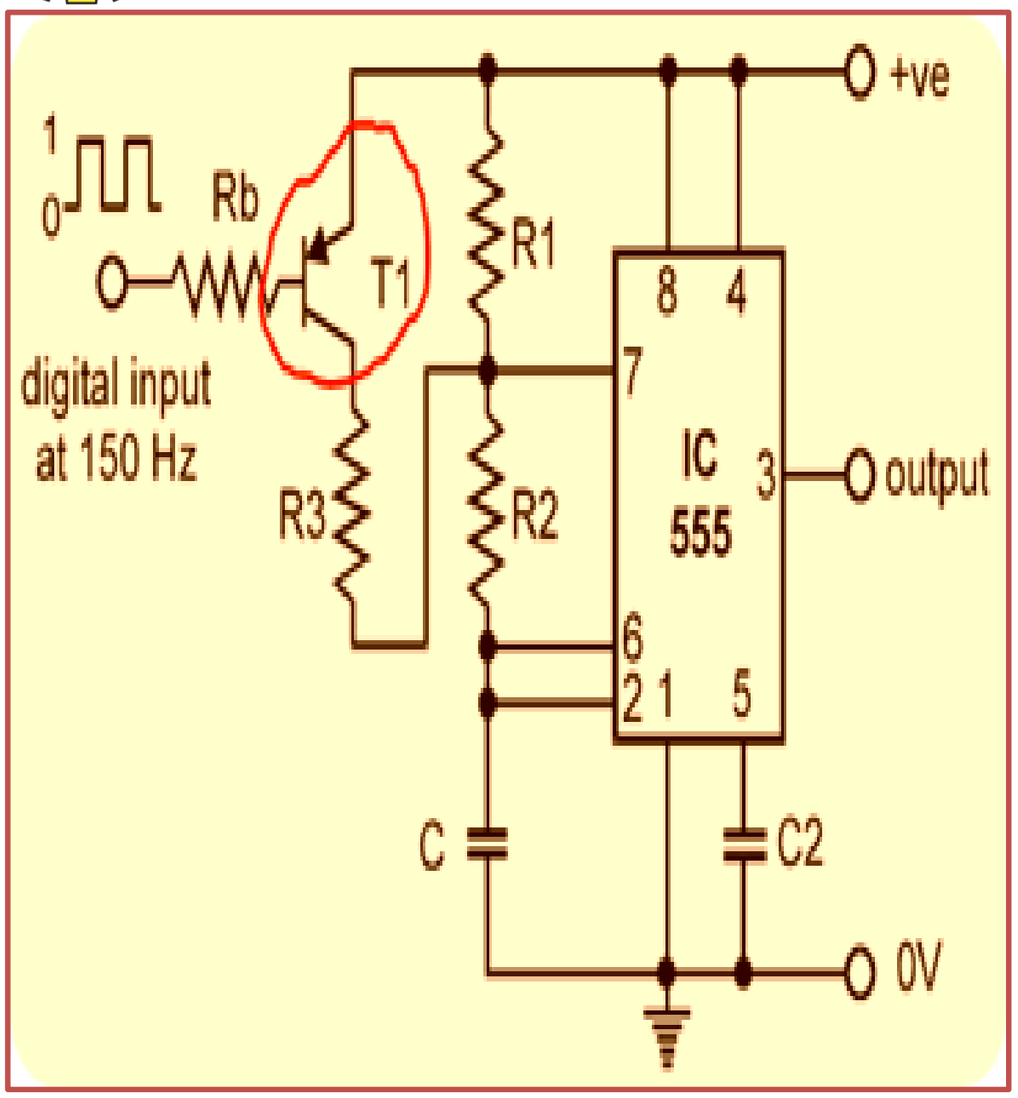
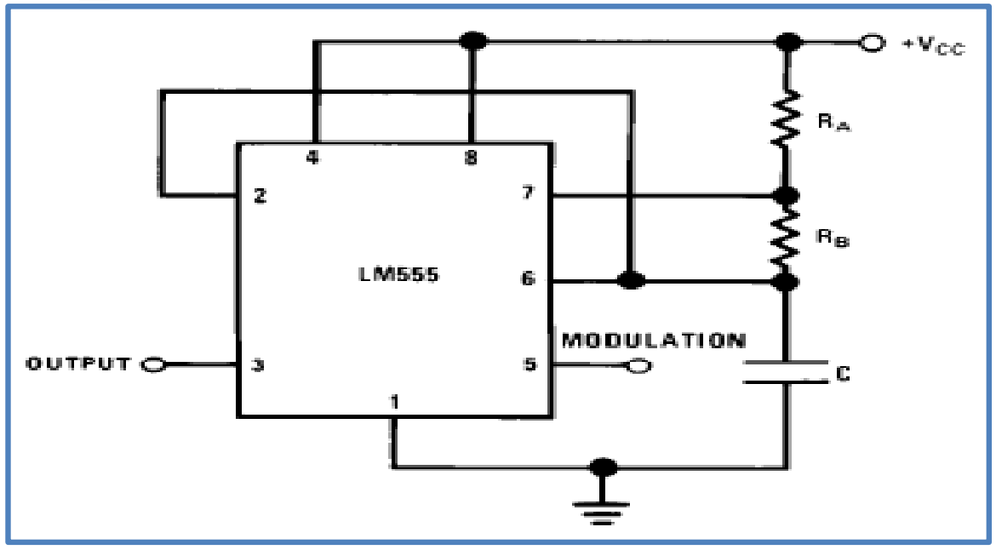


Fig: FSK Generator

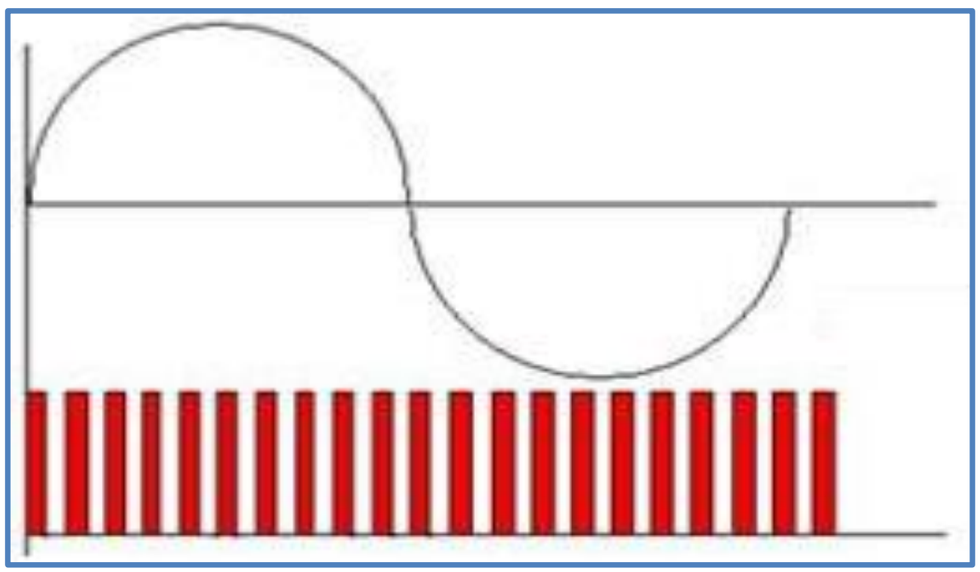
Description:

- In digital data communication, binary code is transmitted by shifting a carrier frequency between two preset frequencies.
- This type of transmission is called Frequency Shift Keying (FSK) technique.

3. PULSE POSITION MODULATOR



Pulse position Modulator



Output Wave Form

- The pulse position modulator can be constructed by applying a modulating signal to pin 5 of a 555 timer connected for astable operation
- The output pulse position varies with the modulating signal, since the threshold voltage and hence the time delay is varied
- The output waveform that the frequency is varying leading to pulse position modulation

Comparison of Multivibrator Circuits

Monostable Multivibrator	Astable Multivibrator
1. It has only one stable state	1. There is no stable state
2. Trigger is required for the operation to change the state.	2. Trigger is not required to change the state hence called free running.
3. Two comparators R and C are necessary with IC 555 to obtain the circuit.	3. Three components R**A**, R**B** and C are necessary with IC 555 to obtain the circuit.
4. The pulse width is given by T=1.1RC Seconds	4. The frequency is given by,
5. The frequency of operation is controlled by frequency of trigger pulses applied.	5. The frequency of operation is controlled by R**A**, R**B** & C.
6. The applications are timer, frequency divider, pulse width modulation etc…	6. The applications are square wave generator, flasher, voltage controlled oscillator, FSK Generator etc..

Assessment

1. A 555 timer in monostable application mode can be used for
   a) Pulse position modulation
   b) Frequency shift keying
   c) Speed control and measurement
   d) Digital phase detector
   Answer: c
2. Which among the following can be used to detect the missing heart beat?
   a) Monostable multivibrator
   b) Astable multivibrator
   c) Schmitt trigger
   d) None of the mentioned
   Answer: a

THANK YOU