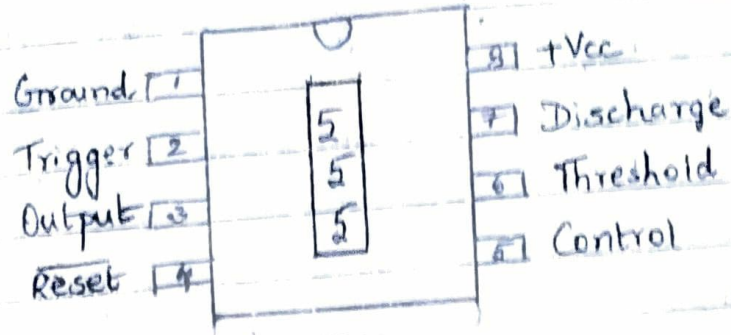
Suba 1

STUDY OF ICs

IC 555 :- This is a timer IC having 8 pins. The pinout diagram of this IC is shown below.



Special features of IC 555

(1) It is a low cost timer capable of producing precise time delays with a wide range.

(2) Connecting it in either of the three operating modes, astable, monastable or bistable, we can connect it in many parts of electronic circuits.

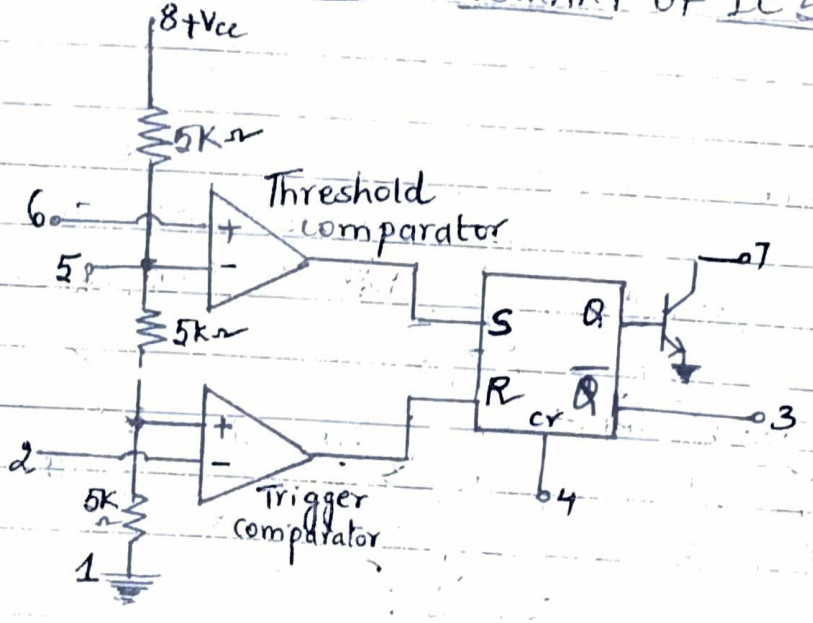
(3) Time delay produced by IC 555 is more acurate and it is independent of supply voltage. For example, if you

adjust it for time delay of 5 seconds with 10 V supply, then this delay time will not change even if you connect the circuit with 12V or 8V supply. In other words, variations in supply do not affect its time delay.

(4) IC 555 is a compatible IC ie it can be used in analog as well as digital circuits

(5) Supply voltage range for this IC is 3 V to 18 V and can provide maximum load current of 200mA.

INTERNAL BLOCK DIAGRAM OF IC 555



Internally, IC 555 has three 5K Ω resistors forming a potential divider arrangement. Hence called 555. The voltage at pin 5 is therefore equal to $\frac{2}{3}$ Vcc. This is a fixed reference voltage for threshold comparator given at its inverting terminal. The other reference voltage is $\frac{1}{3}$ Vcc given to the non-inverting terminal of trigger comparator. When the threshold voltage (pin 6 voltage) is greater than or equal to $\frac{2}{3}$ Vcc, the output of the threshold comparator goes high. Otherwise, output is low. When the trigger voltage (pin 2 voltage) is greater than or equal to $\frac{1}{3}$ Vcc, the output of the trigger comparator goes low. However, when the trigger voltage is less than $\frac{1}{3}$ Vcc, the output goes high. The output of the threshold comparator is the S input of RS FF and output of the trigger comparator is its R input. The $\bar{Q}$ Output of the flipflop is taken out as Q. pin 3, which is the output pin of the IC. Q output is

~~also~~ connected to the base of the transistor whose collector is pin 7.

Pins 8 and 1 :-

Pin 8 is the pin for connecting the positive of a power supply and pin 1 is for its negative terminal. If proper voltage is not applied between pins 8 & 1, IC will not function.

Pin 7 :-

This pin is internally connected to the collector of the discharge transistor. When a externally connected capacitor is placed between pin 7 and ground, the transistor provides a path for this capacitor to discharge. Hence the transistor is called discharge transistor.

Pin 6 :-

This pin is internally connected to the non-inverting terminal of the

threshold comparator. Voltage at pin 6 is called the threshold voltage and when this threshold voltage becomes $\geq \frac{2}{3} V_{cc}$, output of this comparator goes high.

Pin 5 :-

At this pin, we get a reference voltage of $\frac{2}{3} V_{cc}$. This is the control voltage for the IC.

Pin 4:-

Pin 4 is internally connected to the clear or reset input of the RS FF. It is used for resetting a FF. ie if the voltage at pin 4 is low, T_2 starts conducting and a low voltage is given to the clear input of the RS FF resulting in $Q = 0$, $\bar{Q} = 1$. For normal operation, pin 4 voltage must be high.

Pin 3:-

This is is the output pin of the IC 555. An indicator is normally connected between this pin and $+V_{cc}$ or

ground. The indicator condition ON or OFF will indicate the output of this IC.

Pin 2 :-

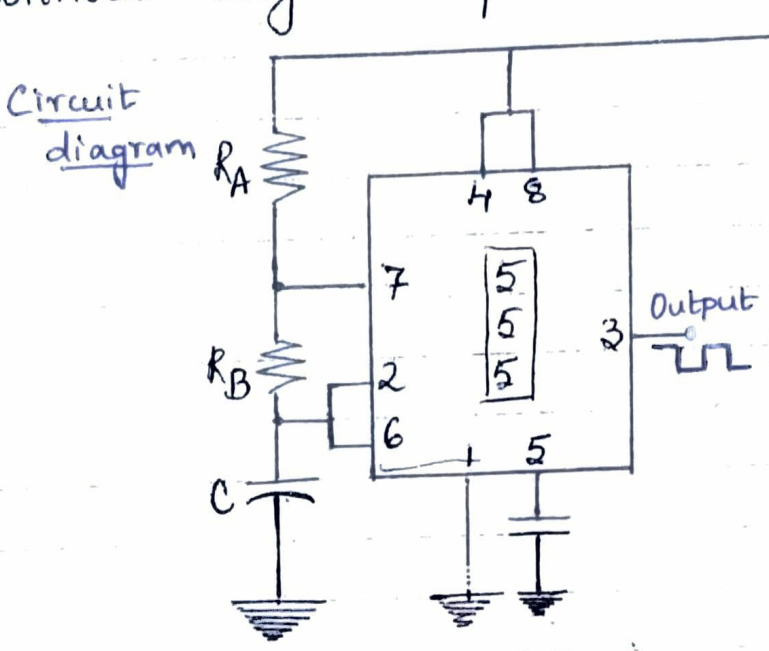
This pin is the trigger point of the IC. Whenever ~~the~~ a trigger is to be given, it is applied to pin 2. If this trigger voltage is $< \frac{1}{3} V_{cc}$, the trigger comparator gives a high output.

Applications :-

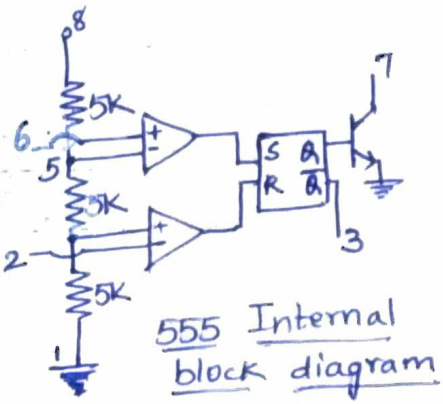
1) 555 as a Astable Multivibrator

Astable multivibrator is one which has no stable state. It remains in one state for a short period of time, decided by the circuit components R & C value, and then by itself, switches to the other possible state. In this state also, it remains for a short period and returns back to the original state. Hence called a 'free-running' multivibrator.

Of all the multivibrators, astable multivibrator is the only oscillator. It generates a square wave output without any ac input.



Circuit diagram



555 Internal block diagram

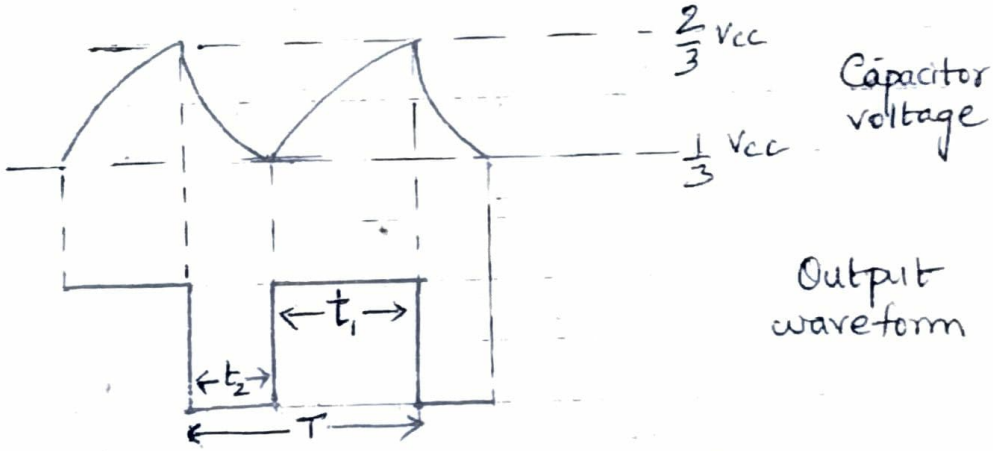
The instant the supply is turned on, capacitor voltage being zero, the voltage at pins 2 and 6 equal zero. The threshold comparator therefore gives a low output, while the trigger comparator gives a high output. For $S=0$, $R=1$ we will have $Q=0$, $\bar{Q}=1$. With $\bar{Q}=1$, the voltage at pin 3 ie the output of

IC is high.

Now, the capacitor is charging through $R_A + R_B$. When the capacitor voltage exceeds $\frac{2}{3}$ Vcc, we will have pin 6 & pin 2 voltage $> \frac{2}{3}$ Vcc. For this threshold comparator will give high output and trigger comparator will give low output. ie R=0, S=1. This will set the FF ie Q=1, $\bar{Q}$=0. Voltage at pin 3 will therefore go low.

Since Q=1, the internal discharge transistor T_1 turns ON. The charged capacitor therefore discharges through R_B and T_1. Capacitor voltage is decreasing and when it falls below $\frac{1}{3}$ Vcc, the voltage at pins 2 and 6 is $< \frac{1}{3}$ Vcc. This will result in threshold comparator providing a low output and trigger comparator providing a high output - ie R=1, S=0 and we have Q=0, $\bar{Q}$=1. Voltage at pin 3 ∴ once again goes high.

This charging and discharging action of capacitor continues, as long as the supply is ON. The result is a square wave output. However the output of this circuit is not a symmetrical square wave because charging time is decided by $(R_A + R_B)C$ and discharging time is decided by $R_B C$.



$$t_1 = 0.693\,(R_A + R_B)C$$

$$t_2 = 0.693\,R_B C$$

$$T = t_1 + t_2$$

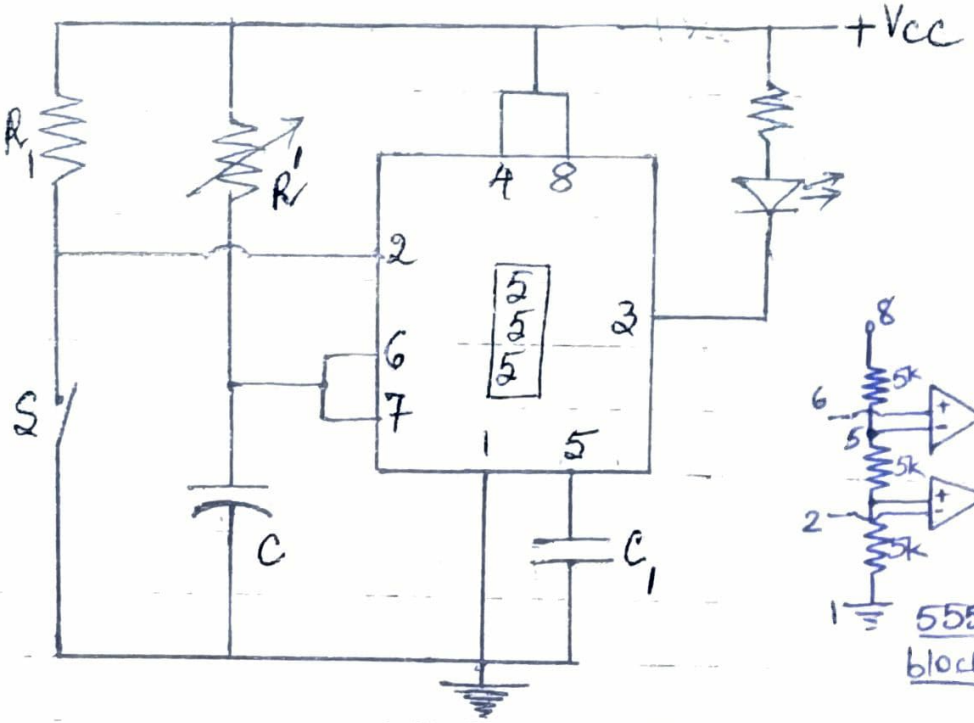
$$F = \frac{1}{T} = \frac{1.44}{(R_A + 2R_B)C} \text{ Hz}$$

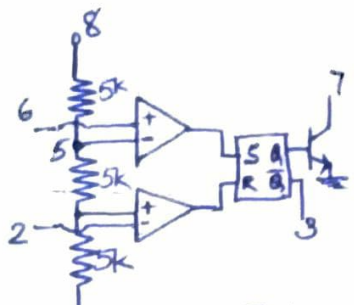
Duty cycle is defined as the ratio of the ON time to the period.

$$\therefore D = \frac{t_1}{T} = \frac{R_A + R_B}{R_A + 2R_B}$$

2) 555 as a Monostable multivibrator:

Circuit diagram





555 Internal block diagram

Monostable multivibrator is one which has one stable state. When triggered it goes from the stable state to an unstable

State where it remains for a short period decided by the value of R & C and then returns by itself to the stable state. It shows a tendency to remain forever in the stable state until triggered.

Suppose the switch is open, with the supply turned ON. Voltage at pin 2 is high and therefore trigger comparator output is low. Capacitor is charging through R' and when the capacitor voltage becomes $\geq \frac{2}{3} V_{cc}$, output of threshold comparator goes high since pin 6 voltage is the capacitor voltage. For R=0, S=1 we have Q=1, $\bar{Q}=0$ Voltage at pin 3 is ∴ low and LED glows.

With Q=1, discharge transistor T_1 turns ON and external capacitor C discharges through it. When capacitor voltage (pin 6 voltage) becomes $< \frac{2}{3} V_{cc}$ output of threshold comparator also goes low. Trigger comparator output is still low since switch is open.

$R=0, S=0$ and FF does not change state. ∴ LED still glows.

Suppose we trigger this circuit by closing and immediately opening the switch. When the switch is closed, pin 2 voltage becomes zero and trigger comparator output goes high. Therefore $S=0$, $R=1$ (∵ threshold comparator output is low). This gives $Q=0$, $\bar{Q}=1$. Voltage at pin 3 is high and LED is dark. T_1 cuts off with $Q=0$ and therefore capacitor starts charging again through R. When capacitor voltage ie pin 6 voltage becomes $> \frac{2}{3} V_{cc}$, threshold comparator output goes high. At the same time, since switch is gone back to the open condition, $R=0$. We have $R=0, S=1$ which SETS the FF, Voltage at pin 3 again goes low & LED glows.

The time taken by the LED to go from the dark state to the

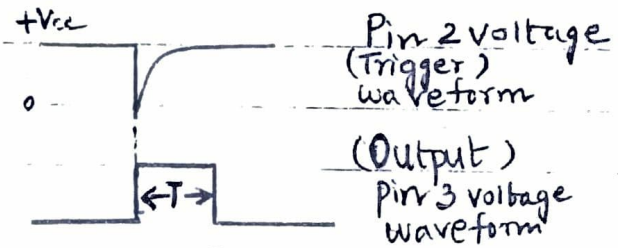
glowing state is simply equal to the time taken by the capacitor to charge to a voltage equal to $\frac{2}{3}V_{cc}$.

The delay time (time for which LED is dark) is therefore dependent on the value of R' and C.

Using the charging equation $V_C = V_{cc}(1 - e^{-T/RC})$ with $V_C = \frac{2}{3}V_{cc}$ we have delay time $T = 1.1R'C$

ie delay time is independent of supply voltage.

Capacitor C_1 is connected in the circuit to keep the control voltage fixed at $\frac{2}{3}V_{cc}$ by providing a path to ground for any unwanted signal that may interefere with this voltage at pin 5. C_1 is used between pins 5 and 1 in all 555 applications.



IC 741 :-

This is basically an OPAMP IC, widely used in industry as a universal package, while designing various instruments, control circuits and in high gain amplifiers.

Special features

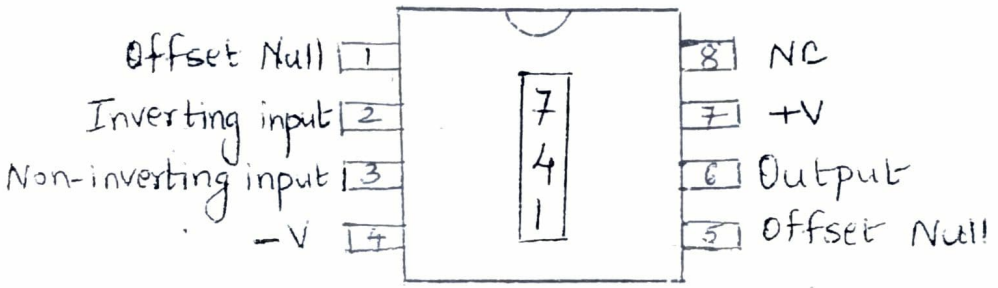
(1) It has two inputs inverting (−) and noninverting (+) and it provides pins for nulling of offset error voltage.

(2) IC 741 is available in two grades, the military 741M and commercial 741C

(3) IC 741 can be used in almost every branch of electronics, in both linear and digital circuits. For instance, linear applications are amplifiers, summing amplifier, differentiator etc. while digital applications are monostable, astable multivibrators, schmitt trigger, Comparator etc.

(4) High gain about 10^3 to 10^6, large bandwidth about few M Hz, high

input impedance and low output impedance. These are the specifications which have made this IC more popular.



Pins 1 and 5 :-

These are the two pins for nulling the offset voltage. A potentiometer can be connected between these two pins and can be adjusted till offset (error output) is made zero.

Pins 2 and 3 :-

These are the two input pins — noninverting (pin 3), inverting (pin 2). An ac signal or dc voltage applied to pin 3 will produce an in phase output signal or a signal of same polarity.

An ac signal or dc voltage applied to pin 2 will produce at the output, 180° out of phase signal or opposite polarity voltage.

Pins 4 and 7:—

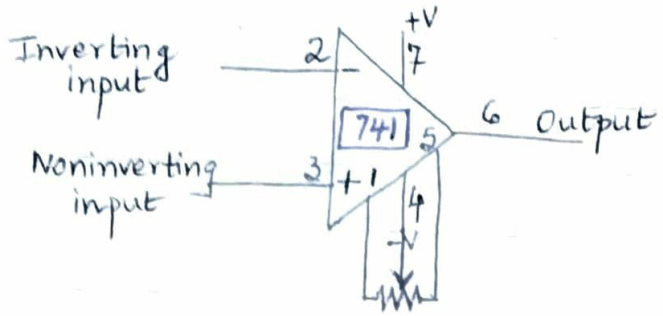
These are the supply pins for the IC. Pin 7 is for connecting positive terminal of dual power supply and pin 4 is for connecting negative terminal. Pin 4 can be connected to ground, but in that case, negative output will not be produced.

Pin 6 :-

This is the output pin of the IC. ie internally connected to the output of an OPAMP.

Pin 8:-

This is an extra pin known as NC ie not connected to the internal circuit and hence in practical applications, it is kept open.



Applications of 741 :-

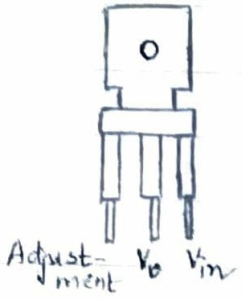
1. Comparator
2. Schmitt Trigger
3. Photo relay
4. Astable multivibrator
5. Monostable multivibrator
6. Any OPAMP application – Buffer, adder, subtractor etc.

} Refer OPAMP notes

IC 317 :-

This is a 3 pin voltage regulator IC.

Pin diagram :-



Block diagram :- Power supply notes

Applications :-

1. As a fixed regulator
2. As a adjustable voltage regulator.

} Power supply notes