Working of 555 Timer

(Unit IV)

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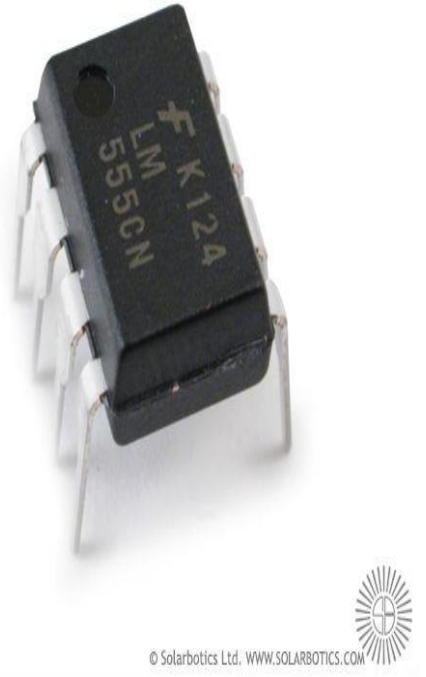
Introduction to IC 555

- The 555 timer IC was introduced in the year 1970 by Signetic Corporation and gave the name **SE/NE 555 timer**.
- It is basically a monolithic timing circuit that produces accurate and highly stable time delays or oscillation.
- When compared to the applications of an op-amp in the same areas, the 555 IC is also equally reliable and is cheap in cost. And works with single power supply (+Vcc only)
- Apart from its applications as a **monostable multivibrator** and **astable multivibrator**, a 555 timer can also be used in **dc-dc converters**, digital logic probes, **waveform generators**, analog frequency meters and tachometers, **temperature measurement** and control devices, **voltage regulators** etc.

Able to generate precise time duration of HIGH and LOW output, from micro seconds to hours, that's why 555 is very popular and versatile IC.

IC 555 details

- The timer IC is set up to work in either of the two modes
- – one-shot or monostable or as a free-running or astable multivibrator.
- The **SE 555** can be used for temperature ranges between – 55°C to 125 °.
- The **NE 555** can be used for a temperature range between 0° to 70°C.

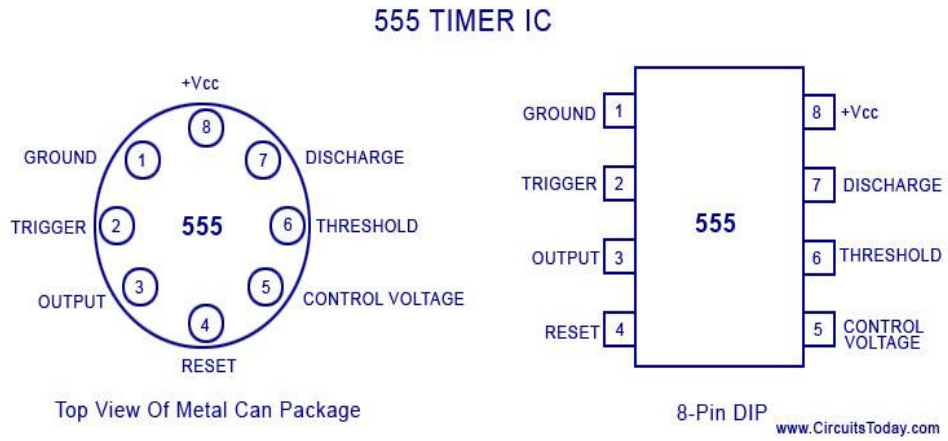


Features of 555

- Power supply ranging from + 5 Volts to + 18 Volts supply voltage.
- Sinking or sourcing 200 mA of load current.
- The external components should be selected properly so that the timing intervals can be made into several minutes along with the frequencies exceeding several hundred kilohertz.
- The output of a 555 timer can drive a transistor-transistor logic (TTL) due to its high current output.
- It has a temperature stability of 50 parts per million (ppm) per degree Celsius change in temperature, or equivalently 0.005 %/ °C.
- The duty cycle of the timer is adjustable.
- The maximum power dissipation per package is 600 mW and its trigger and reset inputs has logic compatibility. More features are listed in the datasheet.

555 pin details

The 555 Timer IC is available as an 8-pin metal can, an 8-pin mini DIP (dual-in-package).

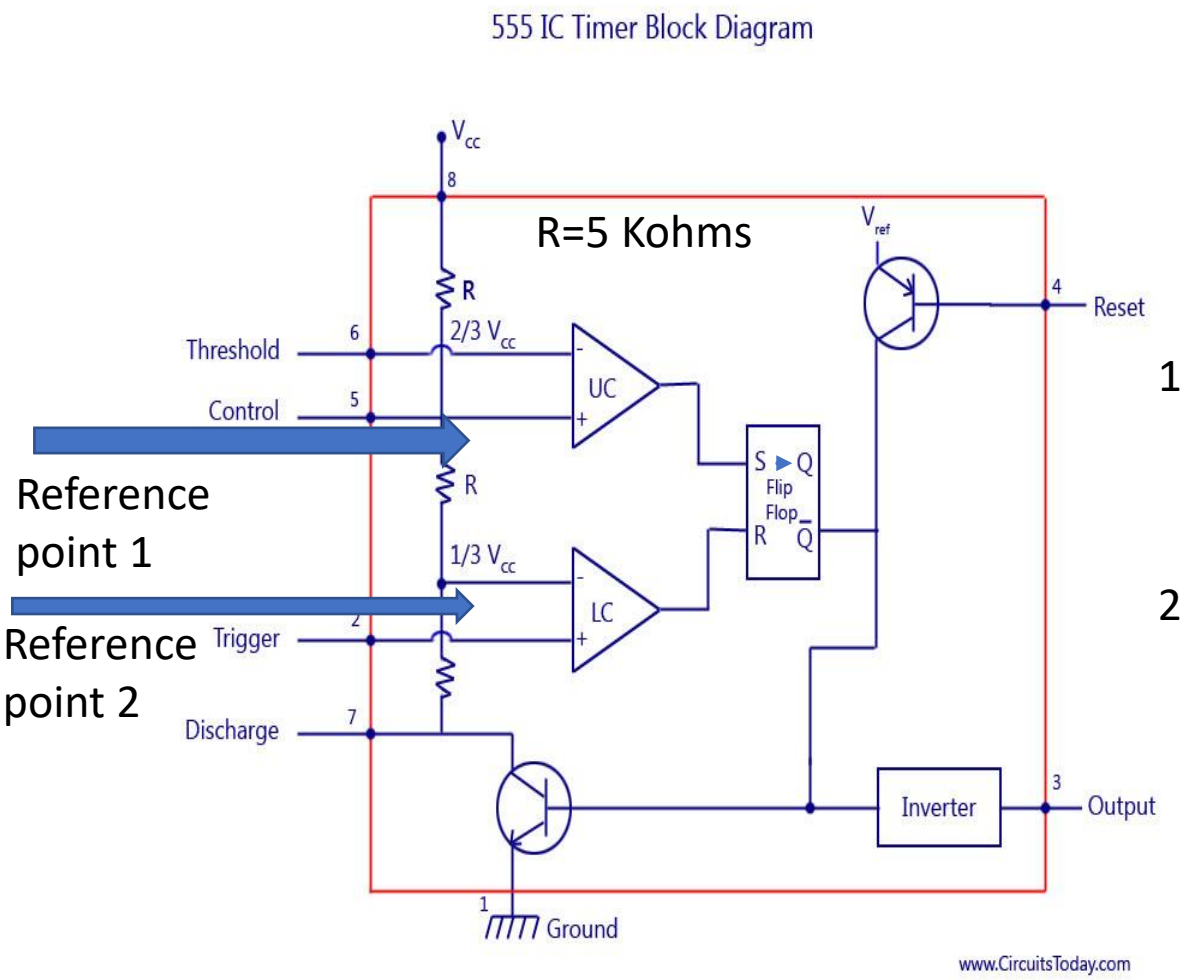


- **Pin 1, ground terminal**
- **Pin 2: Trigger Terminal:** The trigger pin is used to feed the trigger input when the 555 IC is set up as a monostable multivibrator.
- **Pin 3: Output Terminal:** Output of the timer is available at this pin. There are two ways in which a load can be connected to the output terminal.
- **Pin 4: Reset Terminal:** Whenever the timer IC is to be reset or disabled, a negative pulse is applied to pin 4, and thus is named as reset terminal. When this pin is not to be used for reset purpose, it should be connected to + V_{CC} to avoid any possibility of false triggering.
- **Pin 5: Control Voltage Terminal:** The threshold and trigger levels are controlled using this pin. The pulse width of the output waveform is determined by connecting a POT or bringing in an external voltage to this pin.

555- Pin details.

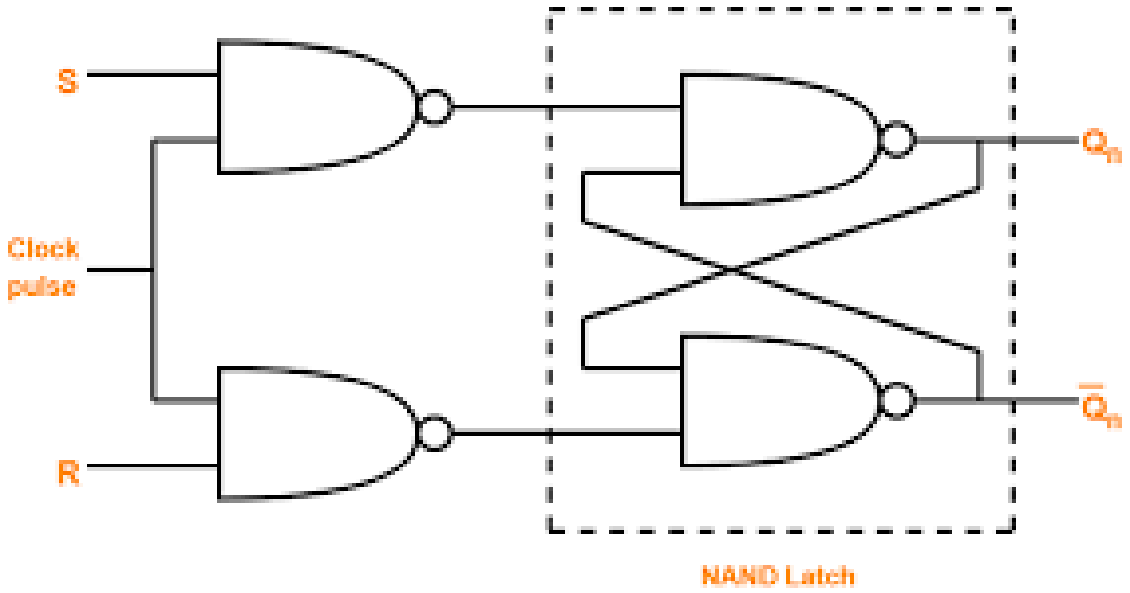
- **Pin 6**: **Threshold Terminal:** This is the non-inverting input terminal of comparator 1, which compares the voltage applied to the terminal with a reference voltage of 2/3 V_{CC}. The amplitude of voltage applied to this terminal is responsible for the set state of flip-flop.
- **Pin 7** : **Discharge Terminal:** This pin is connected internally to the collector of transistor and mostly a capacitor is connected between this terminal and ground. It is called discharge terminal because when transistor saturates, capacitor discharges through the transistor.
- **Pin 8: Supply Terminal:** A supply voltage of + 5 V to + 18 V is applied to this terminal with respect to ground (pin 1).

IC 555 block diagram (Internal Construction)



- A 555 timer has two comparators, which are basically 2 op-amps,
- an R-S flip-flop,
- two transistors and
- a resistive network.
- Resistive network consists of three equal resistors and acts as a voltage divider.
- 5 kohms 3 resistor - so it is named as 5 5 5
- Comparator 1 compares threshold voltage with a reference voltage + 2/3 V_{CC} volts.
- Comparator 2 compares the trigger voltage with a reference voltage + 1/3 V_{CC} volts.

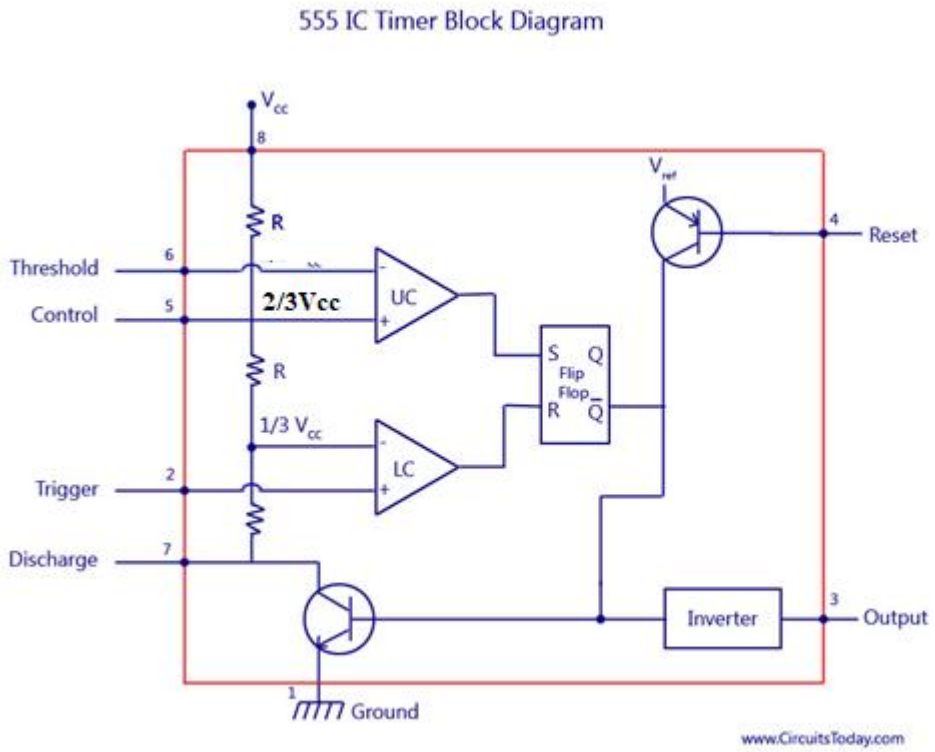
SR flip flop working



SR Flip Flop Using NAND Latch

S	R	Q	Q'	
1	0	1	0	
0	0	1	0	After S = 1 and R = 0
0	1	0	1	
0	0	0	1	After S = 0 and R = 1
1	1	0	0	Invalid

Working of 555 timer



Upper comparator has a threshold input (pin 6) and a control input (pin 5).

Output of the upper comparator is applied to set (S) input of the flip-flop.

Whenever the threshold voltage exceeds the control voltage, the upper comparator will set the flip-flop and its output is high.

Q' from from the flip-flop when given to the base of the discharge transistor saturates it and thus discharges the transistor that is connected externally to the discharge pin 7.

- The complementary signal out of the flip-flop goes to pin 3, the output. The output available at pin 3 is low. These conditions will prevail until lower comparator triggers the flip-flop. Even if the voltage at the threshold input falls below (2/3) V_{CC}, that is upper comparator cannot cause the flip-flop to change again. It means that the upper comparator can only force the flip-flop's output high.

Output of both the comparators is supplied to the flip-flop.

Flip-flop assumes its state according to the output of the two comparators.

One of the two transistors is a discharge transistor of which collector is connected to **pin** 7.

This transistor saturates or cuts-off according to the output state of the flip-flop.

The saturated transistor provides a discharge path to a capacitor connected externally. Base of another transistor is connected to a reset terminal.

A pulse applied to this terminal resets the whole timer irrespective of any input.

THANK YOU