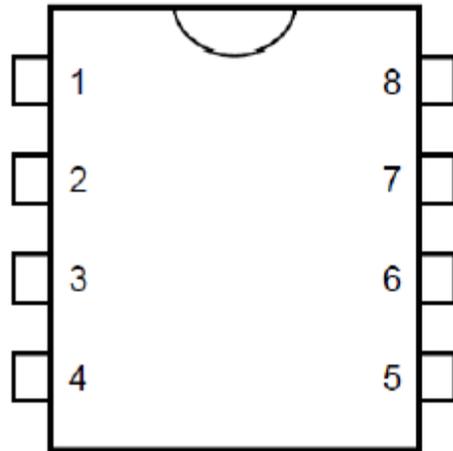# 555 Timer

555 is an IC used to generate a clock. The two attributes of a clock are

- Frequency
- Duty cycle.

Both of these can be changed using this IC, however the duty cycle is always <50%.

1 - GND
2 - Trigger
3 - Output
4 - Reset
5 - Control voltage
6 - Threshold
7 - Discharge
8 - Vcc

There are two modes in which 555 can run.

MONOSTABLE MODE

As the name suggests; in this mode the output is stable in only one (mono) state i.e. 'off' state. Thus it can stay only for a finite time, if **triggered,** to the other state i.e. 'on' state. This time can be set choosing appropriate values of resistances in the formula:
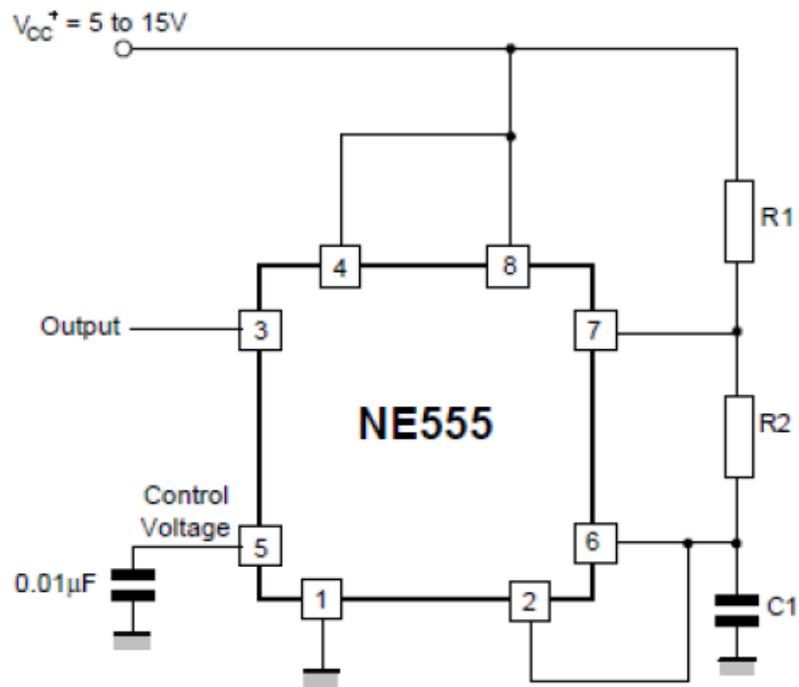
$$T = 1.1 \; X \; R1 \; X \; C1$$
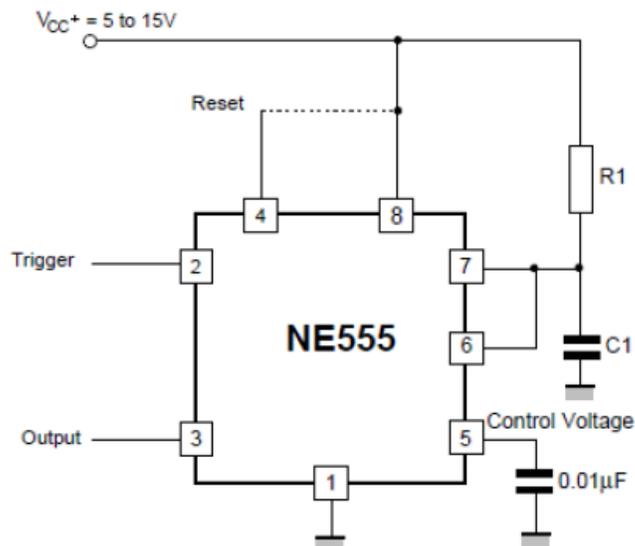
ASTABLE MODE

In this mode; the output is stable neither in 'high' state nor in 'low ' state. Hence it oscillates from one state to another giving us a square wave or clock. We can set the clock frequency and Duty cycle D by the formulae:

$$F = \frac{1.44}{(R1 + 2R2)C1} \qquad D = \frac{R1 + R2}{R1 + 2R2}$$

NOTE: Capacitor C2 is just to filter the noise and its value can be suitably chosen to be 0.01µF. It can also be neglected.

4029 Counter

With the clock made, we are ready to count the number of pulses passed into the circuit. Note that any kind of counting requires a **memory** (you got to know that you have just counted '3' to go to '4'!)**.** Hence 4029 can also be used as a memory element that remembers its immediate previous state.
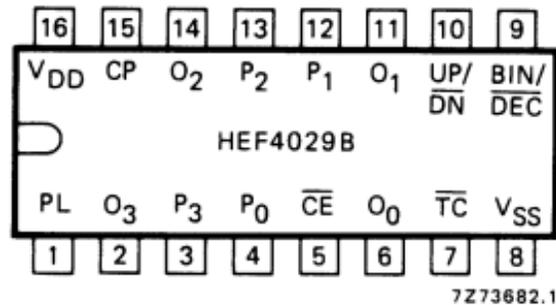
Pin no.	Name	Pin Function
1	Parallel Load	If given high; loads the value of Parallel Input bit into the output bits. Low for normal operation.
2	Output Bit 3	Most significant bit of output
3	Parallel Input Bit 3	Most significant bit of parallel input
4	Parallel Input Bit 0	Least significant bit of parallel input
5	Clock Enable Bar	Low on this pin enables counting as per the clock received
6	Output Bit 0	Least significant bit of output
7	TC Bar	Output bit that gives a low when the count is complete. Can be used to signal the end of counting.
8	Vss (Gnd)	Needed for powering
9	Binary/Dec	To choose b/w binary and hexadecimal modes (low for decimal mode and high for Binary mode)
10	Up/Down Count	To choose b/w up counting and down counting modes (low for down counting mode and high for up counting mode)
11	Output Bit 1	2nd bit of output
12	Parallel Input Bit 1	2nd bit of parallel input
13	Parallel Input Bit 2	3rd bit of parallel input
14	Output Bit 2	3rd bit of output
15	Clock Pulse	Clock pulse is given here
16	Vdd (Live)	Needed for powering

7447: BCD to 7 segment display decoder

For displaying the number in the counter output on a seven segment display (i.e. 7 LEDs making up a figure of '8' as in a general calculator. See fig.) we need to decode the 4 bits and match them to the 7 pins for lighting the LEDs corresponding to the number. This work is done by 7447.
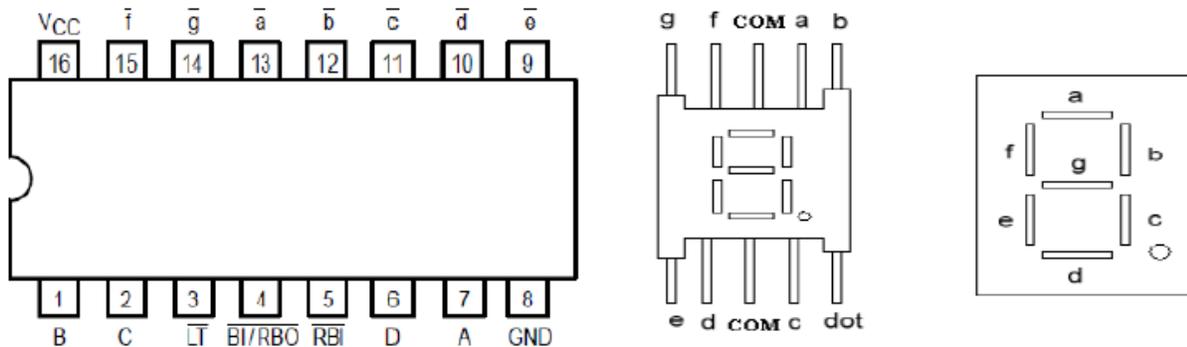
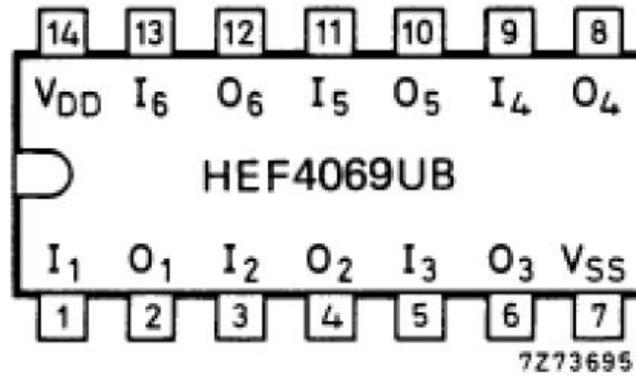| Pin No.	Name	Pin Function
1	Input Pin B	2nd bit of Input
2	Input Pin C	3rd bit of Input
3	Lamp Test Bar	To check whether all LEDs are glowing (High for normal function, Low to glow all LEDs)
4	BI / RBI	Keep high for normal function
5	RBI	Keep high for normal function
6	Input Pin D	Most significant bit of Input
7	Input Pin A	Least significant bit of Input
8	Gnd	For powering the IC
9-15	Output Pins a-g of 7447	To be connected to 7 segment display
16	Vcc	For powering the IC

NOTE:
- The COM pins are to be connected to Vcc via 220 ohm resistor.

- The dot pin is just for display of decimal point and essentially only makes the upper and lower sides distinguishable from each other for a single display. Without the asymmetry produced by dot how will we be able to see which side is upper and which is lower?
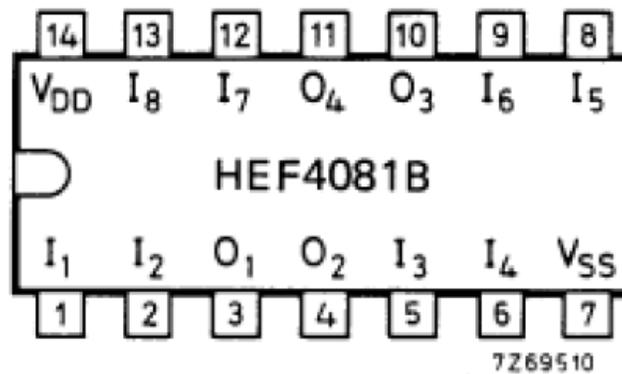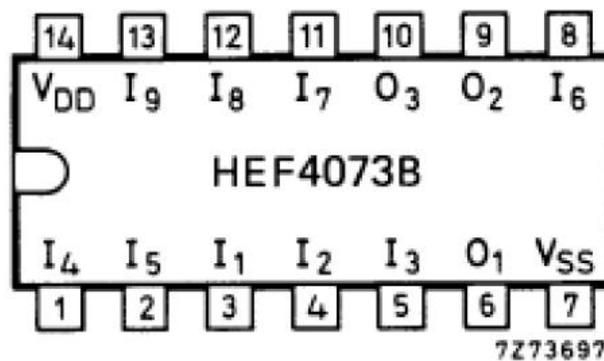
LOGIC GATES

4069 : NOT GATE

```
   14    13    12    11    10     9     8

 V_DD   I_6   O_6   I_5   O_5   I_4   O_4

            HEF4069UB

  I_1   O_1   I_2   O_2   I_3   O_3  V_SS

    1     2     3     4     5     6     7
                                  7Z73695
```

4081: 2 INPUT AND GATE

```
   14    13    12    11    10     9     8

 V_DD   I_8   I_7   O_4   O_3   I_6   I_5

            HEF4081B

  I_1   I_2   O_1   O_2   I_3   I_4  V_SS

    1     2     3     4     5     6     7
                                  7Z69510
```

4073: 3 INPUT AND GATE

```
   14    13    12    11    10     9     8

 V_DD   I_9   I_8   I_7   O_3   O_2   I_6

            HEF4073B

  I_4   I_5   I_1   I_2   I_3   O_1  V_SS

    1     2     3     4     5     6     7
                                  7Z73697
```

4071: 2 INPUT OR GATE

14	13	12	11	10	9	8
V_{DD}	I_8	I_7	O_4	O_3	I_6	I_5

HEF4071B

I_1	I_2	O_1	O_2	I_3	I_4	V_{SS}
1	2	3	4	5	6	7

7Z69507

4075: 3 INPUT OR GATE

14	13	12	11	10	9	8
V_{DD}	I_9	I_8	I_7	O_3	O_2	I_6

HEF4075B

I_4	I_5	I_1	I_2	I_3	O_1	V_{SS}
1	2	3	4	5	6	7

7Z73699

4070 : 2 INPUT XOR GATE

14	13	12	11	10	9	8
V_{DD}	I_8	I_7	O_4	O_3	I_6	I_5

HEF4070B

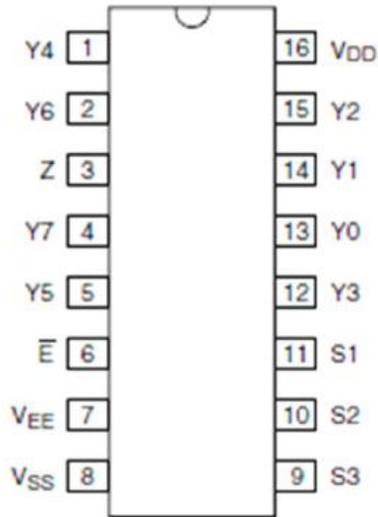| I_1	I_2	O_1	O_2	I_3	I_4	V_{SS}
1	2	3	4	5	6	7

7Z73473

Note : Other gates such as NOR, NAND are also available.

4051 : 8X1 multiplexer/demultiplexer

Pin Symbol	Pin Function
E	Kept low to enable normal functioning of MUX/DEMUX
VEE	Supply Voltage
VSS	Ground Supply Voltage
S1 , S2 , S3	Selection Pin Inputs
Y0 – Y7	Independent Input or Output Pins
Z	Common Input or Output Pin
VDD	Supply Voltage

4052 : 4X1 multiplexer/demultiplexer
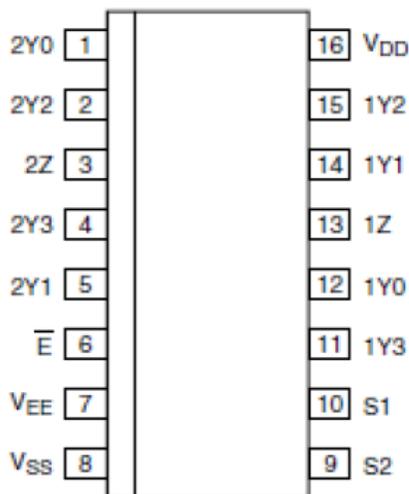
Pin Symbol	Pin Function
E	Kept low to enable normal functioning of MUX/DEMUX
VEE	Supply Voltage
VSS	Ground Supply Voltage
S1 , S2	Selection Pin Inputs
1Y0 – 1Y3, 2Y0 – 2Y3	Independent Input or Output Pins
1Z, 2Z	Common Input or Output Pin
VDD	Supply Voltage

Note : 2X1 and 16X1 MUX/DEMUX are also available and has similar pin configuration.