EXPERIMENT – 3

OBJECT :

Plot timing diagram of Bistable-Multivibrator and use it as divided by two unit.

APPARATUS REQUIRED :

1. Multivibrator set – Up, Model – MV – 12 – 1.
2. Oscilloscope – 1.
3. Connecting heads – 8.
4. Co-axial Cable – 2.

THEORY :

Multivibrator is an Oscillator which produces voltage pulses and extended voltage waveforms, usually occurring periodically. It uses two active devices with positive feedback in such a way that the two devices tend towards opposite states i.e. one ON and other OFF. In principle, it is a two stage R.C. Coupled Amplifier. The output voltage of one stage is feedback to another stage which sustains the oscillations. R.C. constant of the circuit determines the frequency of the multivibrator.

Multivibrators are switching circuit, which form basic blocks of all counting and shaping circuits used in nuclear device. Moreover, they are basis of all digital logicals devices such as
high speed computers. Some of the other applications are as follows:

(i) Generation of pulses occurring periodically
(ii) Generation of extended waveforms occurring periodically.
(iii) Synchronized generation of pulses and extended waveforms.
(iv) Frequency multiplication
(v) Introduction of time delay.

Multivibrators may be classified in the following three categories:

(A) **ASTABLE OR FREE RUNNING MULTIVIBRATOR :** Read in Experiment No1

(B) **UNIVIBRATOR OR MONOSTABLE MULTIVIBRATORS :** Read in Experiment No2

Now third one i.e.

(C) **BISTABLE MULTIVIBRATOR :**

This also generates voltage pulse and extended waveforms but requires two driving pulses, one for each half of the output voltage waveform.

An experiment set – up of these Multivibrators have been laid down on a Phionlic board with all components and connections visible and accessible conveniently. Points on which measurements to be carried out are marked thereon. Three different experiments can be carried out with this set – up.

CIRCUIT DIAGRAM :

The model uses p-n-p switching transistors and two crystal diodes (IN34). The circuit diagram is shown in Fig. 3. Note that the output of each amplifier is directly coupled to the input of the other amplifier.

Because of the symmetry of the circuit, the quiescent current in each amplifier will be the same. Suppose that there is a minute fluctuation in the current. I_1. If I_1 increases, the voltage at the collector of T_1 will decrease and this will then decrease the voltage at the base of T_2. This change in voltage at base of T_2 will be amplified and inverted by T_2 and the collector voltage will increase (i.e. more negative). Hence the voltage at the base of T_1 will become more negative and as a consequence the current I_1 will increase still further. This cycle of events repeats itself. The current I_1 continues to increases and the current I_2 continues to decrease and the circuit moving progressively further away from its initial condition. This action takes places because of the regenerative feedback incorporated into the circuit and will occur only of the loop gain of the circuit is larger than unity. So, in order that a flip-flop be in a stable state, it would be sufficient either that one of the devices be OFF or that one ON and nearby the full supply voltage will appear across the transistor that is OFF.

In Fig. 3 T_2 is conducting heavily with its collector at every low potential and T_1 is turned OFF with its collector at approximately – 9 Volt. The base of T_1 is held below threshold because of the low voltage at the collector of T_2 and voltage divider action of $R_4 - T_5$. The input steering diodes are both reverse biased but D_1 will require – 9Volt (Approximately) Signal to turn ON where as D_2 has only at low collector voltage of T_2 reverse bias.

If a positive pulse of sufficient amplitude is applied at the input it will pass through D_2 and be applied through C_2 at the base of T_1. This will make T_1 slightly conducting and a small current in collector will flow and ultimately in the end T_1 will conduct heavily while T_2 will be OFF. For the second pulse or trigger D_1 will pass and T_2 will start conducting and if continuously triggers are applied pulse output will be observed.

PROCEDURE :

1. Connect the Set – Up to the A.C. mains.
2. Connect the power supply to the free running multivibraor as well as to the bistable multivibrator.
3. Connect output I of free running multivibrator to the input of bistable multivibrator. (Ground of free running must be connected to the ground of biastable multivibrator).
4. To observe the output connect the oscilloscope at the output terminals of bistable multivibrator.

OBSERVATIONS :

Trace the input wave and output wave for the same setting of the oscilloscope

RESULTS :

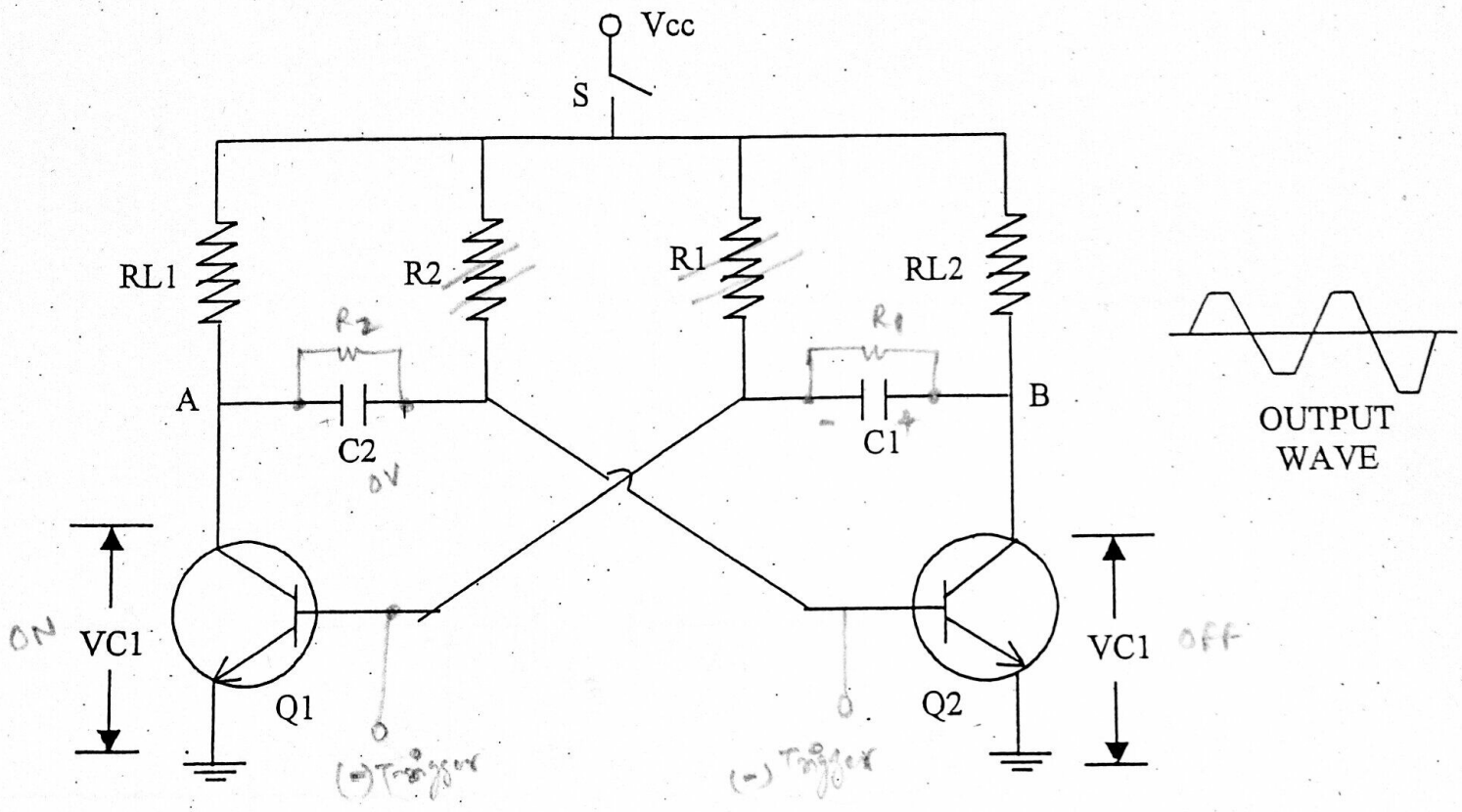
For each input impulse there is a square pulse at the output (this can be inferred from the two traces).

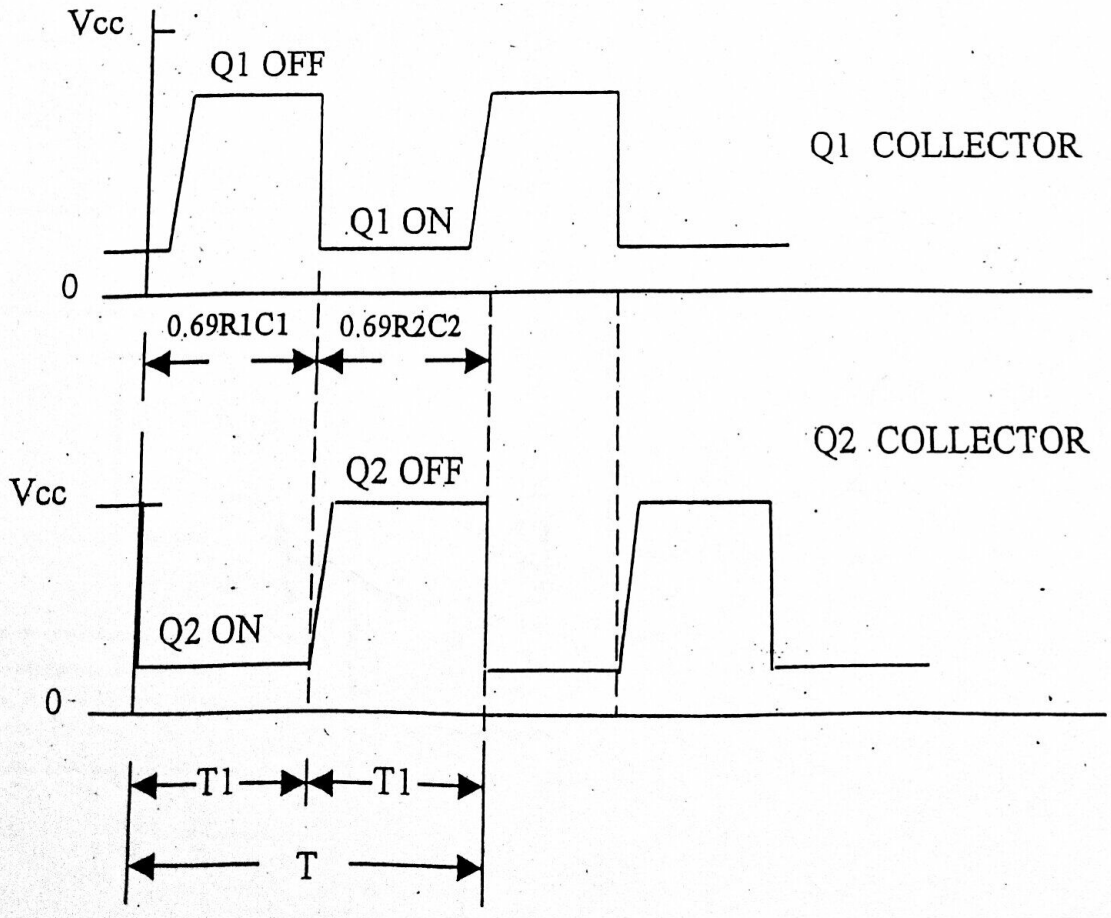
PRECAUTIONS :

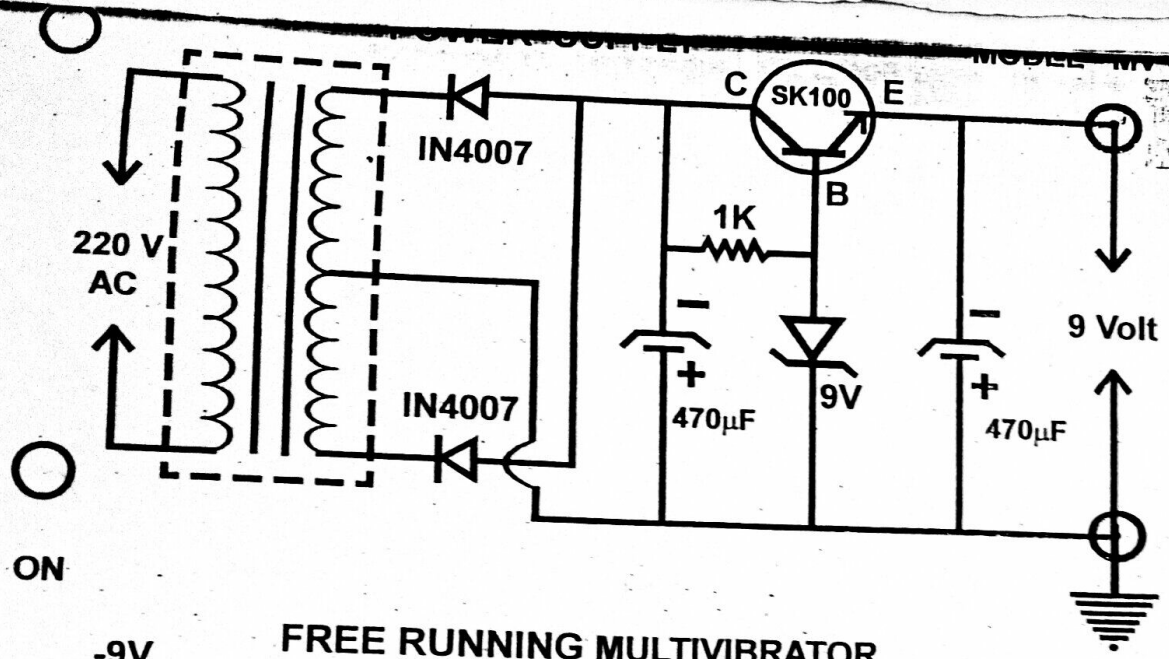
1. Before connecting the power supply, check the output voltage with the help of Multimeter, it should be -9 Volt.
2. Ground of the power supply must be connected to the ground of the other circuit.

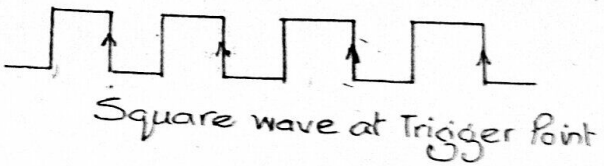
QUESTIONS AND EXERCISES :

1. Explain the operation of Bistable multivibrator.
2. How for each input trigger only pulse is generated in the Bistable multivibratorS?
3. Can we operate this bistable multivibrator as pulse generator?
4. What type of wave shape will you obtain, if the output of Bistable multivibrator is differentiated through an R. C. Combination?

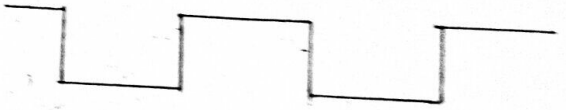

Vcc
S
RL1
R2
R1
RL2
A
B
C2
C1
OUTPUT
WAVE
VC1
VC1
Q1
Q2
(-) Trigger
(-) Trigger


Vcc
Q1 OFF
Q1 COLLECTOR
Q1 ON
0
0.69R1C1
0.69R2C2
Q2 COLLECTOR
Vcc
Q2 OFF
Q2 ON
0
T1
T1
T



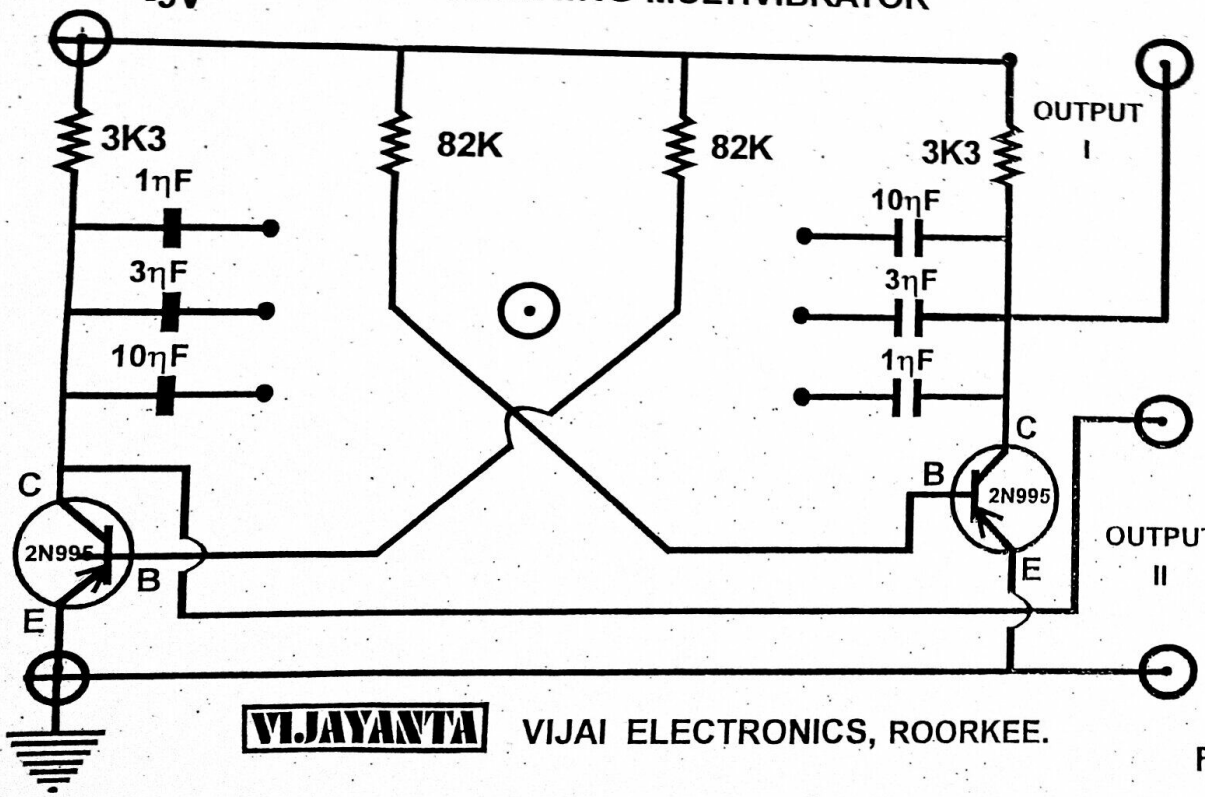


Square wave at Trigger Point



Output waves at Q2.

FREE RUNNING MULTIVIBRATOR



BISTABLE MULTIVIBRATOR

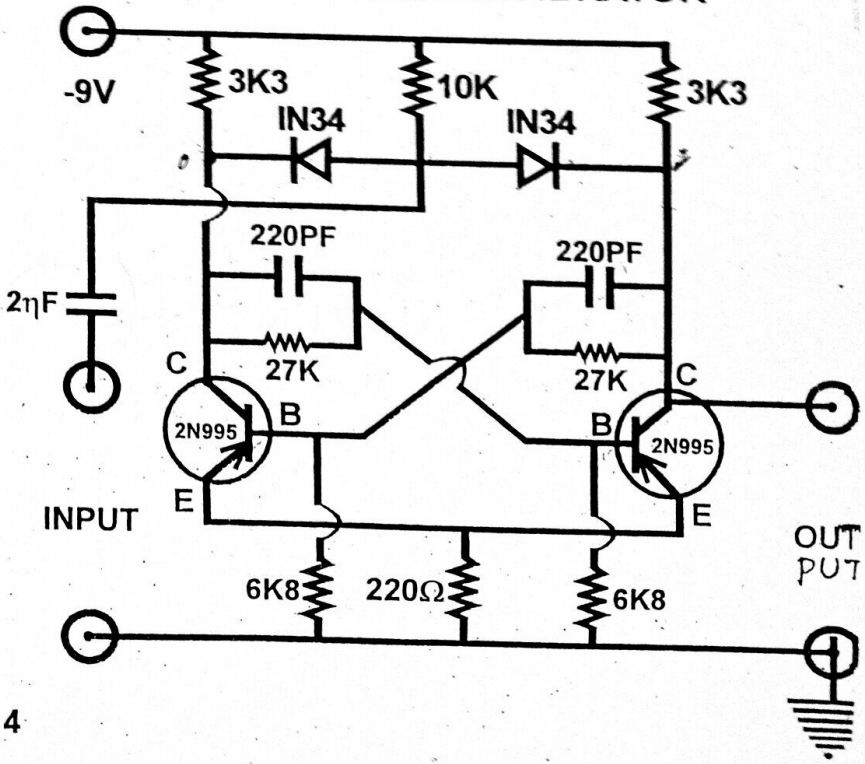


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Fig. 4