Astable Multivibrator

The astable multivibrators devlop waves of shape other than sinusoidal, usually produce rectangular waves of abrupt on - off operation. Generally these circuits does not required any driving pulses. Principally it consists of two R - C coupled amplifier, where the output of each stage is fed back to input of pre stage. Thus it acts as self oscillating regenerative switch in which the on and off periods are controlled by R - C time constants. In these circuits, neither output is in stable state thus called 'astable'.

Circuit description : In given circuit shown in fig 1, when supply applied to the the circuit, one transistor conducts first due to imbalance in parameters. Assume Q1 conducts first then voltage across it will be equal to Vsat (saturation), the collector potential will be few volts. Due to it, Q2 get less potential since capacitor C' connected at base of it force its base to cut - off level and its collector voltage will be +vcc approx. Now the capacitor C' start charging through R' and Q1,exponentially till it reaches a level equal to Vbe, Q2. Now the Q2 is on and C discharges through it pshing Q1 base at cut - off potential. C start charging through R and cycle repeat itself endless.

From the above statement it is clear that discharging of capacitor is quicker since transistors act as switch and charging is slow (exponenetial) through Rbase and Rc. In result the rising waveform is rounded corners whether the falling is fast. It is due to the voltage at RC rise slowly in later time constants.This problem can be removed by isolating the Rc form C through a diode (not provided in practical). As stated Q1 is on and Q2 is off than,

Vbe Q2 = Vcb / IcQ1 R' or = Vcc - 2vcc e (-t / R'C')

The Vbe = 0.6 volt approx, than

0.6 = Vcc { 1 - 2e (-t / R'C')} = e (-t / R'C') = 2

or T1 = R'C' in2 = 0.694R'C' and if R' = R and C' = C than

T = 2 (0.694) RC.

where T in sec, if R in megohm and C in uF.

Experiment procedure

Object : To verify the condition of oscillation in given astable multivibrator. To observe the effect of R and C upon the oscillation period T.

Other apparatus required : A general purpose cathode ray oscilloscope

1. Connect CRO across the Q1 output socket. Switch ON the power. Select R and C.
2. Adjust CRO, Y amplitude and its sweep frequency to obtain stable waveforms. Observe the waveforms appeared upon CRO screen. Measure its period of oscillation. Trace the waveform upon the paper.
3. Connect CRO at Q1 base and observe the waveform. Trace it upon the paper. If dual trace CRO is used than observe both waveforms simultaneously.
4. Connect CRO at collector of Q2. Trace the waveform. Connect it with the Q2 base and trave the waveform.
5. Change the R value and measure the period of oscillation. Change the C and measuer the period of oscillation.
6. Draw the waveforms and verify the statement of transistor switching and charge - discharge of capacitor. Observe the waveforms and verify that period of oscillation depends upon R - C value.
7. Calculate theoratical value of oscillation period for given R - C, and compare it with the practical results taking few percent of component tolrence.

Conclude the results from the experiment.

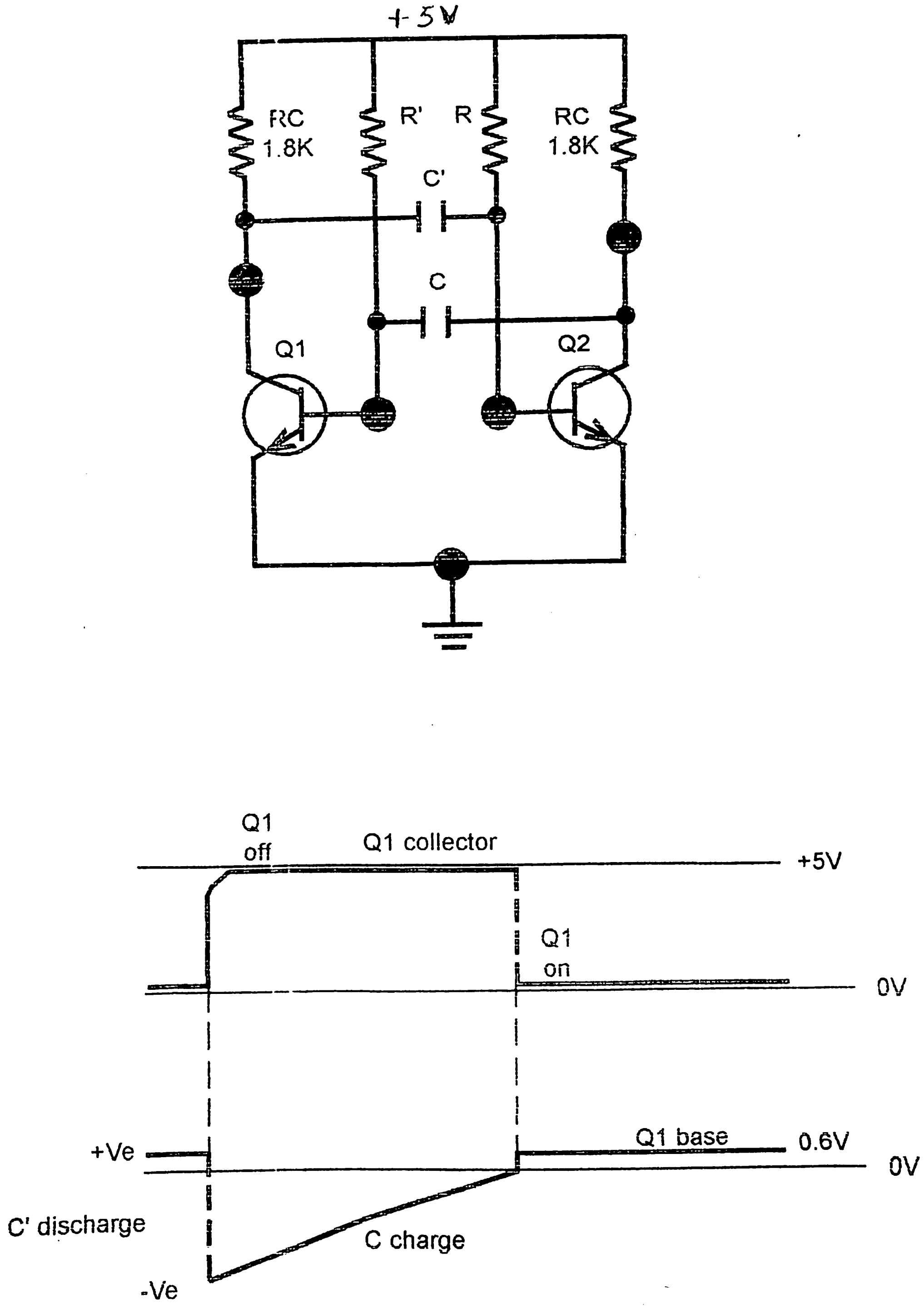


Fig 1 . Circuit diagram and waveforms of astable multivibrator. Only one transistor waveform is shown. Since both stages has similar components the waveforms are identical.

Monostable Multivibrator

The monostable multivibrators has only one stable state and other one quasi stable. It remains in stable state till an input pulse arrives at its trigger input. The period for which it remains in quasi state depends upon time constant R - C. The monostable multivibrators are used to obtain a definate pulse width for symmetric operation from asymmetric inputs. In thease multivibrators one ON time operation is possible in one time constant, in other words during quasi stable state it ignore any trigger pulse, thus these are also called as one shot multivibrators.

Circuit description : In given circuit shown in fig 2, in stable state transistor Q2 is on due to forward bias by R2 and Q1 is off due to low saturation voltage across Q2 collector. Capacitor C is charged through R1 and base - emitter of Q2. When a positive going pulse is applied at trigger input it is differentiated by C1 - R5 and passed through diode D to base of Q1. It forces Q1 to conduct, which result in to fall the collector - emitter voltage at Q1, which result in to discharge C through Q1. The discharge of C generate sharp -ve going pulse at Q2 base which force it to cut - off and its collector voltage rise to latch Q1 on through R3. It is the quasi stable state. Now C start charging through R and Q1 to positive potential till the voltage at its R end approach to Vbe level, where Q2 comes on again and the its collector potential falls which bring Q1 off to return it to stable state.

From the above statement it is clear that the time in which Q2 collector is high, depends upon the time which is taken by C to approach Vbe level. Since Q2 is cut - off during quasi state and reverse resistance of base - emitter is very high. Q1 on resistance is very low, then C get charged through R only, then it can be defined as

Vbe (sat) - { Vcc - Vce (sat)} = Vbe (sat) + Vce (sat) - Vcc, where V (sat) = Vy

The gate pulse width should be = Vcc + { Vy + Vy - 2Vcc } in (-T/RC)

or T = RC in { 2Vcc - 2Vy / Vcc - Vy } or = in RC { 2(Vcc - Vy) / Vcc - Vy }

Therefore T = RC in2 or 0.693RC.

Experiment procedure

Object : To verify the condition of quasi stable state in given monostable multivibrator. To observe the effect of R and C upon the monotime period T.

Other app required : A general purpose cathode ray oscilloscope and function generator.

1. Connect given LED at Q2 collector. Select R 100K and C = 100uF from given selectors situated just below of circuit diagram. Connect given pulser output with trigger input.

2. Switch on power. If LED comes on then wait till it goes off. Now apply a brief push upon the pulser key and observe the LED comes on. Note the time period T of this sate with stop watch. Repeat it for two more times. Find out the mean time of three observation and compare it with the theoratical result. select another R value and repeat the step.

3. Remove LED from the Q2 collector. Select R 100K and C = .01 uF. Connect function generator at the trigger input and ground. Adjust generator frequency to 2Khz square wave of 1.5Vpp approx output.

4. Connect CRO one channel (2V / div) across the Q2 collector and ground. Connect other channel with the Q2 base. Trace the waveforms with their time T. Connect CRO with the Q1 base and at the trigger pulse input i.e. function generator output. Trace the waveforms with time T.

5. Change the value of R and observe the waveform at Q2 collector.

Conclude the result : From waveforms observation T is found. Calculate its theoratical value to compare the result. From the Q2 waveforms it is observed that multivibrator stand in quasi state till C voltage approach to Vbe level (0.64V app). It is verified that multivibrator does not retriggered when it is in quasi stable state.

Monostable multivibrator - 3

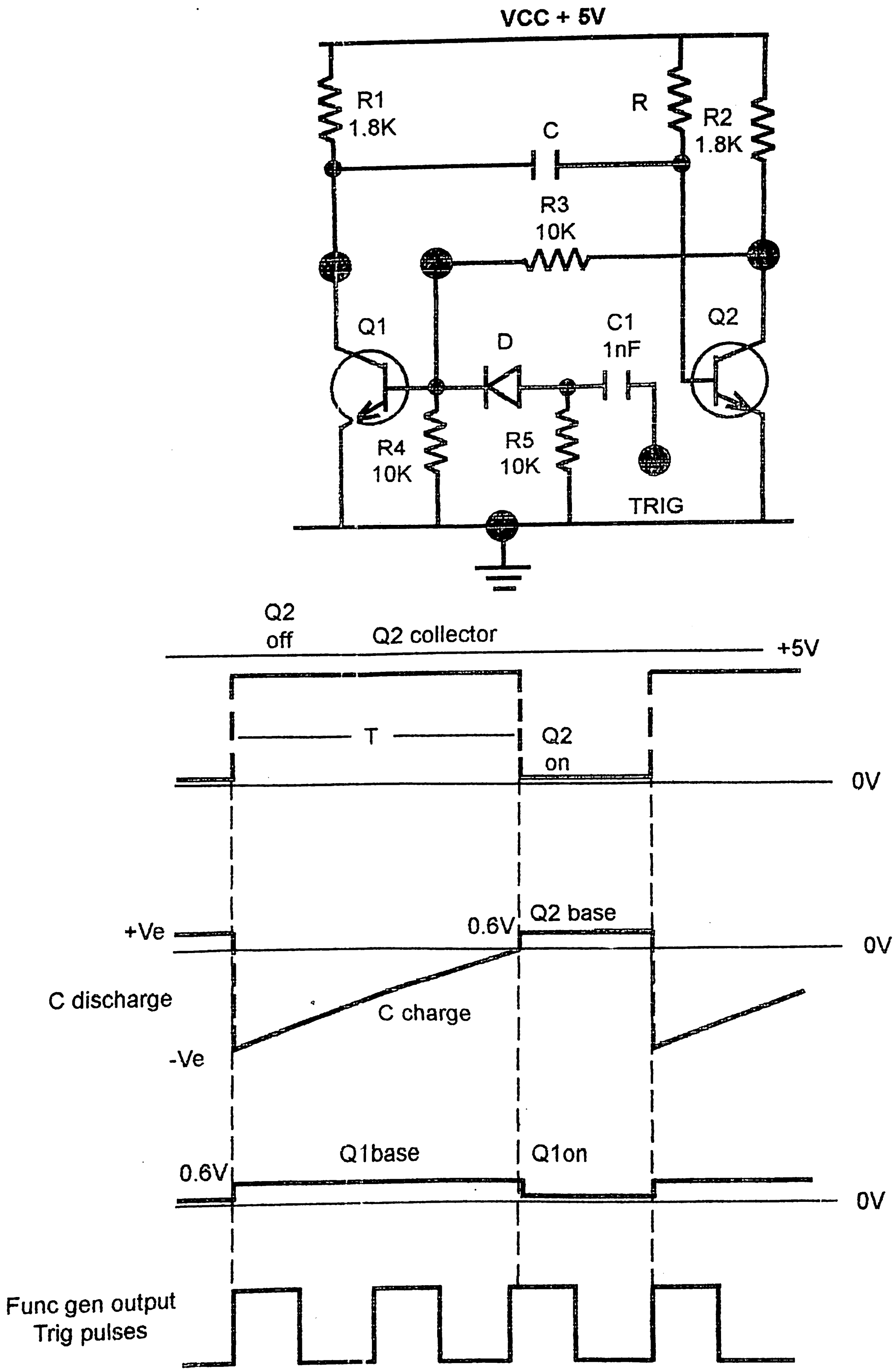


Fig 2. Circuit diag:am and waveforms of monostable multivibrator.

Bistable Multivibrator

The bistable multivibrators has two stable states. It remains in one stable state till an input pulse arrives at its trigger input. The second stable state is changed only when another trigger pulse arrive. the bistables are also known as flip - flops which are used in counting and memory element in digital circuits. A bistable is divide by two frequency divider if output is taken from one end only.

Circuit description : In given circuit shown in fig 3, in stable state assume transistor Q2 is on due to forward bias by RB - RC, and Q1 is off due to low saturation voltage across Q2 collector. It is the one stable state in which Q1 collector gives high level output. When a trigger pulse applied at the trigger input it is differentiated by diode D3 and C1 to obtain sharp pulses of vcc level. The peak -ve going pulse at diode D3 anode bring diode D1 in conduction, while D1 anode is at Vcc level since Q1 is off. This phenomenon bring Q1 collector to 0 volt level for very little time, which force Q2 to be cut - off since it is biased by RB' and RC. In result collector voltage of Q2 rise which force to conduct Q1 because of it get biased by RB and RC'. The second stable state approach in which Q1 is on and Q2 is off. This state does not change untill next -ve going pulse reset Q1 through D2. The capacitor C2 and C3 help to speed up the bistable response on sharp trigger pulses.

From the above statement it is clear that the bistable multivibrators are remain in stable states till it triggered. There are two stable states in which one transistor is on and other is off from which they can be changed their states by triggering (a vibrator action), thus it is called Bi - stable multivibrator. the circuit presented here is called 'symmetrical triggered bistable multivibrator'.

Experiment procedure

Object : To verify the conditior of two stable state in given bistable multivibrator. To observe the effect upon output by triggering it contineous mode.

Other app required : A general purpose cathode ray oscilloscope and function generator.

1. Connect given pulser output socket with bistable trigger input socket. Connect given LED at Q1 or Q2 collector socket.

2. Switch on the power. Observe the LED status. An extinguished LED should be denoted as low (0) level at respective output.

3. Apply a brief push upon the pulser key. Observe the output status of LED. Apply one more trigger pulse by pulser key to change this state.

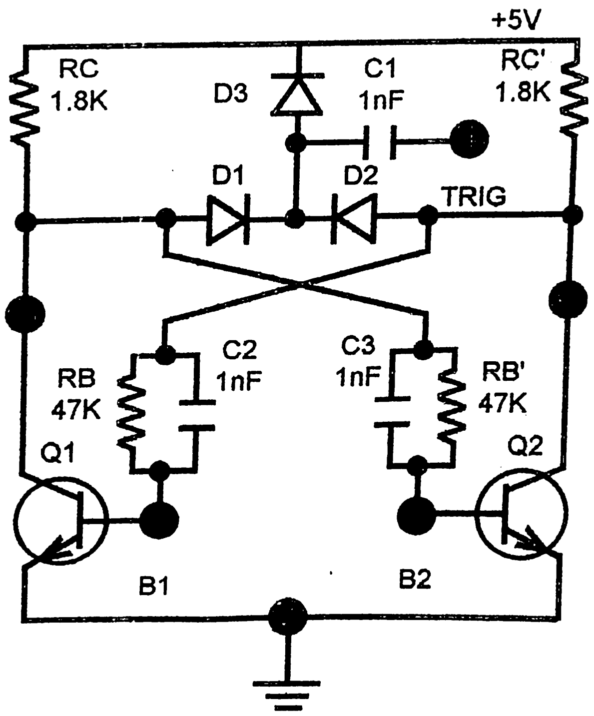
4. Repeat the step above for two or three more times. Note that LED is comes on after each second trigger pulse. (Assume LED is connected with Q1 collector and it is on , applying first trigger at pulser key it is off and application of next trigger by key made it on, which means you has two key strokes to made the situation back).

From the above steps it is verified that bistable multivibrator has two stable states in which one state remain high or low till it is triggered. The one state return to its original state after receiving two successive trigger pulses which show its divide by two nature.

5. Disconnect pulser and LED. Connect CRO one channel with any collector and ground (2V / div). Connect CRO other channel with function generator output. Connect function generator with trigger input and ground.

6. Adjust function generator for 2Khz square wave of 1.5Vpp approx output. Observe and trace the waveforms. The waveforms clearly show that bistable is triggered upon falling pulse and the output is divide by two.

Note : The bistable may be triggered by touching either transistor base(on) with ground.



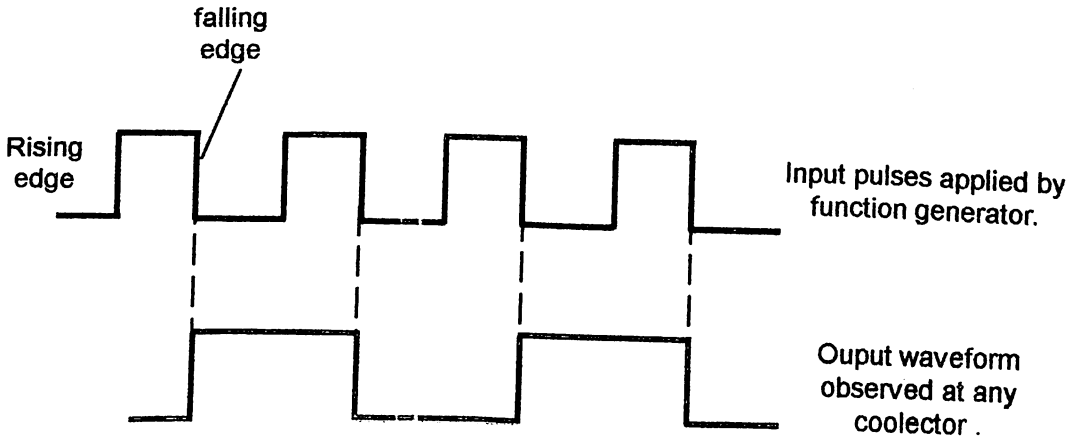


Fig 3 . Circuit diagram and waveforms of bistable multivibrator.