I'm not a bot

There are following three types of a Multi-vibrator. (1). An Astable Multi-vibrator (2). Monostable Multi-vibrator (3). Bistable Multi-vibrator Astable Multi-vibrator In an astable multi-vibrator (AMV) device, neither of the two states/modes is stable or a Multi-vibrator device, none of the outputs of which is stable (i.e. both its states or modes are unstable). Rather it comprises two semi-stable (half-stable) states. Astable Multi-vibrator circuit continuously provides oscillation between these two states without any sort of excitation (i.e. it offers a continuous specific time-bound output pulse without the application of a trigger pulse). In simple words, an astable Multi-vibrator moves back and forth continuously between its two half-stable states. As a result of continuous movement between its two output states, an astable Multi-vibrator produces an incessant specific signal (which continuously keep changing between 0 and 1 on its output. This signal is normally a squared type, as has been illustrated in the figure 6.4. Owing to creating a squared-type waveform signal, it is also known as a square wave generator and due to an incessant movement between its two output states, an astable Multi-vibrator is also known as a free-running Multi-vibrator (i.e. an astable Multi-vibrator circuit can be used as an oscillator or a generator). This circuit is simple, cheap and in case there is no issue of frequency stability, it happens to be a very apposite sort of generator. Remember that this circuit consists of two storing elements (i.e. two capacitors). Figure 6.4-AMV Monostable Multi-vibrator Monostable Multi-vibrator (MMV) is also known as a single-shot or single-swing or one-shot Multi-vibrator. A monostable multi-vibrator, as the name suggests, consists of a stable state and a semi-stable state. And when an external trigger pulse is exerted on it, it switches from one-state to semi-stable state and after remaining on this state for some time, reverts back to its original state. In other words, a monostable Multi-vibrator can remain stable on just one state and on any other state it becomes semi-stable or unstable. When it is being energized (suppose it is on its stable state) it remains on its stable state until some external trigger pulse is applied on it. On providing an extrinsic trigger pulse, monostable Multi-vibrator switches to unstable state. When trigger pulse ceases, it returns back automatically to its stable state (after the passage of some specific time). Trigger pulse changes the state of a monostable Multi-vibrator only temporarily. The period of time or duration during which it remains on an unstable state, is determined by the values of components used on the internal circuit of a monostable Multi-vibrator. Remember that this circuit comprises a storing element (i.e. a capacitor) and this circuit is used as a pulse shaper, because it receives pulses of varying breadth on input and converts them into output pulses of same breadth. As its output state changes at a fixed time after provision of a trigger signal, therefore it can also be used as a delay element. Operation of a monostable Multi-vibrator has been illustrated vide figure 6.5. Figure 6.5-MMV Bistable Multi-vibrator A Multi-vibrator which consists on two stable states or two stable outputs, is called bistable Multi-vibrator (bi means two). This Multi-vibrator remains on either of the two states until some extrinsic trigger pulse interferes and changes it to other state (i.e. trigger pulse can cause a change in Multi-vibrator's state or output and as long as trigger pulse is not received, it retains one of its state). In other words, it may also be said that this bistable Multi-vibrator recognizes its previous output. As a flip-flop has this particular quality therefore, a bistable multi-vibrator is also known as just flip-flop or just flip-flop Multi-vibrator. Moreover, it is also known as binary or divided-by-two elements. Remember that no storage element exists in a bistable Multi-vibrator (BMV) nor does it oscillate. In figure 6.6, operation of a bistable Multi-vibrator has been explained. 555 Timer 555 Timer is a digital monolithic integrated circuit that can be used as a clock generator. In other words, it is a digital timing circuit, which can be connected as an astable or monostable circuit. A 555 timer is a versatile type and a massively used device, which operates on any one of these two states i.e. either an astable or monostable state. It can provide a time delay ranging from few micro seconds to several hours. As this device (555 timer) can be used both as an astable as well as monostable circuit, therefore it is called a timer. A 555 device is a low-priced device, which is available in the form of an IC. It operates within a pretty vast range of potential difference (normally between +4.5V to +15V) and there is no effect on output either of these changing voltages. That is why it is also called a linear device. Due to being compatible, a 555 timer can directly be connected with TTL or CMOS digital devices. However, on the application of other digital circuits, interfacing is always required. Various organizations produce different type of 555 timers, amongst which, the basic number is 555. For example, SE555, CA555, SN555 and MC14 555 etc. Two 555 timers are generally fabricated within one chip and it is allotted 556 number. Now-a -days such types of 555 are also commonly available, on one chip of which four 555 timers exist. These devices are available in the form of 8-pin round IC, or in the shape of a DIP containing 8 pins or 14-pin shaped DIP. In figure 6.7, pin diagram of 555 timer consisting on an 8-pin DIP (dual inline package) has been demonstrated. The pins detail of this IC is as under: Figure 6.7-pin diagram of 555 timer having 8-pins 555 Time Pin Description: (1). Ground It is common ground point of a circuit. Along with ground terminal of an extrinsic circuit, ground terminal of the power supply (VCC) is connected with this common ground point. (2). Trigger When a negative trigger pulse equivalent to 1/3 of a total VCC voltage (i.e. VCC/3) amplitude, is provided on this terminal, output state of the circuit switches from low to high. (3). Output Output is acquired through this terminal and this terminal is connected with load. The terminal can either be low or high at a time. (4). Reset Irrespective of previous output state, providing a trigger pulse on this terminal, resets the device (i.e. output turns out to be low) (5). Control Voltage Two third (2/3) positive VCC voltage of an overall VCC voltage, exist on this terminal. Thus, it becomes a part of a comparator circuit. Normally, a capacitor is mounted between this terminal and ground. (6). Threshold Voltage Threshold voltage and control voltage are two input voltages of a comparator circuit. Circuit compares voltage levels present on the circuit terminal with reference to voltage present on the control terminal. If threshold voltage existing on pin number 6 exceeds control voltage (equivalent to 2/3 of VCC), output turns low. And if voltage of pin number 6 is less as compared to control voltage, output turns high. (7).Discharge When output is low, this terminal provides a low resistance discharge path to the extrinsically fitted capacitor. However, when output is high, this terminal operates similar to an open circuit. (8). Supply Voltage Terminal +VCC Supply voltage are applied on the terminal in order to drive or operate a 555 timer. In figure 6.8, a simple diagram of 555 timer has been illustrated, by means of which its intrinsic circuit has been explained. According to this figure, this timer consists of two comparators, an RS flip-flop, output stage (output buffer) and a discharge transistor Q1. It also contains three resistors mounted of 5KΩ series, one end of which is connected with +VCC (i.e. with pin number 8) and other point or end connected with ground (GND) or pin number 1. Remember that owing to three resistors being fitted on a 5KΩ series, this IC timer chip has been named as 555. Working Method Comparators present in the functional or block diagram of a 555 timer are devices, output of which is high when its positive input voltage is high as compared to negative input voltage. And comparator output is low when negative input voltage comparatively exceeds positive input voltage. The voltage divider in the circuit consists of three resistors of 5KΩ, which provide 1/3 trigger level of VCC (i.e. 1/3 VCC) and 2/3 threshold level of VCC. In order to understand this point, let us suppose that value of VCC is 15. In such a situation, trigger level value is 5V (1/3 x15 = 5) and threshold level value 10V (i.e. 2/3 x 15 = 10V). If there is a need to extrinsically adjust trigger level and threshold level on some other voltage level, then control voltage input (pin number 5) is used for this purpose (i.e. trigger level and threshold level voltages can be changed when required by means of changing input control voltage of pin number 5). However, it must be remembered that in such a situation, trigger level be equal to 1/3VCC and value of threshold level equal to 2/3VCC. The process of circuit operation is as follows: When value of normal high trigger input falls below 1/3VCC momentarily, then comparator B 's output rises from low to high. As a result, RS latch or RS flip-flop becomes set. As a result of a set flip-flop, output (pin number 3) gets high and simultaneously, discharge transistor Q1 turns off. The output tends to remain high so long as the normal threshold input value does not exceed to 2/3 VCC. As soon as, the threshold input voltage exceeds 2/3 VCC, comparator A output turns low from high. As a result of a high comparator voltage, RS flip-flop resets (as comparator A 's output is directly associated with R input of the RS flip-flop, as has been shown in the figure). At this point, the output turns low once again and discharge transistor Q1 turns on. Flip-flop can also be reset without a trigger circuit via application of an extrinsic reset input. Remember that trigger and threshold inputs (pin 2 and pin 6) are controlled through extrinsic components. And by means of this control through these threshold and trigger inputs components, this timer can be used for an astable or monostable action. Previous Topic: Types of Clock: Discrete Components and Integrated Circuit TTL Clock Next Topic: 555 Timer as an Astable and Monostable Multi-vibrator with circuit diagram For electronics and programming-related projects visit my YouTube channel. My YouTube channel Link Multivibrators, like the familiar sinusoidal oscillators, are circuits with regenerative feedback, with the difference that they produce pulsed output. There are three basic types of multivibrator, namely the astable multivibrator,the monostable multivibrator andthe bistable multivibrator.A bistable multivibrator is one in which both LOW and HIGH output states are stable. Irrespective of the logic status of the output, LOW or HIGH, it stays in that state unless a change is induced by applying an appropriate trigger pulse. As we will see in the subsequent pages, the operation of a bistable multivibrator is identical to that of a flip-flop.Fig. 1Figure 1 shows the basic bistable multivibrator circuit. This is the fixed-bias type of bistable multivibrator. Other configurations are the self-bias type and the emitter-coupled type. However, the operational principle of all types is the same. The circuit functions as follows.In the circuit arrangement of Fig. 1 it can be proved that both transistors Q1 and Q2 cannot be simultaneously ON or OFF. If Q1 is ON, the regenerative feedback ensures that Q2 is OFF, and when Q1 is OFF, the feedback drives transistor Q2 to the ON state.In order to vindicate this statement, let us assume that both Q1 and Q2 are conducting simultaneously. Owing to slight circuit imbalance, which is always there, the collector current in one transistor will always be greater than that in the other.Let us assume that Ic2 > Ic1 Lesser Ic1 means a higher Vc1. Since Vc1 is coupled to the Q2 base, a rise in Vc1 leads to an increase in the Q2 base voltage. Increase in the Q2 base potential increases Ic2 and the associated reduction in Vc2 Reduction in Vc2 leads to a reduction in Q1 base voltage and an associated fall in Ic1, with the result that Vc1 increases further. Thus, a slight circuit imbalance has initiated a regenerative action that culminates in transistor Q1 going to cut-off and transistor Q2 getting driven to saturation.To sum up, whenever there is a tendency of one of the transistors to conduct more than the other, it will end up with that transistor going to saturation and driving the other transistor to cut-off.Now, if we take the output from the Q2 collector, it will be LOW (= VCE1 sat.) if Q1 is initially in saturation. If we apply a negative-going trigger to the Q1 base to cause a decrease in its collector current, a regenerative action would drive Q2 to saturation and Q1 to cut-off. As a result, the output goes to a HIGH (= +VCC) state. The output will stay HIGH until we apply another appropriate trigger to initiate a transition.Thus, both of the output states, when the output is LOW and also when the output is HIGH, are stable and undergo a change only when induced by means of an appropriate trigger.That is why it is called a bistable multivibrator.Fig. 2Schmitt Trigger: A Schmitt trigger circuit is a slight variation of the bistable multivibrator circuit of Fig. 1. Figure 2 shows the basic Schmitt trigger circuit. If we compare the bistable multivibrator circuit of Fig. 2, we find that coupling from Q2 collector to Q1 base in the case of a bistable circuit is absent in the case of a Schmitt trigger. Instead, the resistance Re provides the coupling. The circuit functions as follows.When Vin is zero, transistor Q1 is in cut-off. Coupling from Q1 collector to Q2 base drives transistor Q2 to saturation, with the result that Vo is LOW. If we assume that VCE2 (sat.) is zero, then the voltage across Re is given by the equation Voltage acrossRe = [VCCRe/(Re +Rc2)]…….(1)This is also the emitter voltage of transistor Q1. In order to make transistor Q1 conduct, Vin must be at least 0.7 V more than the voltage across Re. That is,Vimin = [VCCRe/(Re +Rc2)] + 0.7 ……(2)When Vin exceeds this voltage, Q1 starts conducting. The regenerative action again drives Q2 to cut-off. Q2 goes to the HIGH state. Voltage across Re changes to a new value given by the equation Voltage acrossRe = [VCCRe/(Re + Rc1)] ……(3)Vin = [VCCRe/(Re + Rc1)] + 0.7……. (4)Transistor Q1 will continue to conduct as long as Vin is greater or equal to greater than the value given by Equation (4).If Vin falls below this level, the regenerative action does the rest, with the process culminating in Q1 going to cut-off and Q2 to saturation. Thus, the state of output (HIGH or LOW) depends upon the input voltage level.The HIGH and LOW states of the output correspond to two distinct input levels given by Equations (2) and (4) and therefore the values of Rc1,Rc2,Re and VCC.The Schmitt trigger circuit of Fig. 2 therefore exhibits hysteresis.Fig. 3Figure 3 shows the transfer characteristics of the Schmitt trigger circuit. The lower trip point VLT and the upper trip point VUT of these characteristics are respectively given byVLT = [VCCRe/(Re +Rc1)] + 0.7…… (5)VUT = [VCCRe/(Re +Rc2)] + 0.7…… (6)A monostable multivibrator, also known as a monoshot, is one in which one of the states is stable and the other is quasi-stable. The circuit is initially in the stable state. It goes to the quasi-stable state when appropriately triggered. It stays in the quasi-stable state for a certain time period, after which it comes back to the stable state.Fig.4Figure 4 shows the basic monostable multivibrator circuit. The circuit functions as follows.Initially, transistor Q2 is in saturation as it gets its base bias from +VCC through R Coupling from Q2 collector to Q1 base ensures that Q1 is in cut-off. Now, if an appropriate trigger pulse induces a transition in Q2 from saturation to cut-off, Q2 goes to the HIGH state.This HIGH when coupled to the Q1 base turns Q1 ON. Since there is no direct coupling from Q1 collector to Q2 base, which is necessary for a regenerative process to set in, Q1 is not necessarily in saturation. However, it conducts some current.The Q1 collector voltage falls by Ic1Rc1 and the Q2 base voltage falls by the same amount, as the voltage across a capacitor (C in this case) cannot change instantaneously. So from the moment we applied the trigger, Q2 went to cut-off and Q1 started conducting. But now there is a path for capacitor C to charge through R and the conducting transistor. The polarity of voltage across C is such that the Q2 base potential rises.The moment the Q2 base voltage exceeds the cut-in voltage, it turns Q2 ON, which, owing to coupling with R1, turns Q1 OFF. And we are back to the original state.Whenever we trigger the circuit into the other state, it does not stay there permanently and returns back to the original state after a time period that depends upon R and C. The greater the time constant RC, the longer is the time for which it stays in the other state, called the quasi-stable state.Retriggerable Monostable Multivibrator: In a conventional monostable multivibrator, once the output is triggered to the quasi-stable state by applying a suitable trigger pulse, the circuit does not respond to subsequent trigger pulses as long as the output is in quasi-stable state. After the output returns to its original state, it is ready to respond to the next trigger pulse.There is another class of monostable multivibrators. These respond to trigger pulses even when the output is in the quasi-stable state.In this class of monostable multivibrators, if a trigger pulses with a time period of Tt are applied to the circuit, the output pulse width, that is, the time period of the quasi-stable state, equals (n−1)Tt +T, where T is the output pulse width for the single trigger pulse and Tt < T.Fig. 5Figure 5 shows the output pulse width in the case of a retriggerable monostable multivibrator for repetitive trigger pulses. In the case of an astable multivibrator, neither of the two states is stable. Both output states are quasi-stable. The output switches from one state to the other and the circuit functions like a free-running square-wave oscillator.Fig. 6Figure 6 shows the basic astable multivibrator circuit. It can be proved that, in this type of circuit, neither of the output states is stable. Both states, LOW as well as HIGH, are quasi-stable. The time periods for which the output remains LOW and HIGH depends upon R2C2 and R1C1 time constants respectively. For R1C1 = R2C2, the output is a symmetrical square waveform. The circuit functions as follows.Let us assume that transistor Q2 is initially conducting, that is, the output is LOW. Capacitor C2 in this case charges through R2 and the conducting transistor from VCC, and, the moment the Q1 base potential exceeds its cut-in voltage, it is turned ON. A fall in Q1 collector potential manifests itself at the Q2 base as voltage across a capacitor cannot change instantaneously. This turns Q2 OFF, and the output goes to the HIGH state, and C1 charges through R1 and the conducting transistor Q1 from VCC. The moment the Q2 base potential exceeds its cut-in voltage, it is again turned ON, with the result that the output goes to the LOW state. The cycle repeats itself, and, owing to the cross-coupling (Q1 collector to Q2 base and Q2 collector to Q1 base), neither of the states is stable. The circuit produces a square-wave output. Home Electrical Molded Case Circuit Breaker (MCCB): Types, Working, and Applications Explained Magnetic Starter : Circuit, Working, Wiring, Vs Contactor, Advantages & Its Applications Preamplifier : Circuit, Working, Types, Differences, How to Choose, & Its Applications 2 Point Starter : Circuit, Working, Differences & Its Applications Plug Flow Reactor : Working, Derivation, Characteristics & Its Applications Electric Boiler : Working, Types, Differences, Maintenance & Its Applications Electronics Drone Propeller : Working, Materials, Types, Sizes, Advantages, Disadvantages & Its Applications Drones Projects for Engineering Students Quadcopter : Components, Working, Types, Interfacing, Differences & Its Applications Intake Air Temperature Sensor : Specifications, Working, Circuit, Differences & Its Application Engine Coolant Temperature Sensor : Specifications, Circuit, Working, Symptoms, Causes & Its Applications TM1637 Module : PinOut, Features, Specifications, Interfacing, Working, Datasheet & Its Applications Communication Loop Antenna : Design, Working, Types, Radiation Pattern & Its Applications Corner Reflector : Working, Types, Calculation, Radiation pattern & Its Applications Space Division Multiplexing : Diagram, Working, Advantages, Disadvantages & Its Applications Microstrip Antenna : Construction, Working, Types, Feeding Methods & Its Applications Alphanumeric Code : Types, Advantages & Its Applications Short Dipole Antenna : Design, Working, Radiation Pattern, Effectiveness & Its Applications Robotics Projects General Drones Projects for Engineering Students A drone is a UAV (unmanned aerial vehicle) that can fly either remotely or autonomously with software-controlled... Drones have rapidly evolved from hobbyist gadgets to sophisticated platforms for innovation, making them... A circuit breaker is an electrical switch that protects the circuit or load... A motor starter is an electrical device used to control an electric motor from overload... Plug flow is a simplified mode of these reactions, so we only have few molecules... Electric Boiler Day by day the usage of electrical boilers is rising due to its popularity... A DC machine is an electromechanical device, used to change DC electricity... There are different types of materials & also substances that are made up... Arduino UNO is a Microcontroller developed using ATmega328P. It has 14 digital I/O pins. From among these 14 pins, 6 are used... Nowadays, "image processing" is normally used by a wide range of applications and in different types of electronics like computers,... The main aim of this proposed project is to design and implement a flexible, cost-effective and powerful GSM Based Industrial... To know more about ATmega16 first, we need to know some history about the microcontroller. Actually what it is? Well as we human... The Arduino Uno is one kind of microcontroller board based on ATmega328, and Uno is an Italian term which means one. Arduino Uno... Robots are automatically operated machines that are developed for multiple purposes. Robotics includes welding, assembly, monitoring, rescue & recovery and lot more.... Copyright 2013 - 2025 © Elprocus Multivibrators are fundamental electronic circuits used in various applications, from timing circuits to pulse generators. In this article, we'll explore the differences between astable, monostable, and bistable configurations are key which are distinguished for their distinct functionalities. In this article, we'll explore the differences between astable, monostable, and bistable multivibrators, shedding light on their unique characteristics and applications. Astable Multivibrator: Oscillating Freedom Astable multivibrators, also known as oscillators, are characterized by their continuous oscillation between two states without the need for external triggering. This makes them ideal for generating square waves with a constant frequency and duty cycle. The key features of astable multivibrators include: 1. No Stable State: Unlike monostable and bistable multivibrators, astable circuits have no stable state. Instead, they continually alternate between high and low states, producing a continuous output waveform. 2. Self-Sustaining Oscillation: Astable multivibrators rely on the charging and discharging of capacitors through resistors to generate oscillations. The timing components determine the frequency and duty cycle of the output waveform. 3. Applications: Astable multivibrators find applications in timing circuits, pulse generators, clock circuits, and frequency modulation systems, where a continuous oscillating signal is required. Monostable Multivibrator: One-Shot Wonders Monostable multivibrators, also known as one-shot multivibrators, produce a single pulse of a predetermined duration in response to an external trigger. Once triggered, the circuit returns to its stable state until reset. The key features of monostable multivibrators include: 1. Stable and Unstable States: Monostable circuits have one stable state and one unstable state. Upon triggering, the circuit transitions from the stable state to the unstable state for a fixed period before returning to stability. 2. External Triggering: Monostable multivibrators require an external trigger signal to initiate the pulse generation. The duration of the output pulse is determined by the timing components of the circuit. 3. Applications: Monostable multivibrators are commonly used in applications such as pulse width modulation (PWM), time delay circuits, debounce circuits, and single-shot pulse generators. Bistable Multivibrator: Two-State Stability Bistable multivibrators, also known as flip-flops, have two stable states and can remain in either state indefinitely until triggered to switch. Bistable circuits are widely used in digital electronics for storing binary information and sequential logic operations. The key features of bistable multivibrators include: 1. Stable States: Bistable circuits have two stable states, often referred to as 'set' and 'reset' states. Once triggered, the circuit switches from one stable state to the other and remains in that state until triggered again. 2. Triggered Switching: Bistable multivibrators require an external trigger pulse to initiate the state transition. The circuit remains in its current state until triggered to switch to the opposite state. 3. Applications: Bistable multivibrators are essential building blocks in digital circuits, such as memory elements, latches, flip-flops, and sequential logic circuits used in counters, registers, and control systems. Harnessing Multivibrators for Diverse Applications Astable, monostable, and bistable multivibrators are essential components in electronic circuits with distinct functionalities and applications. While astable multivibrators produce continuous oscillations, monostable multivibrators generate single pulses in response to triggers, and bistable multivibrators exhibit two stable states for storing binary information. By understanding the differences between these multivibrator configurations, engineers and hobbyists can leverage their unique characteristics to design and implement a wide range of electronic circuits for diverse applications, from timing and pulse generation to digital logic and memory storage. A multivibrator is basically a two stage R-C coupled amplifier with positive feedback from the output of one amplifier to the input of the other, as illustrated in Fig. 31.16. Multivibrator is a switching circuit and may be defined as an electronic circuit that generates nonsinusoidal waves such as rectangular waves, sawtooth waves, square waves etc. Multivibrators are capable of storing binary numbers, counting pulses, synchronizing arithmetic operations and performing other essential functions used in digital systems. Ordinarily square waves can be generated by introducing a switch in a dc circuit, as shown in Fig. 31.17 (a). Square wave will be generated by turning the switch on and off at regular intervals. Hence a multivibrator is essentially a two-stage amplifier with positive feedback in which the two amplifying devices alternately conduct and go off. The circuit operates in two states viz. on and off controlled by circuit condition. The operation of the circuit is such that when one transistor is on (or off) the positive feedback loop maintains the other amplifier in a conducting or on state. When a trigger causes one amplifier to change state, the coupling network acts to change the state of the second amplifier. The outputs are opposite in sense, one indicating a transition from an "off" state to an on state and the other the opposite transition. The condition in which the multivibrator may remain indefinitely until the circuit is triggered by some external signal is termed as the stable state. There are only two possible states of a multivibrator and are as follows : First state : Transistor Q1 on and Transistor Q2 off. Second state : Transistor Q1 off and Transistor Q2 on. Depending upon the type of coupling network employed, the multivibrators are classified into the following three categories. Astable or free running multivibrator. Monostable or single-shot multivibrator. Bistable or flip-flop multivibrator. The first one is the non-driven type whereas the other two are the driven types (also called the triggered type multivibrators). Multivibrators are used for various purposes, such as generation of nonsinusoidal waveforms (square, rectangular, sawtooth etc.) and pulses occurring periodically, frequency division, synchronized generation of pulses and extended waveforms, generation of time delays, storage of binary bit of information etc. 1. Astable or Free Running Multivibrator. In astable multivibrator, both coupling networks provide ac coupling through coupling capacitors. Each amplifier stage provides phase shift of 180° in the midband so as to provide an overall phase shift of 360° or 0° and thus a positive feedback. The circuit, therefore, oscillates, provided that the total loop gain is equal to or greater than unity. It has no stable state. The two states of operation of astable multivibrator are quasi stable (temporary) states. The astable multivibrator, therefore, makes successive transitions from one quasi state to the other one after a predetermined time interval, without the aid of an external triggering signal. The periodic time depends upon circuit time constants and parameters. Thus it is just an oscillator as it does not need any external pulse for its operation. Since its output oscillates in between off and on states freely, it is called a free running multivibrator. It is also named as square-wave generator. AMV may also be used as a synchronised oscillator and for driving sweep generators. 2. Monostable or Single-Shot Multivibrator. It is also called a single swing, one shot, or delay multivibrator. In this circuit, one coupling network provides ac coupling while the other provides dc coupling. It has only one stable (standby) state and one quasi stable state. In this circuit, a triggering signal is required to induce a transition from the stable state to the quasi stable state. The circuit remains in the quasi stable state for a period determined by the circuit components. After this period, the circuit returns to its initial stable state and an external signal is required to induce this reverse transition. Thus, the monostable multivibrator supplies a single output pulse of a desired time duration for every input trigger pulse. Since the circuit vibrates once for a trigger, it is also called as univibrator or monostable multivibrator. As only one triggering signal is required to induce a transition from a stable state to quasi stable state and the circuit returns to the stable state automatically after a definite period, it is also called single-shot multivibrator. 3. Bistable or Flip-Flop Multivibrator: The bistable multivibrator, also called a two-shot multivibrator, requires application of two triggers to return the circuit to its original state. It has two stable states and can exist indefinitely in either of the two stable states. Obviously, such a circuit does not oscillate. In this circuit, both coupling networks provide dc coupling and no energy storage element is used. A bistable multivibrator is employed for performing many digital operations such as counting and storing of binary informations. This circuit also finds extensive use in the generation and processing of pulse type waveforms. Input-output relations for the three types of multivibrators are shown in Fig. 31.18. We Made This Simple Transformerless Power Supply with MOSFET, That Gives 0 to 300V DC and Adjustable Current, But Careful... It is Super Dangerous to touch in uncovered condition.... So [...]Now we explain one powerful voltage regulator circuit using one single chip IC called LM196 which can give big 10 amp current and can give variable voltage from around 1.25V [...]In this post we are talking about how we can charge and use all those bad defective discarded batteries. For this we are using a very different and innovative charging [...]In this article we are basically learning one very easy and straight method how we can get or make 220V AC from just a small 12V DC battery or power [...]In this post we will see how we can take an SMPS and then turn that into a solar charger circuit. This method we are going to discuss will give [...]Here we are making an electronic doorbell circuit that makes a dual-tone sound. So this thing is designed using the well-known IC 555. That IC 555 is something we see [...] A multivibrator is a type of electronic circuit, that is used to implement a two state system like flip-flops, timers and oscillators. Multivibrators are categorized by two amplifying devices like electron tubes, transistors and other devices which are cross coupled by resistors. Multivibrators are classified into three types based on the circuit operation, namely Astable multivibrators, Bistable multivibrators and Monostable multivibrators. In astable multivibrator, the circuit is not stable and it repeatedly switches from one state to the other. In monostable multivibrator, one state is stable and remaining state is unstable. A trigger pulse is the root to the circuit to enter the unstable state. When the circuit enters into the unstable state, then it will return to the normal state after a fixed time. A bistable multivibrator circuit can be changed from one state to other stable by an external trigger pulse. This multivibrator is also called as a flip-flop which can be used to store one bit of data. Monostable Multivibrator Monostable multivibrators have only one stable state that is used to generate a single o/p pulse of a specified width either high or low when an external trigger signal is applied. This trigger pulse causes the o/p to change its state at the time of start of timing cycle and continues in the second state which is determined by the time constant of the capacitor C and resistor R until it returns to its original state. It will stay in its original state until another i/p signal is received. Monostable multivibrators may be used to produce a much longer rectangular waveform. When a trigger pulse is applied externally the leading edge of the waveform rises with the externally applied trigger pulse. Here, trailing edge depends upon the RC time constant of the feedback components used. This RC time constant may be varied with time to produce a series of pulses which have a fixed time delay to the original triggered pulse. Circuit Connections of Monostable Multivibrator with 555 Timer Fig.1 Monostable Muvtivibrator using 555 IC Timer In the above circuit, the pin1 is connected to the ground and the trigger input is given to the pin2.In inactive condition of o/p, this i/p is kept at +VCC. To get transition of the output from a stable state to unstable state, a negative going pulse of narrow width and amplitude of greater than +2/3 VCC is applied to pin2. The o/p is taken from pin3 and pin4 is connected to +VCC to avoid accidental reset.Pin5 is connected to the ground via a 0.01uF capacitor to avoid noise. Pin6 and pin7 are shorted and a resistor is connected between pins 6 and 8. A discharge capacitor is connected between pin 7 and ground and finally the pin8 is connected to the supply VCC. Working of Monostable Multivibrator with 555 Timer Circuit The output of the monostable multivibrator using 555 timer remains in its stable state until it gets a trigger. In monostable 555 multivibrator, when both the transistor and capacitor are shorted then o/p becomes low. When the voltage goes below at the second pin of the 555 IC, the o/p becomes high. This high state is called quasi stable state. The circuit activates from the transition from a stable state to quasi stable state. Then the discharge transistor is cut-off and the capacitor starts charging to VCC. Charging of the capacitor is done via the resistor R1 with a time constant R1C1. Hence, the voltage of the capacitor increases and finally exceeds 2/3 Vcc, it will change the internal control flip flop, thereby turning off the 555 timer IC. Hence, the o/p goes back to its stable state from an unstable state. The Time duration of the pulse is given by T = 1.1RC Where, R is in Ω and C in Farads. Finally we can conclude that, in the monostable multivibrator using 555 timer, the o/p stays in a low state until it gets a trigger i/p. This type of operation is used in push to operate systems. When the input is triggered, the o/p will go to high state & comes back to its original state. Advantages of Monostable Multivibrator It needs only one pulse to get the output and there is no need of extra pulse for its operation. Its construction is very simple and can be constructed easily. Due to simple construction its price is also less. Disadvantages of Monostable Multivibrator The major drawback of using a monostable multivibrator is that the time between the applications of trigger pulse T has to be greater than the RC time constant of the circuit. Applications of Monostable Multivibrator Due to time delay capability, it is mostly used in different timer circuits. It is also used in different storage circuits. It is used to provide input to other pulse generator circuits. It also has ability to reproduce damage pulses again. Astable Multivibrator An astable multivibrator is also known as a free-running multivibrator. It is called free-running because it alternates between two different output voltage levels during the time it is on. The output remains at each voltage level for a definite period of time. If you looked at this output on an oscilloscope, you would see continuous square or rectangular waveforms. The astable multivibrator has two outputs, but no inputs. Working of Astable Multivibrator with 555 Timer Circuit Fig.2 Working of Astable Multivibrator When initially power is turned ON, Trigger Pin voltage is below Vcc/3, this makes lower comparator output HIGH and SETS the flip flop and output of the 555 chip is HIGH. This makes the transistor Q1 OFF, because Qbar, Q'=0 is directly applied to base of transistor. As the transistor is OFF, capacitor C1 starts charging and when it gets charged to a voltage above than Vcc/3, then Lower comparator output becomes LOW (Upper comparator is also at LOW) and Flip flop output remains the same as previous (555 output remains HIGH). Now when capacitor charging gets to voltage of 2/3Vcc, then the voltage of non-inverting end (Threshold PIN 6) becomes higher than the inverting end of the comparator. This makes Upper comparator output HIGH and RESETs the Flip flop, and output of 555 chip becomes LOW. As soon as the output of 555 get LOW means Q'=1, then transistor Q1 becomes ON and short the capacitor C1 to the ground. So the capacitor C1 starts discharging to the ground through the Discharge PIN 7 and resistor R2. As capacitor voltage get down below the 2/3 Vcc, upper comparator output becomes LOW, now SR Flip flop remains in the previous state as both the comparators are LOW. While discharging, when capacitor voltage gets down below Vcc/3, this makes the Lower comparator output HIGH (upper comparator remain LOW) and Sets the flip flop again and 555 output becomes HIGH. Transistor Q1 becomes OFF and again capacitor C1 starts charging.Fig.3 Waveform of Astable Multivibrator This charging and discharging of capacitor continues and a rectangular oscillating output wave for is generated. While capacitor is getting charge output of 555 is HIGH, and while capacitor is getting discharged output will be LOW. So the 555 automatically interchange its state from HIGH to LOW and LOW to HIGH, so it is called Free running Multivibrator. Now, the OUTPUT HIGH and OUTPUT LOW duration, is determined by the Resistors R1 & R2 and capacitor C1. It can be calculated using below formulas: Time High (Seconds) T1 = 0.693 * (R1+R2) * C1 Time Low (Seconds) T2 = 0.693 * R2 * C1 Time Period T = Time High + Time Low = 0.693 * (R1+2*R2) * C1 Frequency f = 1/Time Period = 1/ 0.693 * (R1+2*R2) * C1 = 1.44 / (R1+2*R2) * C1 Duty Cycle: Duty cycle is the ratio of time for which the output is HIGH to the total time. Duty cycle %: (Time HIGH/ Total time) * 100 = (T1/T) * 100 = (R1+R2)/ (R1+2*R2) *100 Advantages of Astable Multivibrator No external triggering required. Circuit design is simple. Inexpensive. Can function continuously. Disadvantages of Astable Multivibrator Energy absorption is more within the circuit. Output signal is of low energy. Duty cycle less than or equal to 50% can't be achieved. Applications of Astable Multivibrator Astable multivibrators are used in many applications such as amateur radio equipment, Morse code generators, timer circuits, analog circuits, and TV systems. What is Multivibrator?The Multivibrator circuits are widely used in electronics. It is the electronics circuit which is used to implement the two state devices like Relaxation Oscillator, Timer and Flip-Flops.Here the two states refers to the two voltage levels (e.g. 0V, and 5V). Many times the two voltage levels are also represented as either logic high or logic low (e.g. 0V).The multivibrators can be classified into three categories.Astable MultivibratorMonostable MultivibratorBistable MultivibratorAstable MultivibratorThe astable multivibrator does not remain stable in any of the two states. And the output of the multivibrator continuously changes between the two states.The relaxation oscillators are the example of the astable multivibrator.Monostable MultivibratorIn monostable multivibrator, the output remains in the one stable state but whenever an external trigger signal is applied, the output momentarily goes into the unstable state. And after some time it comes back into the stable state. The time required to come back into the stable state depends on the passive components like R and C.This type of multivibrator is used as a timer in many applications.Bistable MultivibratorThis type of multivibrator has two stable states. The output used to be in any one of the two stable states. And whenever an external trigger signal is applied, the output goes from one stable state to another stable state. If no triggering action is applied thereafter, then it remains in the new stable state. The bistable multivibrator is one kind of flip-flop circuit.All the three types of multivibrator can be designed using either op-amp, transistor pairs or 555 Timer IC. A monostable multivibrator, as the name implies, has only one stable state. When the transistor conducts, the other remains in non-conducting state. A stable state is such a state where the transistor remains without being altered, unless disturbed by some external trigger pulse. As Monostable works on the same principle, it has another name called as One-shot Multivibrator. Construction of Monostable Multivibrator Two transistors Q1 and Q2 are connected in feedback to one another. The collector of transistor Q1 is connected to the base of transistor Q2 through the capacitor C1. The base Q1 is connected to the collector of Q2 through the resistor R2 and capacitor C. Another dc supply voltage VBB is given to the base of transistor Q1 through the resistor R3. The trigger pulse is given to the base of Q1 through the capacitor C2 to change its state. RL1 and RL2 are the load resistors of Q1 and Q2. One of the transistors, when gets into a stable state, an external trigger pulse is given to change its state. After changing its state, the transistor remains in this quasi-stable state or Meta-stable state for a specific time period, which is determined by the values of RC time constants and gets back to the previous stable state. The following figure shows the circuit diagram of a Monostable Multivibrator. Firstly, when the circuit is switched ON, transistor Q1 will be in OFF state and Q2 will be in ON state. As Q1 is OFF, the collector voltage will be VCC at point A and hence C1 gets charged. A positive trigger pulse applied at the base of the transistor Q1 turns the transistor ON. This decreases the collector voltage, which turns OFF the transistor Q2. The capacitor C1 starts discharging at this point of time. As the positive voltage from the collector of transistor Q2 is applied to transistor Q1, it remains in ON state. This is the quasi-stable state or Meta-stable state. The transistor Q2 remains in OFF state, until the capacitor C1 discharges completely. After this, the transistor Q2 turns ON with the voltage applied through the capacitor discharge. This turn ON the transistor Q1, which is the previous stable state. Output Waveforms The output waveforms at the collectors of Q1 and Q2 along with the trigger input given at the base of Q1 are shown in the following figures. The width of this output pulse depends upon the RC time constant. Hence it depends on the values of R1C1. The duration of pulse is given by $$T = 0.69R_1 C_1$$ The trigger input given will be of very short duration, just to initiate the action. This triggers the circuit to change its state from Stable state to Quasi-stable or Meta-stable or Semi-stable state, in which the circuit remains for a short period of time. There will be one pulse output for one trigger pulse. Advantages The advantages of Monostable Multivibrator are as follows − One trigger pulse is enough. Circuit design is simple Inexpensive Disadvantages The major drawback of using a monostable multivibrator is that the time between the applications of trigger pulse T has to be greater than the RC time constant of the circuit. Applications Monostable Multivibrators are used in applications such as television circuits and control system circuits. Astable and monostable multivibrators are both types of electronic circuits used in generating pulses or waveforms, but they operate differently in terms of their output and behavior.Astable Multivibrator:Continuous Oscillation: The astable multivibrator continuously switches between its two unstable states without external triggering. It generates a waveform output that alternates between high and low states, producing a square wave or a similar periodic waveform.No Stable State: Unlike the monostable multivibrator, the astable multivibrator has no stable state. It oscillates autonomously, creating a continuous output waveform without any external stimuli or triggers.No Fixed Duration: As there's no fixed stable state, the pulse widths in the output waveform of an astable multivibrator are not fixed. Instead, they are determined by the circuit's timing components and elements.See the following circuit diagram of astable multivibrator with transistors. Monostable Multivibrator:Single Pulse Generation: The monostable multivibrator is triggered externally to produce a single pulse output of fixed duration.Stable State and Triggered Operation: It has one stable state and switches to an unstable state when triggered by an external signal. After generating a single pulse, it returns to its stable state.Fixed Pulse Duration: Unlike the astable multivibrator, the monostable multivibrator generates a pulse of fixed duration determined by the circuit's timing components and trigger input.See the circuit diagram of monostable multivibrator with transistors. Differences Summarized:Astable is always oscillating, producing continuous square waveforms, while monostable generates a single pulse in response to an external trigger.Astable has no stable state, continuously shifting between two states, whereas monostable has one stable state until it's triggered to produce a single pulse.Astable doesn't require external triggering, while monostable depends on an external trigger to initiate the pulse generation.In essence, the key difference lies in the continuous oscillation and absence of a stable state in the astable multivibrator, whereas the monostable multivibrator generates a single pulse in response to an external trigger and returns to a stable state afterward.See also:# Differences between astable and bistable multivibrator# Monostable vs Bistable vs Astable Multivibrator Electronic circuit used to implement two-state devices A multivibrator is an electronic circuit used to implement a variety of simple two-state[1][2][3] devices such as relaxation oscillators, timers, latches and flip-flops. The first multivibrator circuit, the astable multivibrator oscillator, was invented by Henri Abraham and Eugene Bloch during World War I. It consisted of two vacuum tube amplifiers cross-coupled by a resistor-capacitor network.[4][5] They called their circuit a "multivibrator" because its output waveform was rich in harmonics.[6] A variety of active devices can be used to implement multivibrators that produce similar harmonic-rich wave forms; these include transistors, neon lamps, tunnel diodes and others. Although cross-coupled devices are a common form, single-element multivibrator oscillators are also common. The three types of multivibrator circuits are: Original vacuum tube Abraham-Bloch multivibrator oscillator, from their 1919 paper Astable multivibrator, in which the circuit is not stable in either state —it continually switches from one state to the other. It functions as a relaxation oscillator. Monostable multivibrator, in which one of the states is stable, but the other state is unstable (transient). A trigger pulse causes the circuit to enter the unstable state. After entering the unstable state, the circuit will return to the stable state after a set time. Such a circuit is useful for creating a timing period of fixed duration in response to some external event. This circuit is also known as a one shot. Bistable multivibrator, in which the circuit is stable in either state. It can be flipped from one state to the other by an external trigger pulse. This circuit is also known as a flip-flop or latch. It can store one bit of information, and is widely used in digital logic and computer memory. Multivibrators find applications in a variety of systems where square waves or timed intervals are required. For example, before the advent of low-cost integrated circuits, chains of multivibrators found use as frequency dividers.[citation needed] A free-running multivibrator with a frequency of one-half to one-tenth of the reference frequency would accurately lock to the reference frequency. This technique was used in early electronic organs, to keep notes of different octaves accurately in tune. Other applications included early television systems, where the various line and frame frequencies were kept synchronized by pulses included in the video signal. A vacuum tube Abraham-Bloch multivibrator oscillator, France, 1920 (small box, left). Its harmonics are being used to calibrate a wavemeter (center). The first multivibrator circuit, the classic astable multivibrator oscillator (also called a plate-coupled multivibrator) was first described by Henri Abraham and Eugene Bloch in Publication 27 of the French Ministère de la Guerre, and in Annales de Physique 12, 252 (1919). Since it produced a square wave, in contrast to the sine wave generated by most other oscillator circuits of the time, its output contained many harmonics above the fundamental frequency, which could be used for calibrating high frequency radio circuits. For this reason Abraham and Bloch called it a multivibrateur. It is a predecessor of the Eccles-Jordan trigger[7] which was derived from the circuit a year later. Historically, the terminology of multivibrators has been somewhat variable: 1942 – multivibrator implies astable: "The multivibrator circuit (Fig. 7-6) is somewhat similar to the flip-flop circuit, but the coupling from the anode of one valve to the grid of the other is by a condenser only, so that the coupling is not maintained in the steady state."[8] 1942 – multivibrator as a particular flip-flop circuit: "Such circuits were known as 'trigger' or 'flip-flop' circuits and were of very great importance. The earliest and best known of these circuits was the multivibrator."[9] 1943 – flip-flop as one-shot pulse generator: "...an essential difference between the two-valve flip-flop and the multivibrator is that the flip-flop has one of the valves biased to cutoff."[10] 1949 – monostable as flip-flop: "Monostable multivibrators have also been called 'flip-flops'."[11] 1949 – monostable as flip-flop: "... a flip-flop is a monostable multivibrator and the ordinary multivibrator is an astable multivibrator."[12] This section does not cite any sources. Please help improve this section by adding citations to reliable sources. Unsourced material may be challenged and removed. (February 2022) (Learn how and when to remove this message)An astable multivibrator consists of two amplifying stages connected in a positive feedback loop by two capacitive-resistive coupling networks.[failed verification] The amplifying elements may be junction or field-effect transistors, vacuum tubes, operational amplifiers, or other types of amplifier. Figure 1, below right, shows bipolar junction transistors. The circuit is usually drawn in a symmetric form as a cross-coupled pair. The two output terminals can be defined at the active devices and have complementary states. One has high voltage while the other has low voltage, except during the brief transitions from one state to the other. The circuit has two astable (unstable) states that change alternatively with maximum transition rate because of the "accelerating" positive feedback. It is implemented by the coupling capacitors that instantly transfer voltage changes because the voltage across a capacitor cannot suddenly change. In each state, one transistor is switched on and the other is switched off. Accordingly, one fully charged capacitor discharges (reverse charges) slowly thus converting the time into an exponentially changing voltage. At the same time, the other empty capacitor quickly charges thus restoring its charge (the first capacitor acts as a time-setting capacitor and the second prepares to play this role in the next state). The circuit operation is based on the fact that the forward-biased base-emitter junction of the switched-on bipolar transistor can provide a path for the capacitor restoration. State 1 (Q1 is switched on, Q2 is switched off) Figure 1: Basic BJT astable multivibrator An oscilloscope shot of the voltage of the collector (trace 1) and the base (trace 2) of a transistor in an BJT astable multivibrator. The emitter of the transistor in this example is connected to ground. In the beginning, the capacitor C1 is fully charged (in the previous State 2) to the power supply voltage V with the polarity shown in Figure 1. Q1 is on and connects the left-hand positive plate of C1 to ground. As its right-hand negative plate is connected to Q2 base, a maximum negative voltage (-V) is applied to Q2 base that keeps Q2 firmly off. C1 begins discharging (reverse charging) via the high-value base resistor R2, so that the voltage of its right-hand plate (and at the base of Q2) is rising from below ground (-V) toward +V. As Q2 base-emitter junction is reverse-biased, it does not conduct, so all the current from R2 goes into C1. Simultaneously, C2 that is fully discharged and even slightly charged to 0.6 V (in the previous State 2) quickly charges via the low-value collector resistor R4 and Q1 forward-biased base-emitter junction (because R4 is less than R2, C2 charges faster than C1). Thus C2 restores its charge and prepares for the next State C2 when it will act as a time-setting capacitor. Q1 is firmly saturated in the beginning by the "forcing" C2 charging current added to R3 current. In the end, only R3 provides the needed input base current. The resistance R3 is chosen small enough to keep Q1 (not deeply) saturated after C2 is fully charged. When the voltage of C1 right-hand plate (Q2 base voltage) becomes positive and reaches 0.6 V, Q2 base-emitter junction begins diverting a part of R2 charging current. Q2 begins conducting and this starts the avalanche-like positive feedback process as follows. Q2 collector voltage begins falling; this change transfers through the fully charged C2 to Q1 base and Q1 begins cutting off. Its collector voltage begins rising; this change transfers back through the almost empty C1 to Q2 base and makes Q2 conduct more thus sustaining the initial input impact on Q2 base. Thus the initial input change circulates along the feedback loop and grows in an avalanche-like manner until finally Q1 switches off and Q2 switches on. The forward-biased Q2 base-emitter junction fixes the voltage of C1 right-hand plate at 0.6 V and does not allow it to continue rising toward +V. State 2 (Q1 is switched off, Q2 is switched on) Now, the capacitor C2 is fully charged (in the previous State 1) to the power supply voltage V with the polarity shown in Figure 1. Q2 is on and connects the right-hand positive plate of C2 to ground. As its left-hand negative plate is connected to Q1 base, a maximum negative voltage (-V) is applied to Q1 base that keeps Q1 firmly off. C2 begins discharging (reverse charging) via the high-value base resistor R3, so that the voltage of its left-hand plate (and at the base of Q1) is rising from below ground (-V) toward +V. Simultaneously, C1 that is fully discharged and even slightly charged to 0.6 V (in the previous State 1) quickly charges via the low-value collector resistor R1 and Q2 forward-biased base-emitter junction (because R1 is less than R3, C1 charges faster than C2). Thus C1 restores its charge and prepares for the next State 1 when it will act again as a time-setting capacitor...and so on... (the next explanations are a mirror copy of the second part of State 1). This section does not cite any sources. Please help improve this section by adding citations to reliable sources. Unsourced material may be challenged and removed. (January 2011) (Learn how and when to remove this message) The duration of state 1 (low output) will be related to the time constant R2C1 as it depends on the charging of C1, and the duration of state 2 (high output) will be related to the time constant R3C2 as it depends on the charging of C2. Because they do not need to be the same, an asymmetric duty cycle is easily achieved. The voltage on a capacitor with non-zero initial charge is: V cap (t) = [(V capinit − V charging) · e − t R C] + V charging $\displaystyle V_{\text{cap}}(t)=\left[\left(V_{\text{capinit}}-V_{\text{charging}}\right)\cdot e^{-{\frac {t}{RC}}}\right]+V_{\text{charging}}$ Looking at C2, just before Q2 turns on, the left terminal of C2 is at the base-emitter voltage of Q1 (VBE_Q1) and the right terminal is at VCC ("VCC" is used here instead of "+V" to ease notation). The voltage across C2 is VCC minus VBE_Q1 . The moment after Q2 turns on, the right terminal of C2 is now at 0 V which drives the left terminal of C2 to 0 V minus (VCC - VBE_Q1) or VBE_Q1 - VCC. From this instant in time, the left terminal of C2 must be charged back up to VBE_Q1. How long this takes is half our multivibrator switching time (the other half comes from C1). In the charging capacitor equation above, substituting: VBE_Q1 for V cap (t) $\displaystyle V_{\text{cap}}(t)$ (VBE_Q1 - VCC) for V capinit $\displaystyle V_{\text{capinit}}$ VCC for V charging $\displaystyle V_{\text{charging}}$ results in: V BE _ Q1 = ([(V BE _ Q1 − V CC) − V CC] · e − t R C) + V CC $\displaystyle V_{{\text{BE}}\_{\text{Q1}}}=\left(\left[\left(V_{{\text{BE}}\_{\text{Q1}}}-V_{\text{CC}}\right)-V_{\text{CC}}\right]\cdot e^{-{\frac {t}{RC}}}\right)+V_{\text{CC}}$ Solving for t results in: t = − R C · ln ⁡ (V BE _ Q1 − V CC V BE _ Q1 − 2 V CC) $\displaystyle t=-RC\cdot \ln \left({\frac {V_{{\text{BE}}\_{\text{Q1}}}-V_{\text{CC}}}{V_{{\text{BE}}\_{\text{Q1}}}-2V_{\text{CC}}}}\right)$ For this circuit to work, VCC>>VBE_Q1 (for example: VCC=5 V, VBE_Q1=0.6 V), therefore the equation can be simplified to: t = − R C · ln ⁡ (− V CC − 2 V CC) $\displaystyle t=-RC\cdot \ln \left({\frac {-V_{\text{CC}}}{-2V_{\text{CC}}}}\right)$ which can be simplified to: t = − R C · ln ⁡ (1 2) = R C · ln ⁡ 2 $\displaystyle t=-RC\cdot \ln \left({\frac {1}{2}}\right)=RC\cdot \ln {2}$ The period of each half of the multivibrator is therefore given by t = R C · ln ⁡ 2 $\displaystyle t=RC\cdot \ln {2}$. The total period of oscillation is given by: T = (R 2 C 1 + R 3 C 2) · ln ⁡ 2 $\displaystyle T=(R_{2}C_{1}+R_{3}C_{2})\cdot \ln {2}$ f = 1 T = 1 (R 2 C 1 + R 3 C 2) · ln ⁡ 2 ≈ 1.443 R 2 C 1 + R 3 C 2 $\displaystyle f={\frac {1}{T}}={\frac {1}{(R_{2}C_{1}+R_{3}C_{2})\cdot \ln {2}}}\approx {\frac {1.443}{R_{2}C_{1}+R_{3}C_{2}}}$ where... f is frequency in hertz. R2 and R3 are resistor values in ohms. C1 and C2 are capacitor values in farads. T is the period (In this case, the sum of two period durations). For the special case where t1 = t2 (50% duty cycle) R2 = R3 C1 = C2 f = 1 T = 1 2 R C · ln ⁡ 2 ≈ 0.72 R C $\displaystyle f={\frac {1}{T}}={\frac {1}{2RC\cdot \ln {2}}}\approx {\frac {0.72}{RC}}$ [13] The output voltage has a shape that approximates a square waveform. It is considered below for the transistor Q1. During State 1, Q2 base-emitter junction is reverse-biased and capacitor C1 is "unhooked" from ground. The output voltage of the switched-on transistor Q1 changes rapidly from high to low since this low-resistive output is loaded by a high impedance load (the series connected capacitor C1 and the high-resistive base resistor R2). During State 2, Q2 base-emitter junction is forward-biased and capacitor C1 is "hooked" to ground. The output voltage of the switched-off transistor Q1 changes exponentially from low to high since this relatively high resistive output is loaded by a low impedance load (capacitor C1). This is the output voltage of R1C1 integrating circuit. To approach the needed square waveform, the collector resistors have to be low in resistance. The base resistors have to be low enough to make the transistors saturate in the end of the restoration (RB < β.RC). When the circuit is first powered up, neither transistor will be switched on. However, this means that at this stage they will both have high base voltages and therefore a tendency to switch on, and inevitable slight asymmetries will mean that one of the transistors is first to switch on. This will quickly put the circuit into one of the above states, and oscillation will ensue. In practice, oscillation always occurs for practical values of R and C. However, if the circuit is temporarily held with both bases high, for longer than it takes for both capacitors to charge fully, then the circuit will remain in this stable state, with both bases at 0.60 V, both collectors at 0 V, and both capacitors charged backwards to −0.60 V. This can occur at startup without external intervention, if R and C are both very small. An astable multivibrator can be synchronized to an external chain of pulses. A single pair of active devices can be used to divide a reference by a large ratio, however, the stability of the technique is poor owing to the variability of the power supply and the circuit elements. A division ratio of 10, for example, is easy to obtain but not dependable. Chains of bistable flip-flops provide more predictable division, at the cost of more active elements.[13] While not fundamental to circuit operation, diodes connected in series with the base or emitter of the transistors are required to prevent the base-emitter junction being driven into reverse breakdown when the supply voltage is in excess of the Veb breakdown voltage, typically around 5-10 volts for general purpose silicon transistors. In the monostable configuration, only one of the transistors requires protection. Astable Multivibrator using Op-Amp circuit Assume all the capacitors to be discharged at first. The output of the op-amp Vo at node c is +Vsat initially. At node a, a voltage of +β Vsat is formed due to voltage division where β = [R 2 R 1 + R 2] $\displaystyle \beta =\left[{\frac {R2}{R1+R2}}\right]$. The current that flows from nodes c and b to ground charges the capacitor C towards +Vsat. During this charging period, the voltage at b becomes greater than +β Vsat at some point. The voltage at inverting terminal will be greater than the voltage at the non-inverting terminal of the op-amp. This is a comparator circuit and hence, the output becomes -Vsat. The voltage at node a becomes -βVsat due to voltage division. Now the capacitor discharges towards -Vsat. At some point, the voltage at b becomes less than -β Vsat. The voltage at the non-inverting terminal will be greater than the voltage at the inverting terminal of the op-amp. So, the output of the op-amp is +Vsat. This repeats and forms a free-running oscillator or an astable multivibrator. If VC is the voltage across the capacitor and from the graph, the time period of the wave formed at capacitor and the output would match, then the time period could be calculated in this way:Graph showing the output waveform of the op-amp and the waveform formed across the capacitor C. V c = V c (∞) + [V c (0) − V c (∞)] e − t R C $\displaystyle V_{c}=V_{c}(\infty)+[V_{c}(0)-V_{c}(\infty)]e^{\tfrac {-t}{RC}}$ V c (t) = V s a t + [− β V s a t − V s a t] e (− t R C) $\displaystyle V_{c}(t)=V_{sat}+[-\beta V_{sat}-V_{sat}]e^{\left({\frac {-t}{RC}}\right)}$ At t =T1, β V s a t = V s a t (1 − [β + 1] e − T 1 R C) $\displaystyle \beta V_{sat}=V_{sat}(1-[\beta +1]e^{\tfrac {-T1}{RC}})$ Upon solving, we get: T 1 = R C ln ⁡ [1 + β 1 − β] $\displaystyle T1=RC\ln \left[{\frac {1+\beta }{1-\beta }}\right]$ We are taking values of R, C and β such that we get a symmetrical square wave. Thus, we get T1 = T2 and total time period T = T1 + T2. So, the time period of the square wave generated at the output is: T = 2 R C ln ⁡ [1 + β 1 − β] $\displaystyle T=2RC\ln \left[{\frac {1+\beta }{1-\beta }}\right]$ Figure 2: Basic BJT monostable multivibratorThis section does not cite any sources. Please help improve this section by adding citations to reliable sources. Unsourced material may be challenged and removed. (February 2022) (Learn how and when to remove this message) In the monostable multivibrator, one resistive-capacitive network (C2-R3 in Figure 1) is replaced by a resistive network (just a resistor). The circuit can be thought as a 1/2 astable multivibrator. Q2 collector voltage is the output of the circuit (in contrast to the astable circuit, it has a perfect square waveform since the output is not loaded by the capacitor). When triggered by an input pulse, a monostable multivibrator will switch to its unstable position for a period of time, and then return to its stable state. The time period monostable multivibrator remains in unstable state is given by t = ln(2)R2C1. If repeated application of the input pulse maintains the circuit in the unstable state, it is called a retriggerable monostable. If further trigger pulses do not affect the period, the circuit is a non-retriggerable multivibrator. For the circuit in Figure 2, in the stable state Q1 is turned off and Q2 is turned on. It is triggered by zero or negative input signal applied to Q2 base (with the same success it can be triggered by applying a positive input signal through a resistor to Q1 base). As a result, the circuit goes in State 1 described above. After elapsing the time, it returns to its stable initial state. monostable multivibrator using op-amp The circuit is useful for generating single output pulse of adjustable time duration in response to a triggering signal. The width of the output pulse depends only on external components connected to the op-amp. A diode D1 clamps the capacitor voltage to 0.7 V when the output is at +Vsat. Let us assume that in the stable state the output Vo = +Vsat. The diode D1 clamps the capacitor to 0.7 V. The voltage at the non-inverting terminal through the potential divider will be + βVsat. Now a negative trigger of magnitude V1 is applied to the non-inverting terminal so that the effective signal at this terminal is less than 0.7 V. Then the output voltage switches from +Vsat to -Vsat. The diode will now get reverse biased and the capacitor starts charging exponentially to -Vsat through R. The voltage at the non-inverting terminal through the potential divider will be - βVsat. After some time the capacitor charges to a voltage more than - βVsat. The voltage on the non-inverting input is now greater than on the inverting input and the output of the op-amp switches again to +Vsat. The capacitor discharges through resistor R and charges again to 0.7 V. The pulse width T of a monostable multivibrator is calculated as follows: The general solution for a low pass RC circuit is V o = V f + (V i − V f) e − t / R C $\displaystyle V_{o}=V_{f}+(V_{i}-V_{f})e^{-t/RC}$ where V f = − V sat $\displaystyle V_{f}=-V_{\text{sat}}$ and V i = V d $\displaystyle V_{i}=V_{d}$, the diode forward voltage. Therefore, V c = − V sat + (V d + V sat) e − t / R C $\displaystyle V_{c}=-V_{\text{sat}}+(V_{d}+V_{\text{sat}})e^{-t/RC}$ at t = T $\displaystyle t=T$, V c = − β V sat $\displaystyle V_{c}=-\beta V_{\text{sat}}$ − β V sat = − V sat + (V d + V sat) e − T / R C $\displaystyle -\beta V_{\text{sat}}=-V_{\text{sat}}+(V_{d}+V_{\text{sat}})e^{-T/RC}$ after simplification, T = R C ln ⁡ (1 + V d / V sat 1 − β) $\displaystyle T=RC\ln \left({1+V_{d}/V_{\text{sat}} \over 1-\beta }\right)$ where β = R 2 R 1 + R 2 $\displaystyle \beta ={R2 \over R1+R2}$ If V sat >> V d $\displaystyle V_{\text{sat}}>>V_{d}$ and R 1 = R 2 $\displaystyle R1=R2$ so that β = 0.5 $\displaystyle \beta =0.5$, then T = 0.69 R C $\displaystyle T=0.69RC$ Main article: Flip-flop (electronics) This section does not cite any sources. Please help improve this section by adding citations to reliable sources. Unsourced material may be challenged and removed. (February 2022) (Learn how and when to remove this message) Figure 3: Basic animated interactive BJT bistable multivibrator circuit (suggested values: R1, R2 = 1 kΩ R3, R4 = 10 kΩ) In the bistable multivibrator, both resistive-capacitive networks (C1-R2 and C2-R3 in Figure 1) are replaced by resistive networks (just resistors or direct coupling). This latch circuit is similar to an astable multivibrator, except that there is no charge or discharge time, due to the absence of capacitors. Hence, when the circuit is switched on, if Q1 is on, its collector is at 0 V. As a result, Q2 gets switched off. This results in more than half +V volts being applied to R4 causing current into the base of Q1, thus keeping it on. Thus, the circuit remains stable in a single state continuously.

Similarly, Q2 remains on continuously, if it happens to get switched on first. Switching of state can be done via Set and Reset terminals connected to the bases. For example, if Q2 is on and Set is grounded momentarily, this switches Q2 off, and makes Q1 on. Thus, Set is used to "set" Q1 on, and Reset is used to "reset" it to off state. Blocking oscillator RC circuit Schmitt trigger ^ Jain, R. P.; Anand, M. (1983). Digital Electronics Practice Using Integrated Circuits. Tata McGraw-Hill Education. p. 159. ISBN 0074516922. ^ Rao, Prakash (2006). Pulse And Digital Circuits. Tata McGraw-Hill Education. p. 268. ISBN 0070606560. ^ Clayton, G B (2013). Operational Amplifiers, 2nd Ed. Elsevier. p. 267. ISBN 978-1483135557. ^ Abraham, H.; E. Bloch (1919). "Mesure en valeur absolue des périodes des oscillations électriques de haute fréquence" [Measurement of the periods of high frequency electrical oscillations]. Annales de Physique (in French). 9 (1). Paris: Société Française de Physique: 237–302. Bibcode:1919AnPh....9..237A. doi:10.1051/jphystap:019190090021100. ^ Ginoux, Jean-Marc (2012). "Van der Pol and the history of relaxation oscillations: Toward the emergence of a concepts". Chaos: An Interdisciplinary Journal of Nonlinear Science. 22 (2): 023120. arXiv:1408.4890. Bibcode:2012Chaos..22b3120G. doi:10.1063/1.3670008. PMID 22757527. S2CID 293369. ^ Multivibrator in IEEE Std. 100 Dictionary of Standards Terms 7th ed., IEEE Press, 2000 ISBN 0-7381-2601-2 page 718 ^ William Henry Eccles and Frank Wilfred Jordan, "Improvements in ionic relays" British patent number: GB 148582 (filed: 21 June 1918; published: 5 August 1920). ^ Wilfred Bennett Lewis (1942). Electrical counting: with special reference to counting alpha and beta particles. CUP Archive. p. 68. ^ The Electrician. 128. Feb 13, 1942. {{cite journal}}: Missing or empty |title= (help) ^ Owen Standige Puckle and E. B. Moullin (1943). Time bases (scanning generators): their design and development, with notes on the cathode ray tube. Chapman & Hall Ltd. p. 51. ^ Britton Chance (1949). Waveforms (Vol. 19 of MIT Radiation Lab Series ed.). McGraw-Hill Book Co. p. 167. ^ O. S. Puckle (Jan 1949). "Development of Time Bases: The Principles of Known Circuits". Wireless Engineer. 26 (1). Iliffe Electrical Publications: 139. ^ a b Donald Fink (ed), Electronics Engineers' Handbook, McGraw Hill, 1975 ISBN 0-07-020980-4, page 16-40