

ble state is based on conduction of  $Q_2$  with  $Q_1$  cut off. The stable state occurs when  $Q_1$  is conductive and  $Q_2$  is cut off. The circuit relaxes in its stable state when no trigger pulse is supplied. The unstable state is initiated by a trigger pulse. When a trigger pulse arrives at the input, the circuit changes from its stable state to the unstable state. After the time of  $0.7 \times R_2 C_1$ , the circuit goes back to its stable state. No current occurs until another trigger is applied to the input.

### Bistable Multivibrator

A *bistable multivibrator* has two stable states of operation. A trigger pulse applied to the input causes the circuit to assume one stable state. A second pulse causes it to switch to the alternate stable state. This type of multivibrator changes states only when a trigger pulse is applied. It is often called a flip-flop. It flips to one state when triggered and flops back to the other state when triggered. The circuit becomes stable in either state. It does not change states, or *toggle*, until commanded to do so by a trigger pulse. Figure 4-82 shows a schematic of a bistable multivibrator using bipolar transistors.

### IC Waveform Generators

The NE/SE 555 IC is a multifunction device that is widely used today. It can be modified to respond as an *astable multivibrator*. This particular circuit can be achieved with a minimum of components and a power

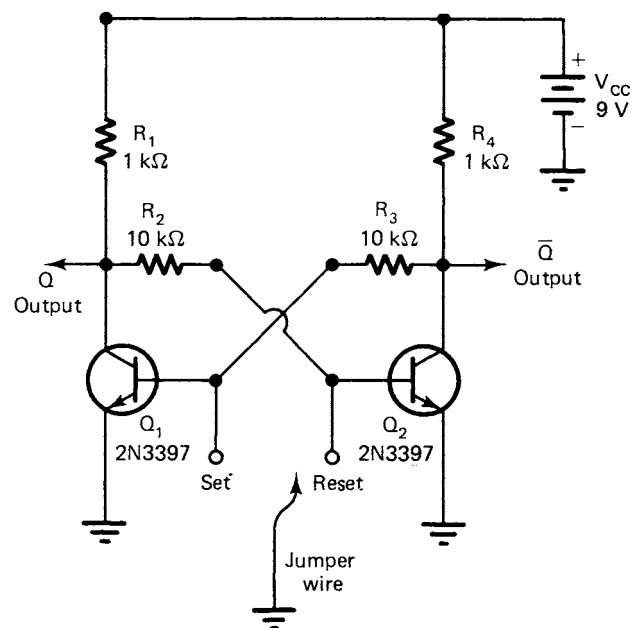


Figure 4-82. Bistable multivibrator.

source. Circuit design is easy to accomplish, and operation is very reliable through a number of manufacturers. As a rule, the number 555 usually appears in the manufacturer's part identification number. Some of the common part numbers for this chip are SN72555, MC14555, SE555, LM555, XR555, and CA555.

The internal circuitry of a 555 IC is generally viewed in functional blocks. In this regard, the chip has two comparators, a bistable flip-flop, a resistive divider, a discharge transistor, and an output stage. Figure 4-83 shows the functional blocks of a 555 IC.

The *voltage divider* of the IC consists of three 5-kΩ resistors. The network is connected internally across the +  $V_{CC}$  and ground-supply source. Voltage developed by the lower resistor is one-third of  $V_{CC}$ . The middle divider point is two-thirds of the value of  $V_{CC}$ . This connection is terminated at pin 5. Pin 5 is designated as the control voltage.

The two *comparators* of the 555 respond as an amplifying switch circuit. A reference voltage is applied to one input of each comparator. A voltage value applied to the other input initiates a change in output when it differs with the reference value. Comparator is referenced at two thirds of  $V_{CC}$  at its negative input, which is where pin 5 is connected to the middle divider resistor. The other input is terminated at pin 6. This pin is called the *threshold* terminal. When the voltage at pin 6 rises above two-thirds of  $V_{CC}$ , the output of the comparator swings positive. This is then applied to the *reset* input of the flip-flop.

Comparator 2 is referenced to one third of  $V_{CC}$ . The

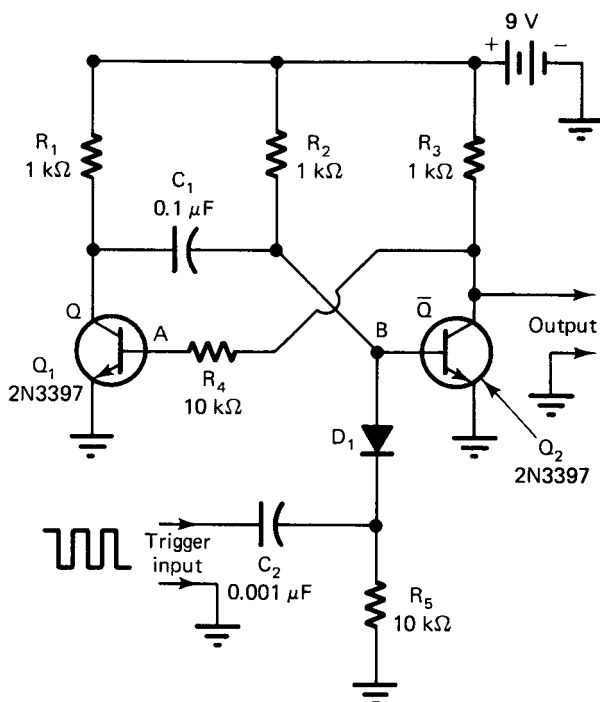


Figure 4-81. Monostable multivibrator.