

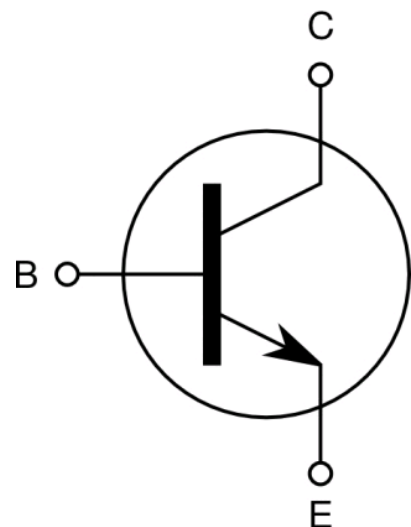
TIP31 BJT Transistor

Abstract

The TIP31 is a standard NPN bipolar junction transistor that is often used for medium power applications. A bipolar junction transistor (BJT) is a three terminal device that is allows for amplification or switching applications. It is formed by joining three sections of semiconductors with alternatively different dopings. The middle section (base) is narrow and the other two outside regions (emitter and collector) are heavily doped. Some transistors can amplify a small current which will then be powerful enough to operate a lamp or other high current devices. These devices are also able to detect a change in voltage and act as a switch. The TIP31 is a common transistor that is inexpensive and easy to use for multiple applications.

Introduction

BJTs consists of three differently doped semiconductor regions, the collector region, the base region, and the emitter region. For the TIP31 transistor, these regions are p type, n type, and p type, respectively. Each of these regions is connected to a terminal and appropriately labeled. Wiring a transistor needs be done carefully because an incorrect connection can cause immediate and permanent damage to the transistor. There are



4 states of operations for this type of transistor: forward-active, reverse-active, cut-off, and saturated. Each serves a certain purpose and function that can be very useful in many different situations. In our hyena project, we can use the TIP31 as a switch to turn on certain parts of a circuit depending on the position of the hyena tail, head, or ears. This device could also be used for amplification of the audio signals sent to the speaker of our model. A BJT is very versatile and can be implemented easily into our project.

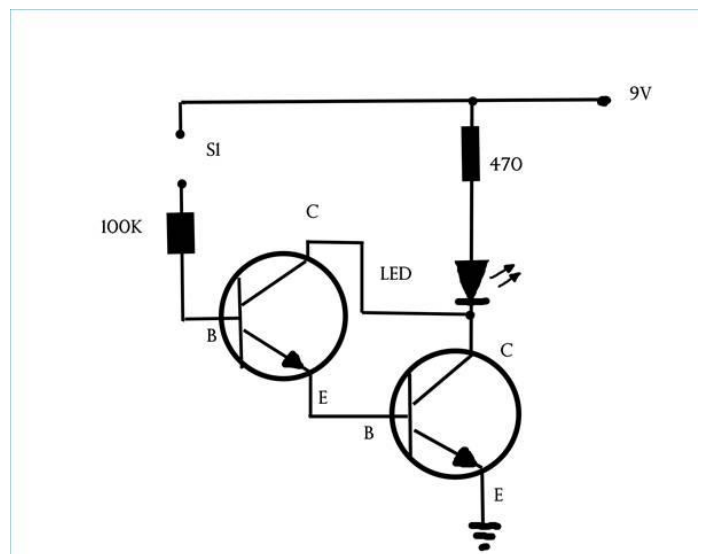
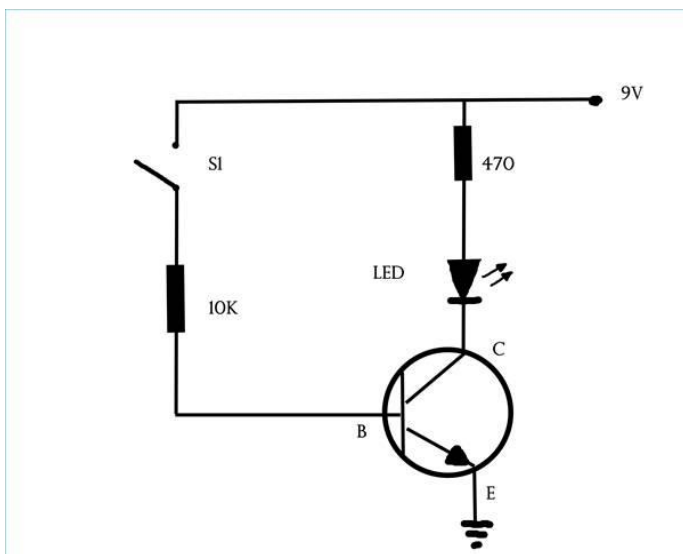
Specifications

This specific transistor can be used in many conditions and usually behaves in a similar way even if this part is purchased from a different manufacturer. The saturation voltage for the collector-emitter node is 1.2V while the base-emitter saturation voltage is 1.8V. It does not require a big voltage to activate this transistor but the value is also not too small where a false activation would occur. The gain of this BJT can vary from 20 to 25, which can be extremely useful especially when amplifying audio signals or activating LEDs. In our specific project, we will be working with a 6V voltage which is regulated with a LM7806 voltage regulator. This value is great enough to cause a change of state in the transistor and move from the cut-off state to saturation.

Application

The applications of this BJT transistor come down to two basic ideas. The TIP31 can be used to create a switch or an amplifier. The first schematic below shows the proper installation of this device to act as a switch that will turn on a LED. When the switch (S1) closes, current begins to

flow to the base of the transistor causing it to activate. The junction V_{CE} now is able to allow current flow which activated the LED. The second schematic shows how two BJT transistors can be created to form a quite powerful amplifier. When the open circuit at S1 is replaced with a short, current begins to flow to the first transistor. This causes amplification in the current and also turns on the second transistor. This occurs because the emitter of the first BJT is directly connected to the base of the second. The second BJT will now saturate and cause the LED to activate. The resulting output of the second emitter has been amplified twice.



Conclusions

The TIP31 is a versatile component used in many circuits to act as a switch or an amplifier. In our project we have the opportunity to utilize this BJT transistor in both applications. The 6V battery will provide more than enough power to activate the device from the base junction. This will be a great way to provide stability and make sure that components don't move without the activation of the TIP31. Our team can also use this transistor to create a powerful amplifier for the speaker. It is unsure how loud the speaker needs to be, but this circuit will

provide enough amplification to ensure the hyena sounds are loud enough to be heard from a distance.