

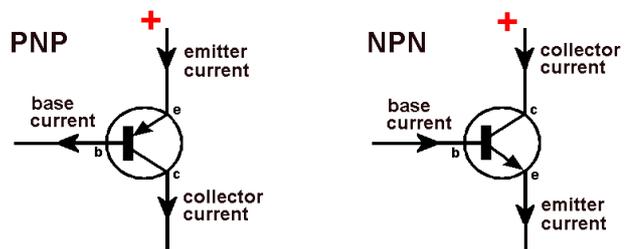
Using transistors

Members have asked which transistor is best for particular situations.

The most common types are known as bi-polar junction transistors, with different construction methods that produce PNP types (such as the BC557) and the more common NPN types (such as the BC547 and TIP122).

Their three leads are called the emitter, base and collector and the illustration shows the symbols for the two types.

In both cases, the base connection can be thought of as a tap that regulates the amount of current flowing between the other two connections.



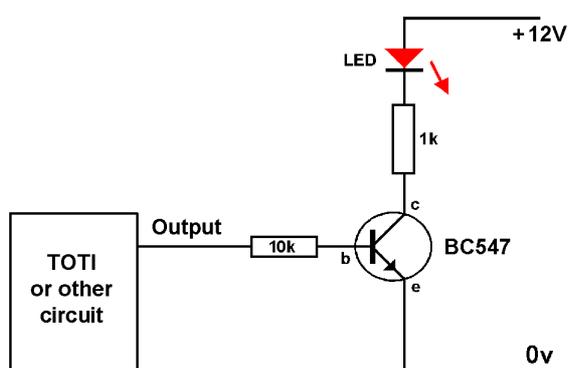
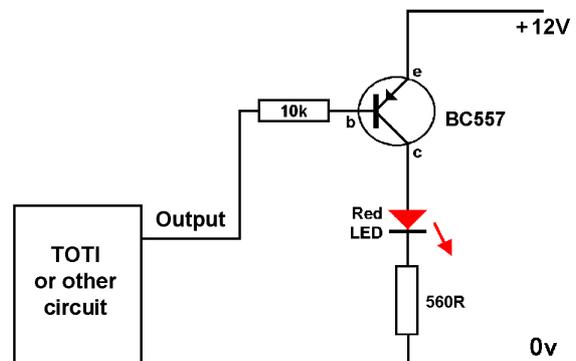
Used as switches

Although transistors have many uses, in most model railway projects they are used as switches. This allows a module to switch a device, such as a motor or a relay, that needs higher current than the module can handle on its own.

The PNP transistor switch

When the output of the driving circuit (the TOTI, etc.) goes high, no emitter/collector current flows and the LED is unlit.

If the output changes to 0V, current flows through the 10k resistor and through the base-emitter junction. This allows current to flow through the collector/emitter junction and the LED lights.



The NPN transistor switch

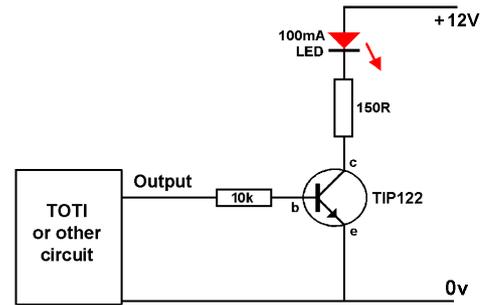
This transistor conducts when the driving circuit goes high, illuminating the LED. If the output changes to 0V, the current flow stops and the LED extinguishes.

The BC547 and the BC557 are capable of switching up to 100mA.

If you need to switch a higher current you can replace the BC547 with a high power transistor such as the TIP122.

As with other power transistors, its collector is bonded to a metal plate to allow a heat sink to be fitted to transfer away heat when high currents are being drawn.

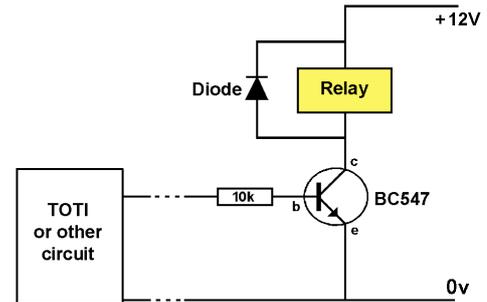
The circuit shows it handling a single high power LED. If you connect a LED strip, you do not need to use the 150 Ohm dropper resistor.



Relay

Some relays operate with a relatively small current. Others require a transistor to act as a current amplifier to switch the relay. You have to check the manufacturer's specifications.

In this circuit, the relay resistance is 250 ohms, therefore requiring 48mA to operate it. The BC547 provides the required current amplification.



Used as inverters

You may have noticed that when the base of a BC547 transistor is taken high, its collector voltage goes low (i.e. the output is the inverse of its input).

This is useful in some situations.

For example, the output of the key fob receiver goes high when the transmitter button is pressed.

Unfortunately, most modules require their inputs to go low to activate them.

The solution is to insert a BC547 between the two devices, as in this circuit. Now, when the receiver's output goes high the BC547's collector goes low and the DFPlayer is activated.

The PMP 17 (Automatic signals) kit also uses this technique. When light change is detected, pin3 will go high or low. When pin 3 goes high, the green LED illuminates but the red LED stays unlit as the BC557 transistor is switched off. When pin 3 goes low, the green LED is extinguished and the transistor is switched on, illuminating the red LED.

