How to Design a Transistor Amplifier?

Transistors are inevitable parts of Electronic circuits. The success of a circuit design lies in the selection of proper transistor type and calculation of voltage and current flowing through it. A small variation in the voltage or current level in the transitor will affects the working of whole circuit. Here explains how a transitor works.

How to calculate Voltage and Current in the Transistor design

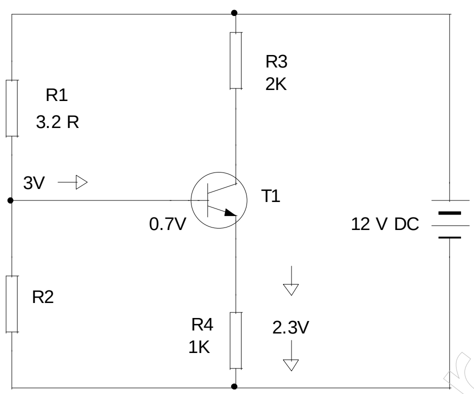

Fig.1

The Fig.1 explains how voltage and current are flowing through a bipolar transistor. Input voltage to the circuit is 12 volt DC. The base of T1 is connected to a potential divider R1-R2. If they have equal values, half supply voltage will be available at the base of T1. Here the value of R1 is 3.2 Ohms. If the value of R1 is three times greater than R2, then three quarter of 12V drops by R1 and allow one quarter to pass through R2. Therefore the base voltage of T1 will be 12 / 4 = 3 V.

Thus the voltage provided by R1 to the base of T1 is 3 volts. The emitter voltage of T1 will be 0.7 volts less than 3 volts since T1 drops 0.7 volts for its biasing. Thus the emitter voltage appears as 3-0.7 = 2.3 volts. If the value of the emitter resistor R4 is 1K, then if 2.3 volt passes through it, emitter current will be 2.3V/ 1 = 2.3 mA.Collector current also remains same. If the value of the load resistor R3 is 2K, two times higher than that of R4, then the voltage drop across it will be 2 x 2.3V = 4.6 volts.There fore the collector voltage of T1 remains as 12 – 4.6 = 7.4 volts.

Load current

In the circuit shown in Fig.2 ,6 volt DC supply is provided. T1 is a general purpose NPN transtior like BC 548. A potential divider comprising R1 and R2 bias the base of T1. Minimum base voltage necessary for biasing T1 is 0.7 volts.

The potential divider R1-R2 drops 6-0.7 = 6.3 volts.

If the load takes 4 volts,then the collector voltage will be 2 volts. 6-4=2 volts.

Value of the collector current depends on the base voltage. When the base voltage increases, collector current also increases. This results in more volts in the load. In short, 0.1 volt increase in base voltage causes 1 Volt increases in the load.

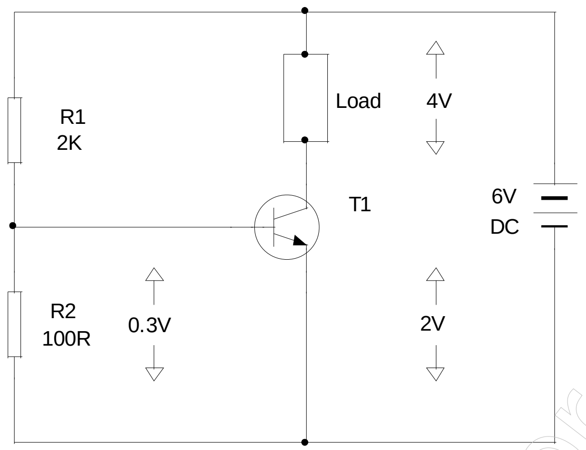

Fig.2

Current in the Transistor Amplifier

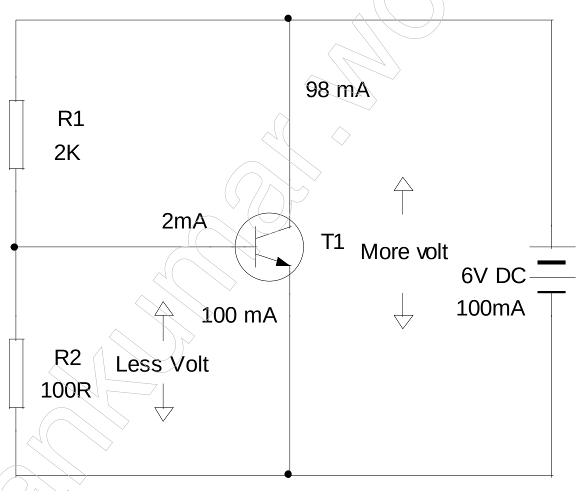

Fig.3

Normally when a High volt is present at the collector and Low volt in the base, Base-Emitter junction of T1 will be reverse biased.If the collector remains open, collector voltage will be 0 and hence the base current will be 100 mA. If collector of T1 is connected to the Vcc, 98 mA current flows through the collector and 2mA to the base.That is

Emitter current = Base current +Collector current = 2mA+98mA = 100mA
Collector current = Emitter current – Base current = 100mA – 2 mA =98 mA
Base current = Emitter current – Collector current = 100mA – 98mA = 2 mA
The condition is just reversed in the case of a PNP transistor as shown in Fig.4. The base- emitter junction of T1 forward biased and the base-collector junction is reverse biased. In this state,T1

remains non conducting. If we makes the base more negative, T1 conducts and collector current appears.

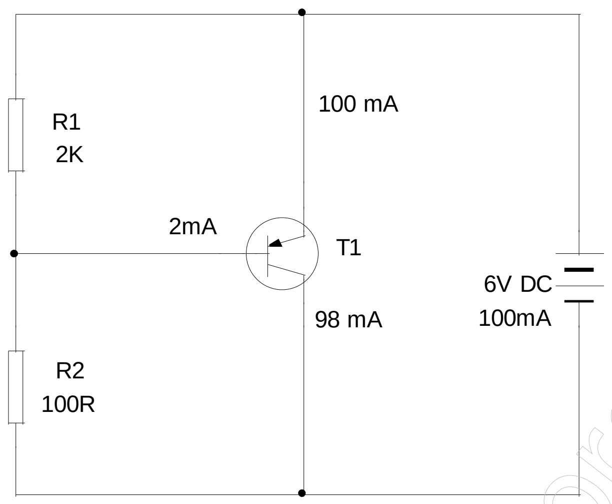

Fig.4

Transistor as a Signal Amplifier

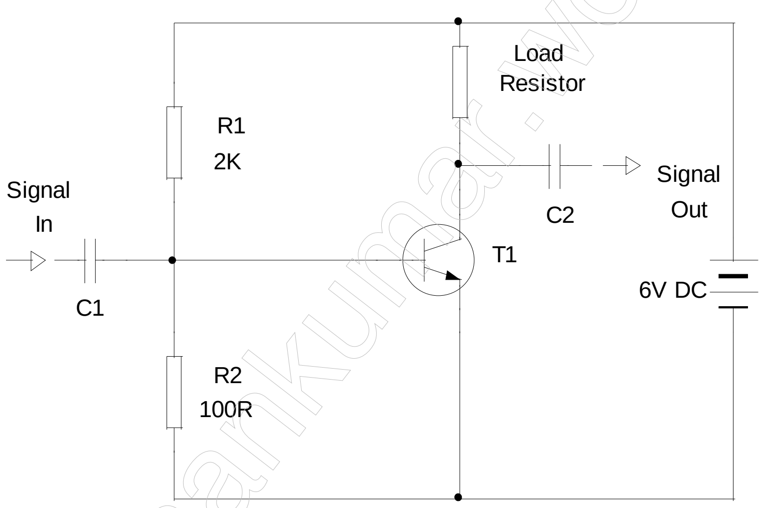

Fig.5

Through a small capacitor AC signals of small volt can be given to the base of a signal amplifier as shown in Fig.5.This changes the load voltage. A large change in base voltage – Amplified Signal – gives output signals from the collector of T1.

Amplification = Value of Output signal / Value of Input signal.

Amplification usually lies between 10 and 100. That is the Output signal is 10 to 100 times higher than the input signal.