

LED Series resistor value calculation

LED always has a series resistor along with it. This is "Ballast resistor", the life saving device of LED. It control the forward current to the LED to a safer limit and protect it from burning. Value of the resistor if the factor that determines the forward current and hence the brightness. The simple equation $V_s - V_f / I_f$ solves the problem of resistor value. V_s represents input voltage, V_f the forward voltage and I_f the allowable current through the LED. The resulting value will be in Ohms. It is better to restrict the current to a safer limit of 20 mA.

LED along with the limiting resistor R_4 is the power on status indicator. A significant voltage drop (about 2 volts) occurs across the LED when it passes forward current. The forward voltage drops of various LEDs are shown in Table 2.

Table 2

Red	Orange	Yellow	Green	Blue	White
1.8 V	2 V	2.1 V	2.2 V	3.6 V	3.6 V

A typical LED can pass 30 –40 mA current without destroying the device. Normal current that gives sufficient brightness to a standard Red LED is 20 mA . But this may be 40 mA for Blue and White LEDs. Current limiting resistor R_4 protects LED from excess current that is flowing through it. The value of R_4 should be carefully selected to prevent damage to LED and also to get sufficient brightness at 20 mA current. The current limiting resistor can be selected using the formula

$$R = V / I$$

Where R is the value of resistor in ohms, V is the supply voltage and I is the allowable current in Amps. For a typical Red LED, the voltage drop is 1.8 volts. So if the supply voltage is 12 V (V_s) , voltage drop across the LED is 1.8 V (V_f) and the allowable current is 20 mA (I_f) then the value of R_4 will be

$$V_s - V_f / I_f = 12 - 1.8 / 20 \text{ mA} = 10.2 / 0.02 \text{ A} = 510 \text{ Ohms.}$$

A suitable available value of resistor is 470 Ohms. But is advisable to use 1 K resistor to increase the life of the LED even though there will be a slight reduction in the brightness. Since the LED takes 1.8 volts , the output voltage will be around 10 volts. So if the circuit requires 12 volts, it is necessary to increase the value of Zener slightly. Table 3 is a ready reckoner for selecting limiting resistor for various versions of LEDs at different voltages.

Table 3

Supply voltage	Red	Orange	Yellow	Green	Blue	White
12 V	470 E	470 E	470 E	470 E	390 E	390 E
9 V	330 E	330 E	330 E	330 E	270 E	270 E
6 V	180 E	180 E	180 E	180 E	120 E	120 E
5 V	180 E	150 E	150 E	150 E	68 E	68 E
3 V	56 E	47 E	47 E	33 E	-	-

* Available resistor values in ohms