

# POWER\_LED -- Overview

## Drive LED Using Transistor Driver Circuit



## OBJECTIVES

After performing this lab exercise, learner will be able to:

- Program Arduino board to generate PWM
- Design the Driver circuit using TIP127 TRANSISTOR.
- Measure MEAN & DUTY CYCLE of the captured signal using inbuilt functions of the scope.

## EQUIPMENT

To carry out this experiment, you will need:

- TBS1KB - Digital Oscilloscope from Tektronix
- Arduino Duemilanve or Uno board
- Voltage probe (provided with oscilloscope) / BNC cables
- Breadboard and connecting wires
- Resistor (1K & 10 Ohm)
- TIP127 Transistor

## THEORY

- Power Light Emitting Diode requires more current than the usual LED. Most of the GPIO pins of the controller can not supply such large current to drive LEDs. To provide the higher current we have to use driver circuit.
- Driver can be very simple, using little more than an NPN or PNP transistor to control the current. All that the low-power circuitry has to provide is enough base current to turn the transistor on and off.
- In our experiment NPN transistor is being used for driver. Series base resistor R is used to set the base current for transistor, so that the transistor is driven into saturation (fully turned on). By this way we can achieve minimal voltage drop across transistor.

## CIRCUIT DESIGN

- $R_b = (V_{CC} - V_{BE}) / I_B = (5 - 0.7) / (5 \times 10^{-3}) = 860 \Omega \approx 1K \Omega$
- $R_C = (V_{CC} - V_{CE}) / I_C = (9 - 3.6) / (350 \times 10^{-3}) = 15.42 \Omega$
- Power rating of collector resistance,

$$P_{RC} = (I_C)^2 \times R_C = (350 \times 10^{-3})^2 \times 55 \approx 1 \text{ W}$$

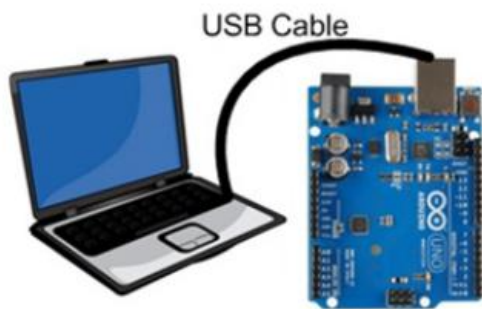
- PRC  $\approx$  1 Watt is the best choice based on availability.

## POWER\_LED -- Procedures

### Step 1

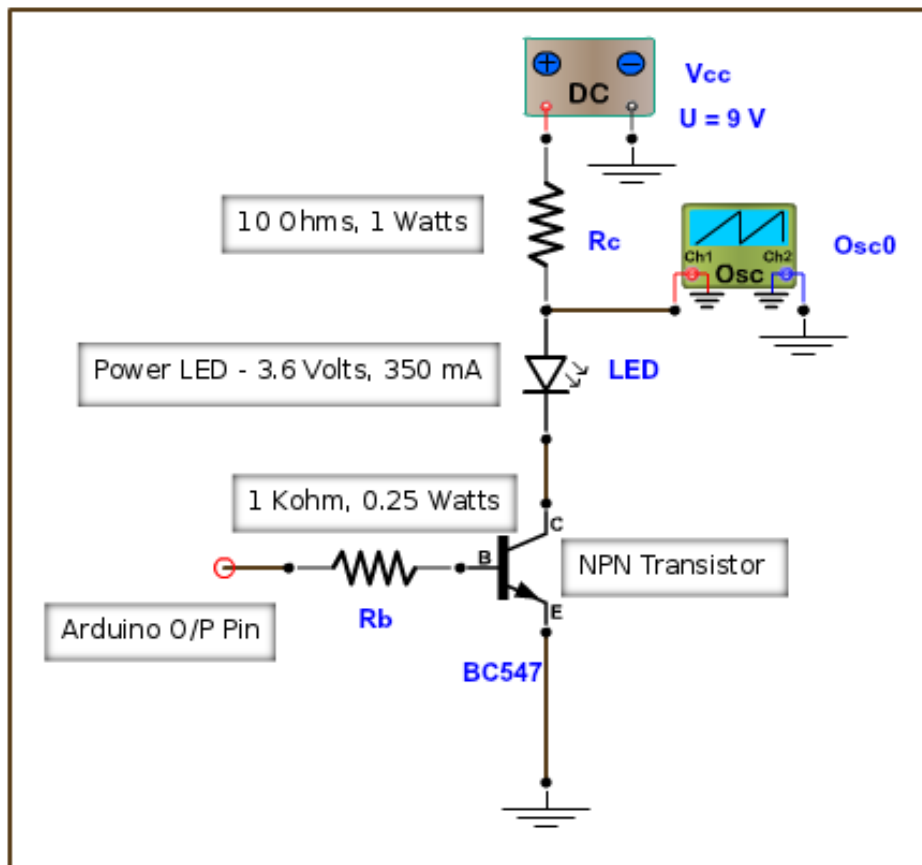
#### DUT / SOURCE SETUP

- Ensure you have Arduino IDE (software to program the Arduino boards) installed on your computer.
- Connect the Arduino board to PC using USB cable and program it with given code



### Step 2

- Rig up the circuit as shown.
- Measure the output across LED.



### Step 3

#### MEASUREMENT / SCOPE SETUP

- Power ON the oscilloscope
- Connect the Channel 1 probe of the oscilloscope to pin number 6 of Arduino and Channel 2 probe at the Anode of the LED

### Step 4

- Do the Autoset on the scope to efficiently capture and view the signal
- If AUTOSSET feature is not enabled, then manually set the horizontal and vertical scale, and trigger condition to view 3-4 cycles of waveform without any clipping.

### Step 5

- From the measurement menu, configure MEAN and DUTY CYCLE measurements on acquired channel - Higher the duty cycle, average value will be more - the LED will draw more current and give more brightness