

AC Dimmer

—by **Bhawna Singh** and **Maninder Bir Singh Gulshan**

Dimmers are devices connected to a variable device fixture and it is used to lower the brightness of the variable device. By changing the voltage waveform applied to that device, it is possible to lower the intensity of the device output. Although variable-voltage devices are used for various purposes, the term dimmer is specially for those intended to control light output from resistive incandescent and compact fluorescent lights (CFLs)(specially).

AC Dimmer is designed to control the alternating current voltage, which can transfer current up to 600V/16A. In most cases, Dimmer is used to turn power ON/OFF the lamps or heating elements, it can also be used in fans, pumps, air cleaners and the demonstrated Dimmer will work for all the AC appliances.

Disclaimer: The demonstrated device will not work for Light Emitting Diodes (LEDs). But due to some advancement in the technology of the LEDs, it becomes easier to find a suitable energy-efficient LED replacement to work with the dimming system.

This device is generally used for smart home system. When a user want to change the brightness of the lamp smoothly, this dimmer will be used. The lamp will slowly turns ON or OFF, creating a comfortable atmosphere for the lamp to fade evenly. Dimmer works most effective with filament lamps. It is less stable with low brightness dimmable LED lamps, but with moderate and high brightness it will perform a solid job.

The **luminescent lamps** (gas discharge lamps) do not support dimming as light is produced by **gas discharge** that occurs in an arc tube between two electrodes after ignition. Electrical conductivity in **gas discharge** is established by ionized filler components. The electrodes are fed into a completely sealed discharge vessel. Most **discharge lamps** require a control gear to spark them and limit their current due to this reason (gas discharge lamps) do not support dimming capability.

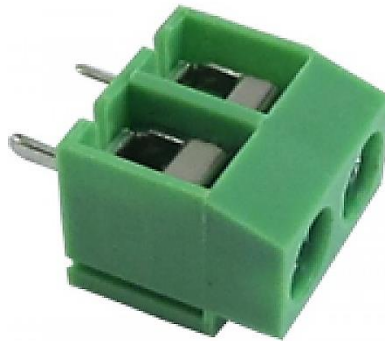
Power part of dimmer is isolated from the control part, to exclude the possibility of high current disruption to a microcontroller.

COMPONENTS REQUIRED:

- 2-Pin PCB Mount Terminal Block Connector x 2
- BTA16 IC
- MOC3021 IC
- DF10 IC
- 4N25 IC
- Resistors 10k ohm x 1
- Resistors 1k ohm x 3
- Resistors 30k ohm ½ watt x 2
- Led
- 4-pin Header

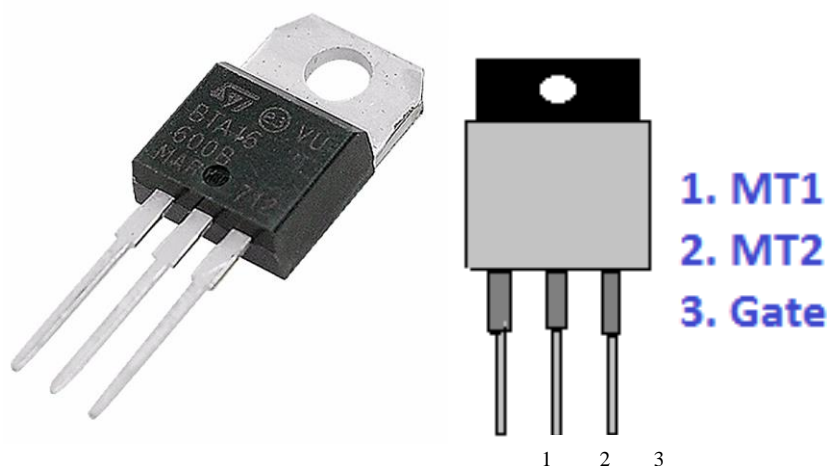
Component Description

2-Pin PCB Mount Terminal Block Connector



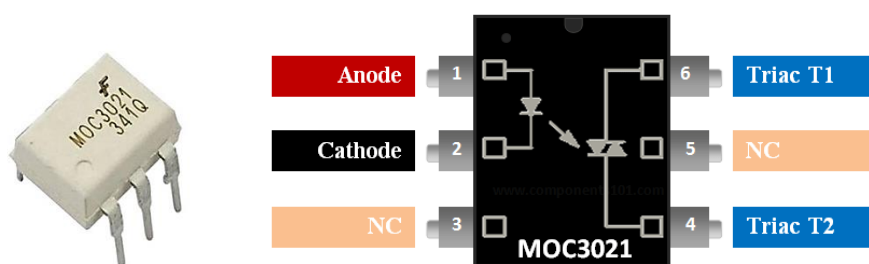
BTA16

The TRIAC is an ideal device used for the AC switching applications. This can control the flow of current over both halves of an alternating cycle. Only the Thyristor can control over the one-half of a cycle. The other remaining half no conduction occurs and accordingly only half the waveform can be utilized. This device is used widely in AC power control applications.



MOC3021

The MOC3021 was designed for interfacing between electronic controls and high power TRIAC to control loads for (AC Voltage) operations. A small pulse (Clock pulse with 5 V range) is applied to its input that is pin 1 and pin 2. The light produced by this LED activates the TRIAC and that time power is switched ON. Mainly it is used to maintain isolation between low power circuits to high power circuits (that is a 5v pulse controls 3 phase load volts).



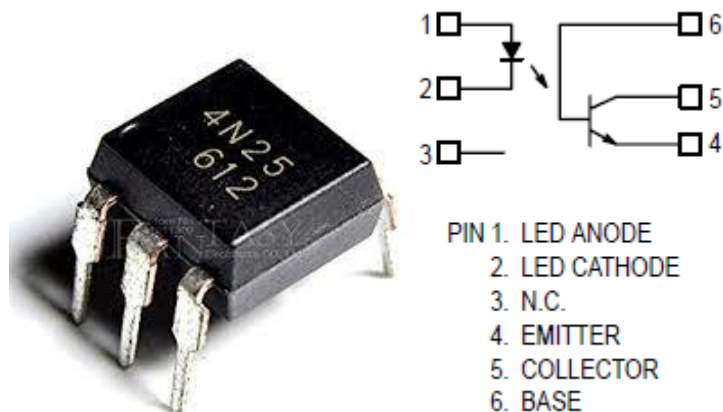
DF10

DF10 is a single phase full wave Diode rectifier. It is used in AC-to-DC conversion. The rectifier is rated with a maximum 1KV reverse voltage and 1A current rating. It comes with 4-pin case DF tube. Features: Glass Passivated Die Construction, Low Forward Voltage Drop, High Current Capability, Surge Overload Rating to 50A Peak and Designed for Printed Circuit Board Applications.



4N25

4n25 is a standard single channel 6 pin industry standard phototransistor coupler that contains silicon NPN phototransistor and gallium arsenide infrared LED. It is also known as an optocoupler, photocoupler, or optoisolator. The main purpose of this device is to transfer an electrical signal between two electrically isolated circuits by using light. Simply put, the input signal is transformed into light, which then sends to the dielectric channel, the light is extracted at the output and then it is transformed back to the electric signal. Optoisolator is very useful when Electronic power transmission lines are encountered with high voltage surges that can be induced by radio frequency transmissions and lighting. Remote lighting strikes are able to produce surges up to 10kV, which is much larger than voltage limits of any electronic device. Optocoupler prevents the high voltages surges from entering the system which ultimately keeps the system from permanent damage.



Resistors 10kΩ



Resistors 1k Ω

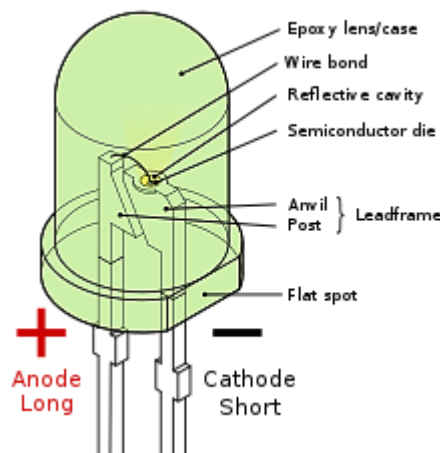


Resistors 30k Ω ½ watt



LED

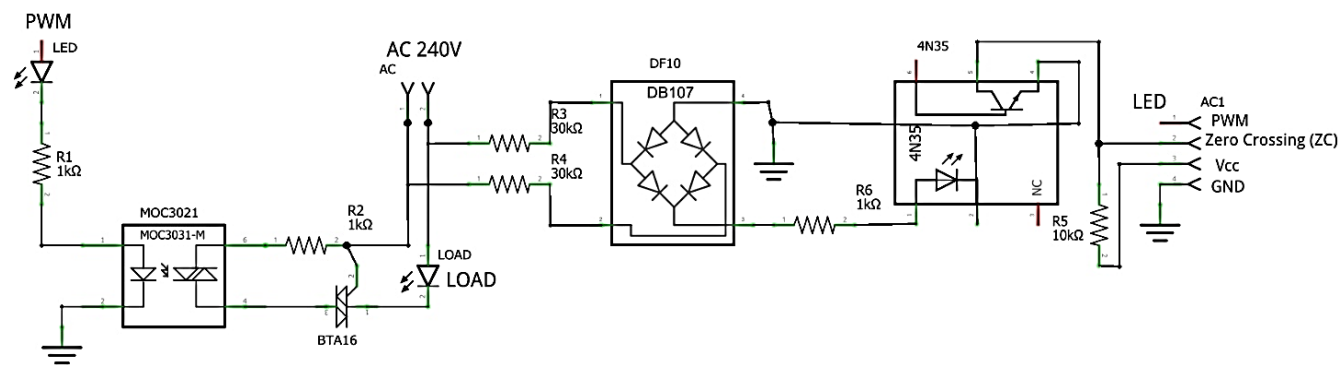
A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. This effect is called electroluminescence. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor. White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device.



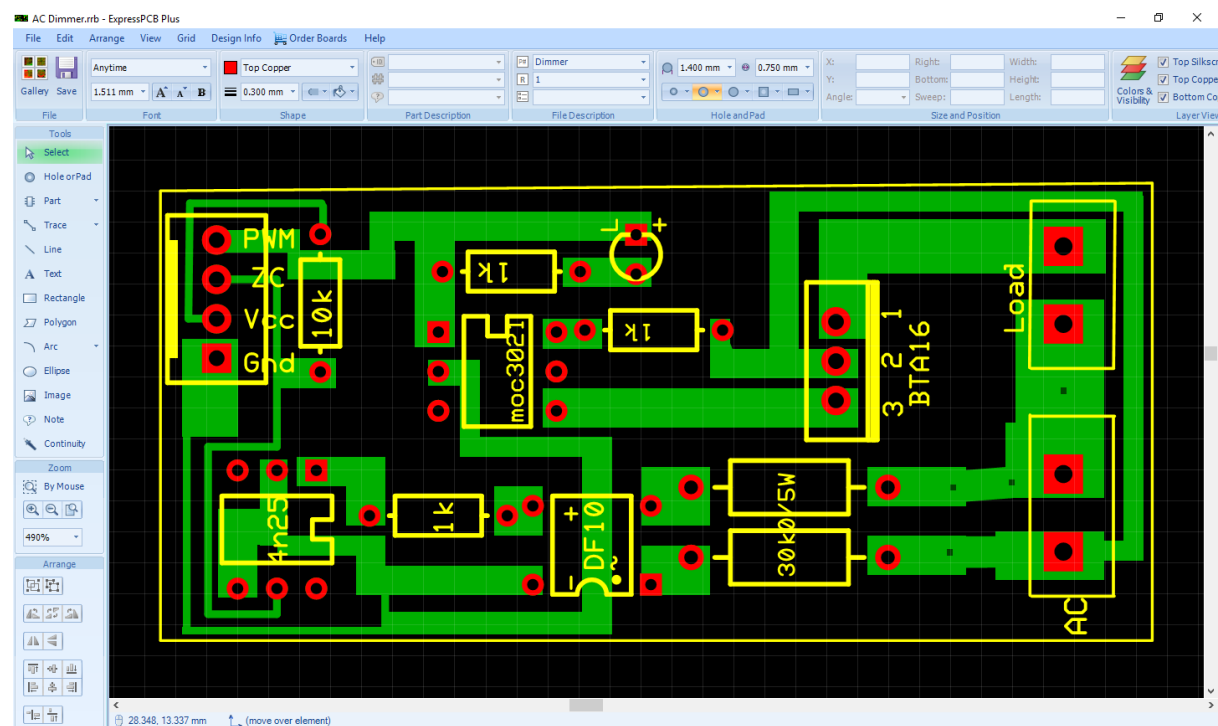
4-pin Header



Circuit Diagram

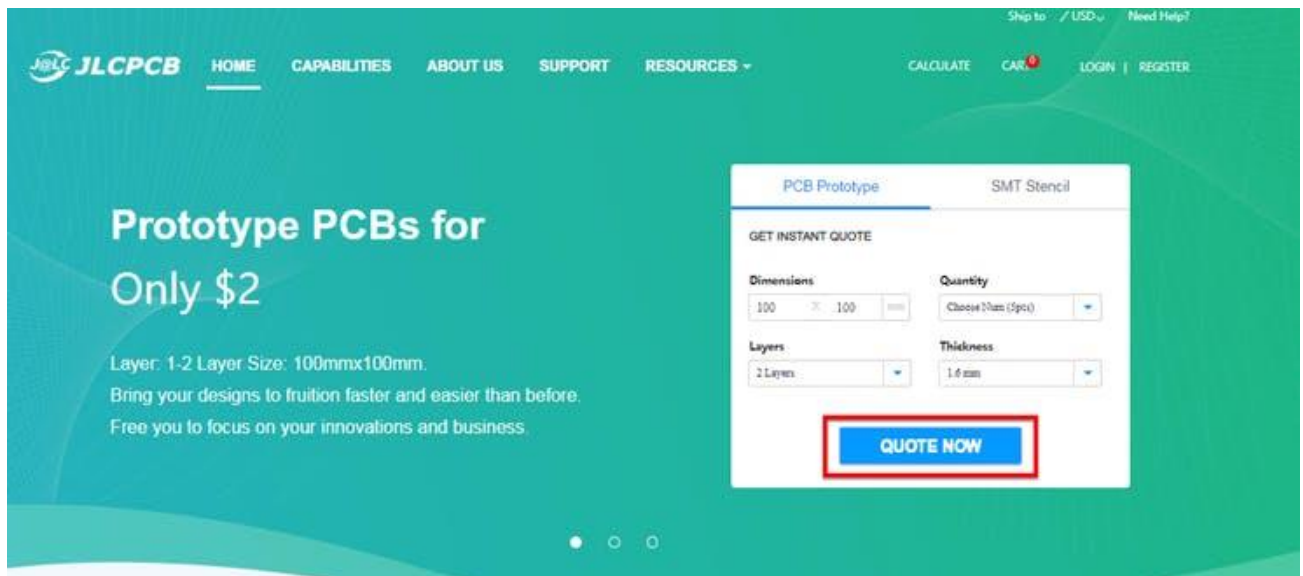


PCB Design



Ordering the PCBs

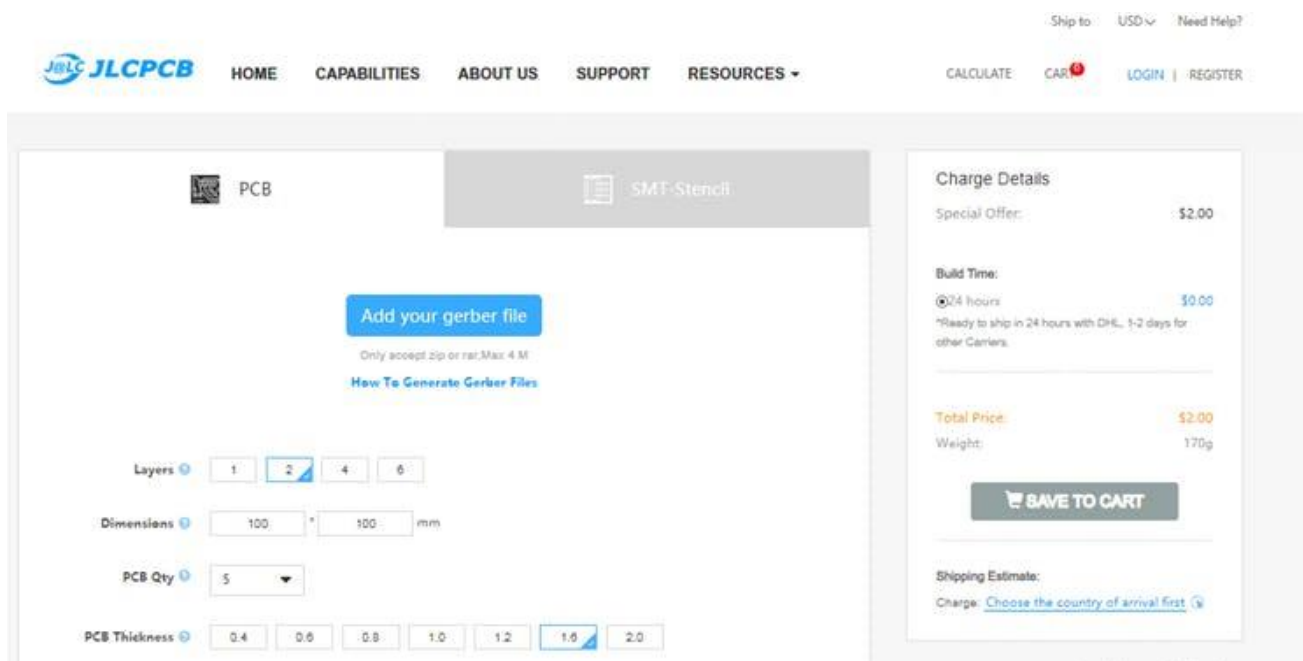
Now we have got the PCB design and it's time to order the PCB's. For that, you just have to go to JLCPCB.com, and click on “QUOTE NOW” button.



The image shows the JLCPCB website's landing page for ordering PCB prototypes. The page has a teal background with a white navigation bar at the top containing links like HOME, CAPABILITIES, ABOUT US, SUPPORT, and RESOURCES. On the right side of the navigation bar are links for CALCULATE, CART, LOGIN, and REGISTER. The main content area features a large heading "Prototype PCBs for Only \$2" and a subheading "Layer: 1-2 Layer Size: 100mmx100mm. Bring your designs to fruition faster and easier than before. Free you to focus on your innovations and business." To the right of this text is a white box titled "PCB Prototype" with a "GET INSTANT QUOTE" section. This section contains input fields for Dimensions (100 x 100 mm), Quantity (Choose Num (Spot)), Layers (2 Layers), and Thickness (1.6 mm). A prominent blue "QUOTE NOW" button is highlighted with a red rectangle.

JLCPCB are also sponsor of this project. JLCPCB (ShenzhenJLC Electronics Co., Ltd.), is the largest PCB prototype enterprise in China and a high-tech manufacturer specializing in quick PCB prototype and small-batch PCB production. You can order a minimum of 5 PCBs for just \$2.

To get the PCB manufactured, upload the gerber file you downloaded in the last step. Upload the.zip file or you can also drag and drop the gerber files.



The image shows the JLCPCB website's order form for PCB prototypes. The page has a white background with a teal navigation bar at the top. The main content area is divided into two sections: "PCB" and "SMT-Stencil". The "PCB" section contains a blue "Add your gerber file" button, a note "Only accept zip or rar,Max 4 M", and a link "How To Generate Gerber Files". Below this are input fields for Layers (1, 2, 4, 6), Dimensions (100 x 100 mm), PCB Qty (5), and PCB Thickness (0.4, 0.6, 0.8, 1.0, 1.2, 1.6, 2.0). The "SMT-Stencil" section is currently selected. On the right side of the page is a "Charge Details" box. It shows a "Special Offer" of \$2.00, a "Build Time" of 24 hours for \$0.00, a "Total Price" of \$2.00, and a "Weight" of 170g. A "SAVE TO CART" button is present. At the bottom of the "Charge Details" box is a "Shipping Estimate" section with a link "Choose the country of arrival first".

After uploading the zip file, you'll see a success message at the bottom if the file is successfully uploaded.

PCB

SMT-Stencil

Detected 2 layer board of 50x89mm(1.99x3.49 inches) .

Your upload has finished processing. Enter the project details below and we'll move on to checking all the individual layers to make sure that they're correct .

The gerber viewer is for reference purpose only and may differ from the actual PCB product.

[Gerber Viewer](#)

success

[<< Back to Upload File](#)

You can review the PCB in the Gerber viewer to make sure everything is good. You can view both top and bottom of the PCB.

JLCPCB

[HOME](#)
[CAPABILITIES](#)
[ABOUT US](#)
[SUPPORT](#)
[RESOURCES](#)

[Ship to: USD](#)
[Need help?](#)

[CALCULATE](#)
[CART](#)
[LOGIN](#)
[REGISTER](#)

File:Gerber_Transmitter_20190711100324.zip The gerber viewer is for reference purpose only and may differ from the actual PCB product.

[Gerber Viewer](#)
[Analysis Results](#)

[Top](#)
[Bottom](#)

Capabilities

PCB Color : [Green](#)

Surface Finish : [ENIG-RoHS](#)

Analysis Results

layers : 2

minimum trace width : ≥ 10 mil

minimum trace spacing : ≥ 10 mil

minimum drill size : 0.305 mm

width : 88.52 mm

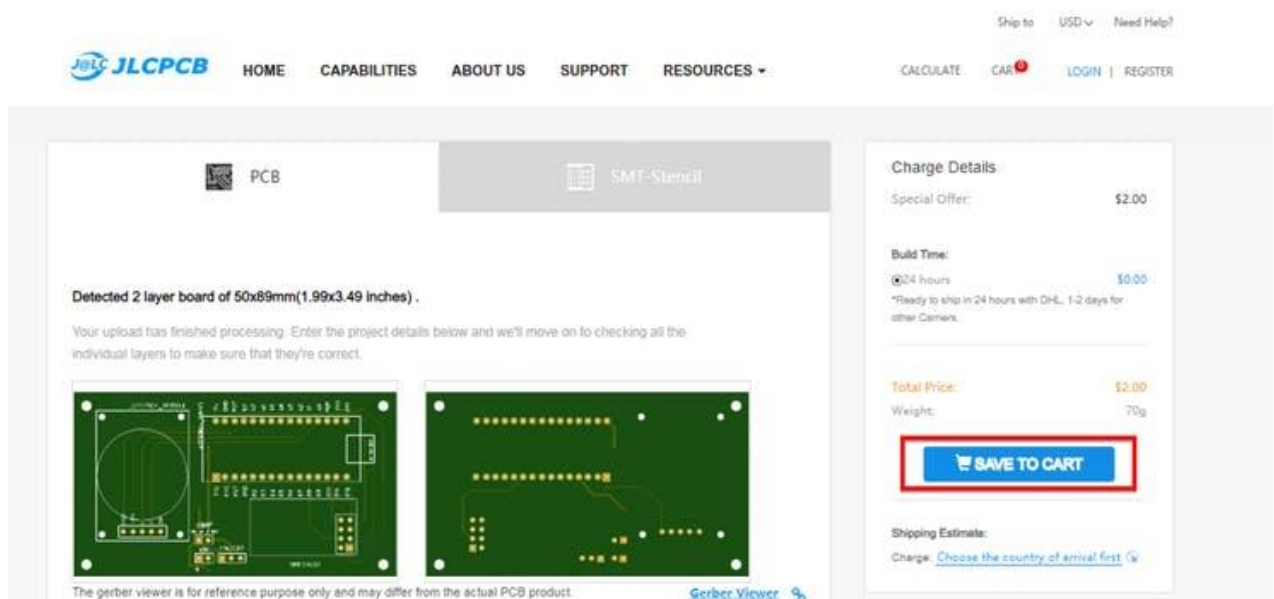
height : 50.42 mm

Mouse Controls:

move - Left mouse button + drag

Zoom - Scroll / Middle mouse button

After making sure our PCB looks good, we can now place the order at a reasonable price. You can order 5 PCBs for just \$2 but if it's your first order then you can get 10 PCBs for \$2. To place the order, click on **"SAVE TO CART"** button.



My PCBs took 2 days to get manufactured and arrived within a week using DHL delivery option. PCBs were well packed and the quality was really good.