



Lecture (01)

AC Lamp Dimmer using PWM

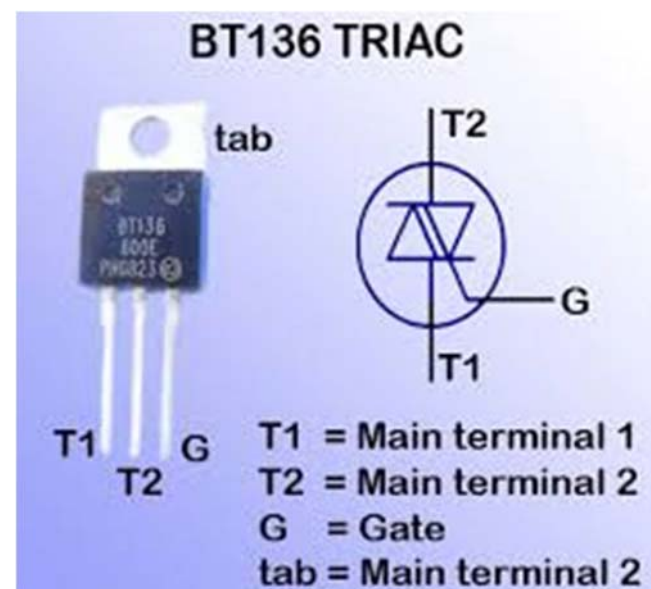
By:

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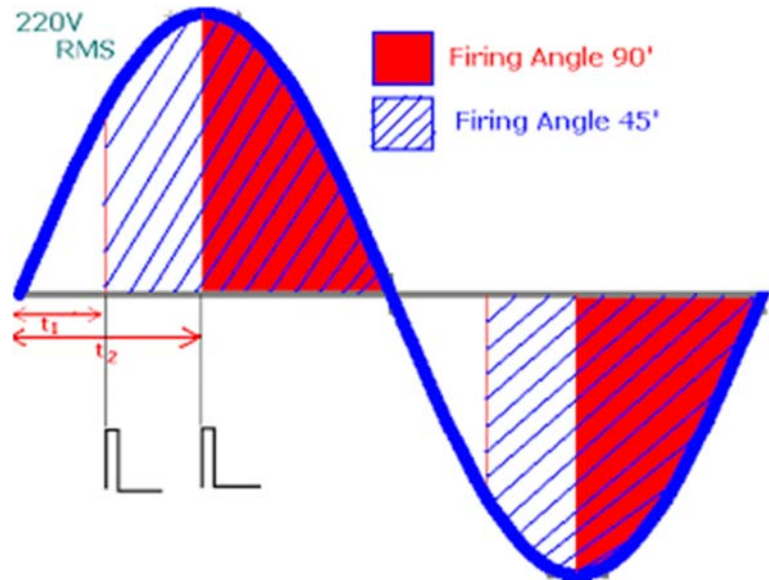
Power electronic driver

- Triac is a power electronic component that conducts in both directions when triggered through gate.



- As it can be seen that at time t_1 , angle of sinusoid is 45° which means that if we triggered triac at this angle i-e at 45° , only shaded blue area will pass through the triac and hence through the load.

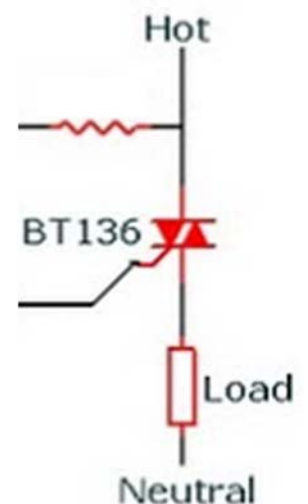
- Observe that shaded blue area has RMS Voltage less than the pure sinusoid.



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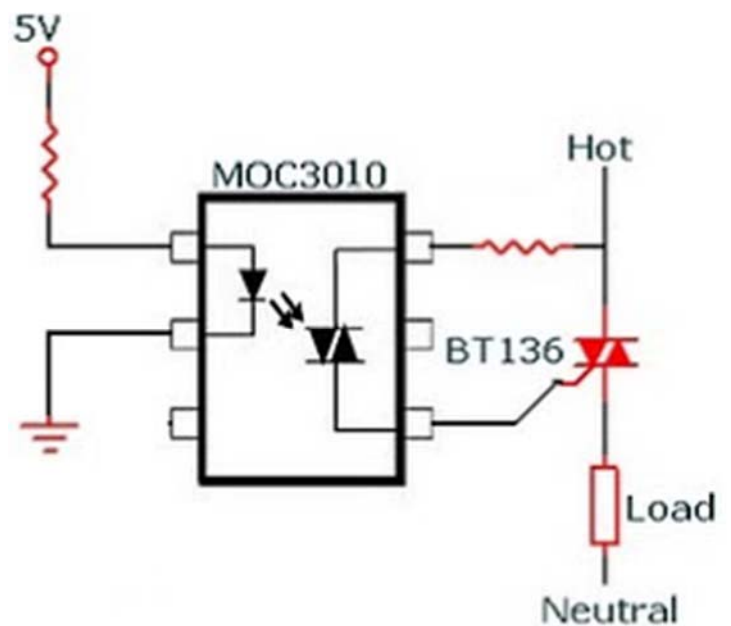
- This is the basic principle by which RMS Voltage control is accomplished.
- Firing needs a small pulse at gate that can be give through monostable.



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- MOC3010 is an optotriac (product of Motorola) that is used for isolation between power and driving circuitry.
 - As the triac gets triggered now, the positive or negative voltage (whatever maybe) get pass through the gate of BT136 (triac) and hence triggered it.



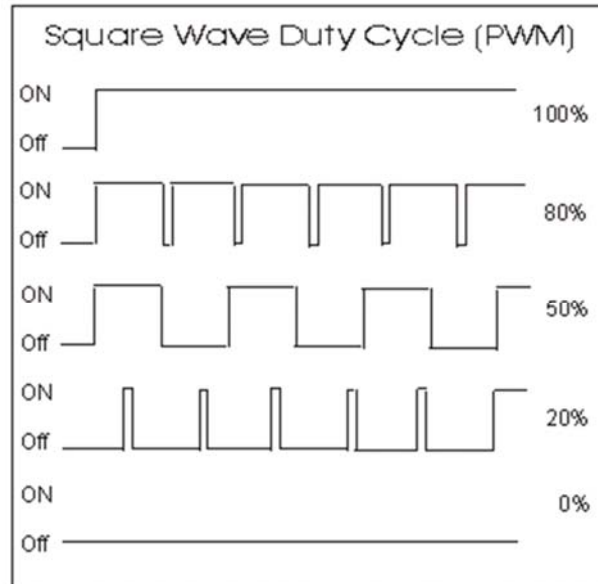
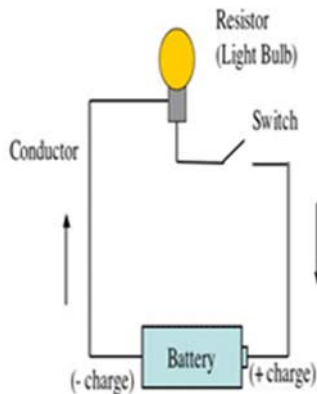
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- It should be noted here that by using above arrangement we can control the RMS voltage in both directions.
 - circuit is mainly used as a dimmer and is often used speed controlling of AC motor.

PWM

- The **LED DIMMER** is primarily a 555 IC based PWM (Pulse Width Modulation) circuit developed to get variable voltage over constant voltage.

Basic Electrical Circuit



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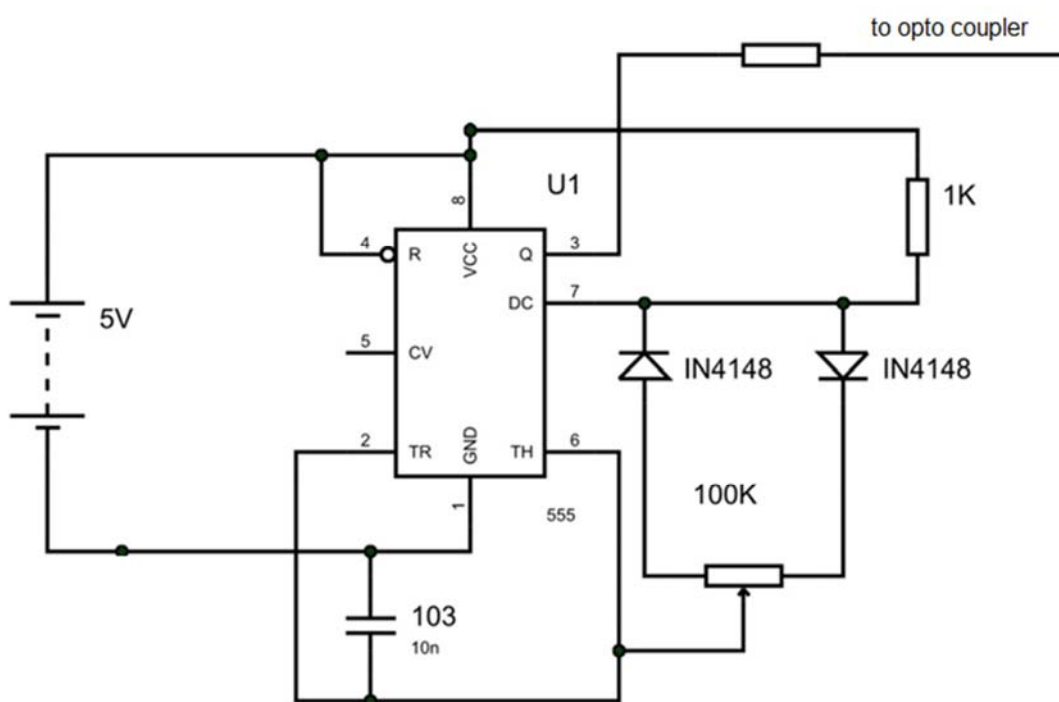
- Now if the switch in the figure is closed continuously over a period of time then the bulb will continuously ON during that time.
- If the switch is closed for 8ms and opened for 2ms over a cycle of 10ms, then the bulb will be ON only in the 8ms time.
- Now the average terminal over across the over a period of 10ms = Turn ON time/ (Turn ON time + Turn OFF time), this is called **duty cycle** and is of 80% ($8 / (8+2)$), so the average output voltage will be 80% of the battery voltage.
- In the second case, the switch is closed for 5ms and opened for 5ms over a period of 10ms, so the average terminal voltage at the output will be 50% of the battery voltage.

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- Say if the battery voltage is 5V and the duty cycle is 50% and so the average terminal voltage will be 2.5V.

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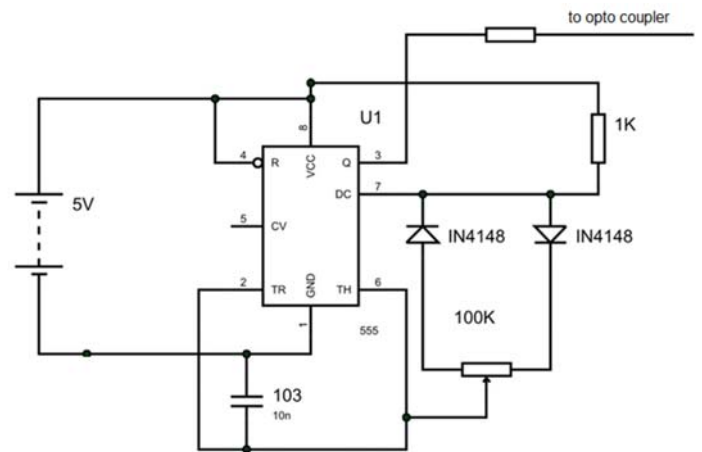
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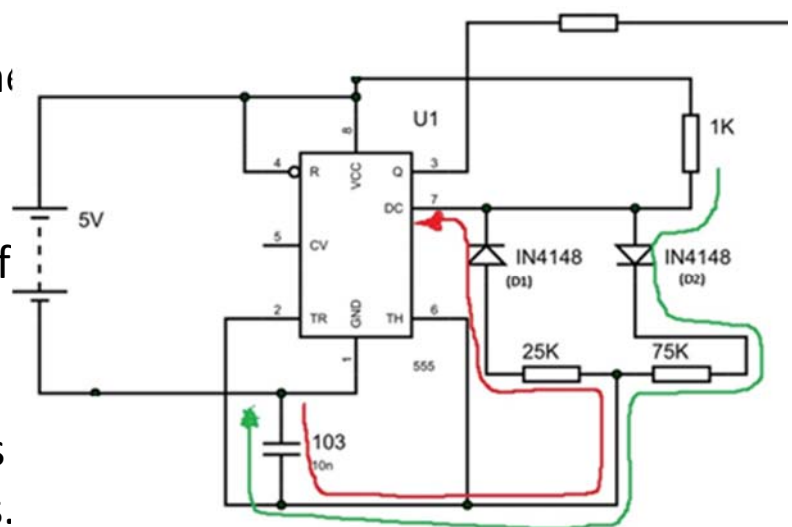
- The whole PWM generation takes place due to difference in charging and discharging times of the capacitor in the circuit.
- Now to understand this, consider the pot is adjusted and the resistance is divided as 25K on one side and 75K on the other as shown in the figure.



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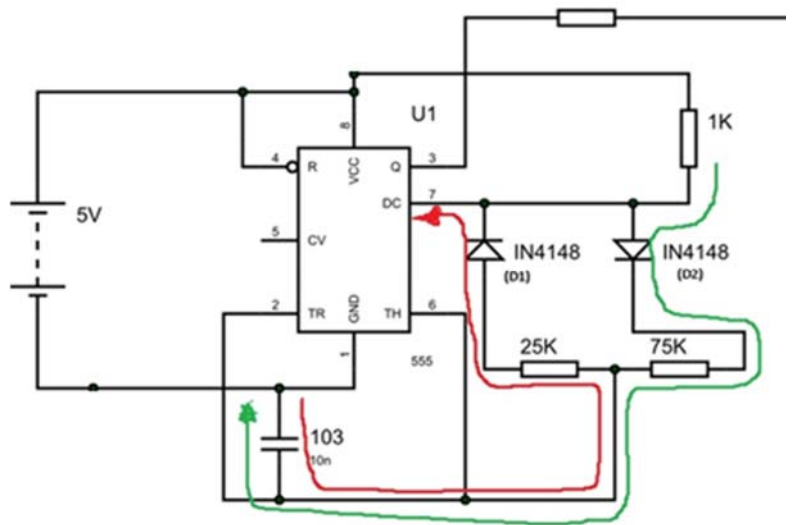
- Now the charging of capacitor (green line) can take place only through the resistance part of 75K because of diode D2.
- During the charging time of capacitor, 555 TIMER IC outputs high.
- Once the capacitor charges to a potential, it discharges.



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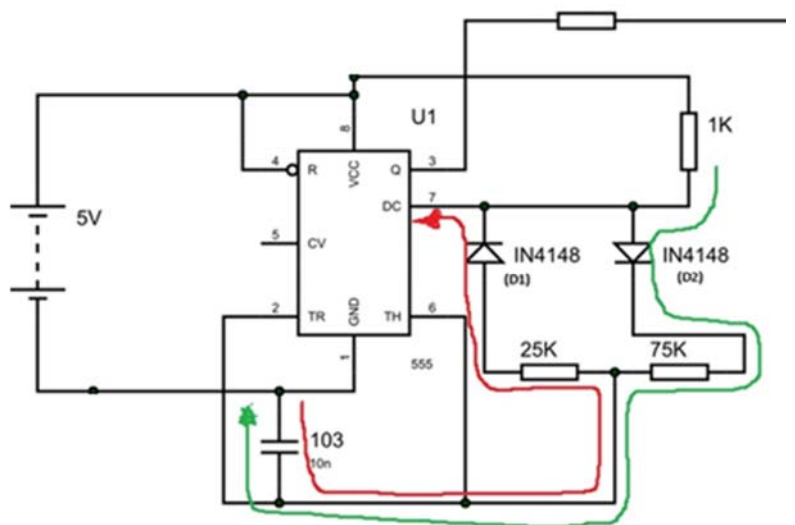
- Now the discharge of capacitor (red line) must take place through 25K resistance part because of D1, at this time the 555 TIMER outputs LOW.
- So now consider the case one can say while charging of capacitor the current flows through 75K part taking much more time than to discharge, as discharge current should flow through only 25K.



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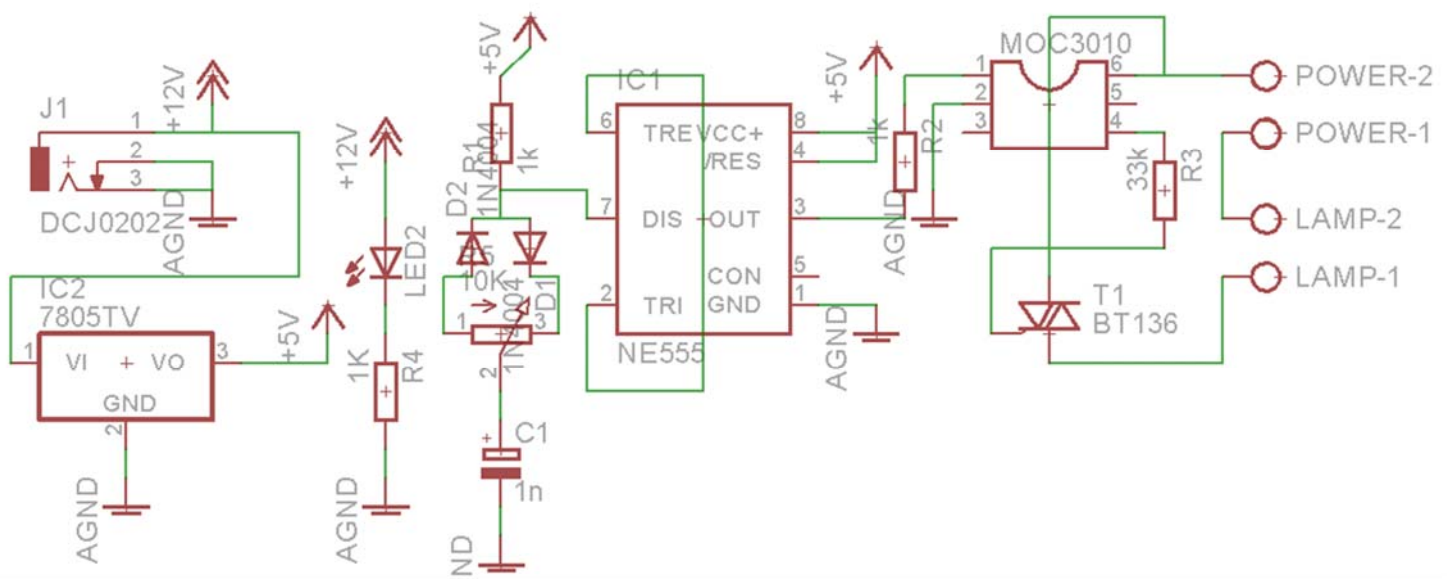
- Therefore it can be concluded the capacitor charging time is 3 times the discharge implying the 555TIMER turn ON time is 3 times the turn OFF time.
- So the duty ratio of the timer output signal is $\frac{3}{4} = 75\%$.



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- So each time when we change the potentiometer is varied we get different on and off times giving PWM output.
- Now this PWM signal is fed in to opto coupler the in turn triac, for driving the AC load.
- Now based on the last case, the AC lamp will be ON for 7.5 ms and OFF for 2.5 ms, now the effect is the human eye can catch a maximum of 50Hz and after the human eye cannot catch the frame and so it seems continuous so because the AC lamp will be ON only for 8ms the AC lamp glow looks dim over original intensity for the human eye.





Thanks,..
See you next week (ISA),...