PWM BASED DC MOTOR SPEED CONTROL USING LM555 IC

Abstract

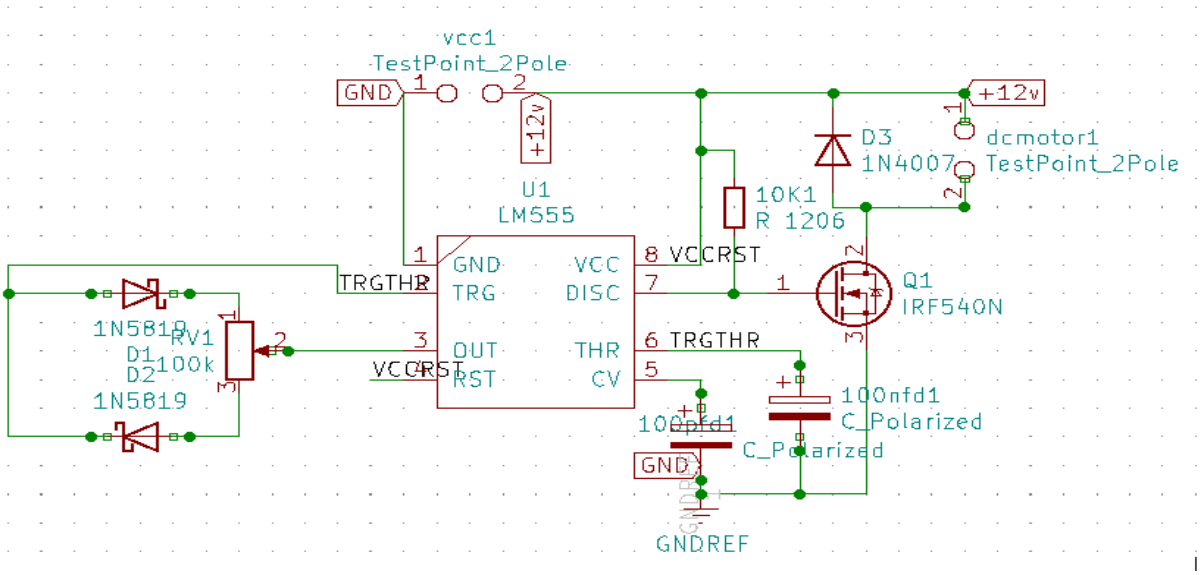
As we know that speed control of a DC motor can be obtained by varying its applied terminal voltage. This causes reduction in magnetic field strenght produced by an winding. In this project, we have been implementing this technique through pwm (pulse width modulation) method such that speed control achieved consistently.This circuit can be used to vary the speed of the DC motor by using a variable resistor. It uses a 555 timer IC as a pulse width modulator for varying the speed of the DC motor. In this project, I have developed a Schematic design & PCB Layout for the circuit that will vary the speed of the DC motor using the IC.

- Use the 555 timers as a pulse width modulator
- Using a variable resister you need to vary the speed of the DC motor.

Introduction:

In this project, I will show How Speed Control of DC Motor can be implemented using 555 and Pulse Width Modulation (PWM). We use DC Motors in many systems in our day to day life. For example, CPU fans, fume extinguishers, toy cars etc. are all DC Motors which are operated by DC power supply. Most of the times we will have to adjust the speed of the motors as per our requirement. we will have to adjust the speed of the DC Motor ourselves occasionally.

schematic circuit diagram:



Components Required:

- 555 Timer IC
- 12V DC Motor
- 1N5819 x 2
- 1N4007

- 100nF
- 100pF
- 10KΩ Resistor
- 100KΩ Potentiometer
- 12V Power Supply
- Connecting Wires

These are the components required to build a PCB circuit.

Design Instruction:

I am not going to explain the Pin Diagram of 555 IC and will assume that you are already familiar with that. Continuing to design of the circuit, Pin 1 of 555 is connected to GND. Pins 8 and 4 are connected to +12V Supply. Pins 6 and 2 are short and a 100nF Capacitor is connected between Pin 2 and GND. The wiper pin of the POT is connected to Pin 3 of 555. Two Schottky diodes (1N5819) are connected to the other two pins of the POT as shown in the circuit diagram. The common point of the diodes is connected to Pin 2. Pin 7 is pulled high with the help of a 10KΩ Resistor. The Gate terminal of the MOSFET is connected to Pin 7 of 555. The motor is connected between +12V Supply and Drain of MOSFET while the Source of MOSFET is connected to GND. A PN Junction Diode is connected across the Motor terminals to prevent the back emf.

NOTE: I haven't used the Schottky Diodes but replaced them with simple 1N4007 Diodes as the frequency of the PWM is less (around 220Hz)

Working:

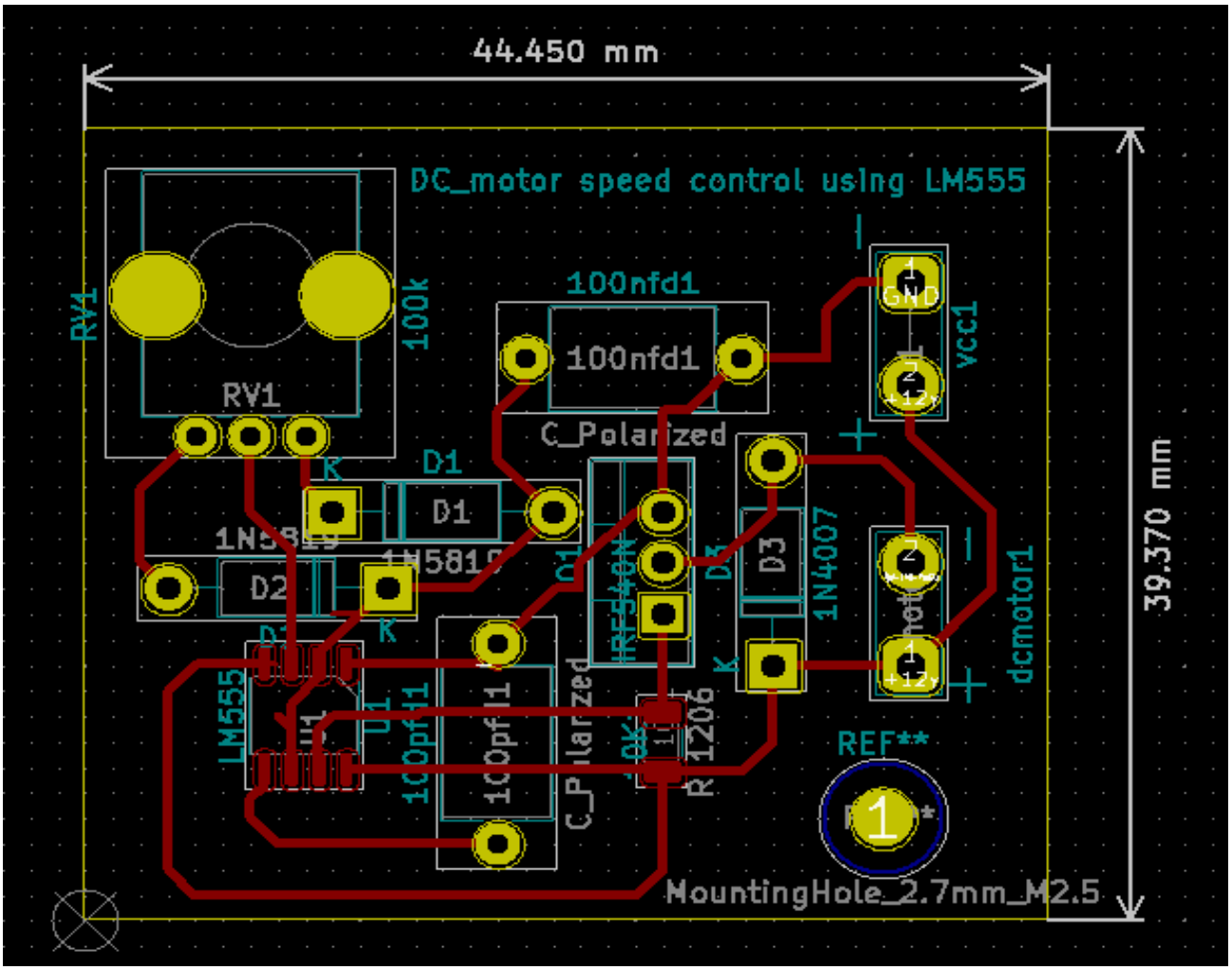
In this circuit, the DC motor is operated by a 555 integrated circuit. The IC 555 in this circuit is being operated in astable mode, which produces a continuous HIGH and LOW pulses. In this mode, the 555 IC can be used as a pulse width modulator with a few small adjustments to the circuit. The frequency of operation of the circuit is provided by the passive parameters of resistances and capacitors attached to it.

t=1.1*r*c.

- One of the best things about this circuit is that you can make it work as an astable multivibrator with little hardware and little cost, which can save both the cost involved in making it as well as the space on the printed circuit board (PCB).
- If you want a sophisticated pulse width modulator which works more accurately and which can have more adjusting capabilities, then it is better to use a microcontroller based pulse width modulator than the one which we are using now.
- However, the circuit or the application for which we are using a pulse width modulator is not so sensitive and hence does not demand so much of accuracy. In such a case, the circuit which we are using with a bare IC 555 is better as it saves our monetary as well as space resources in building the circuit.
- The duty cycle of the circuit can be changed by changing the value of the potentiometer. If we increase the duty cycle, the speed of the motor increases and if we decrease the duty cycle, the speed of the motor decreases.

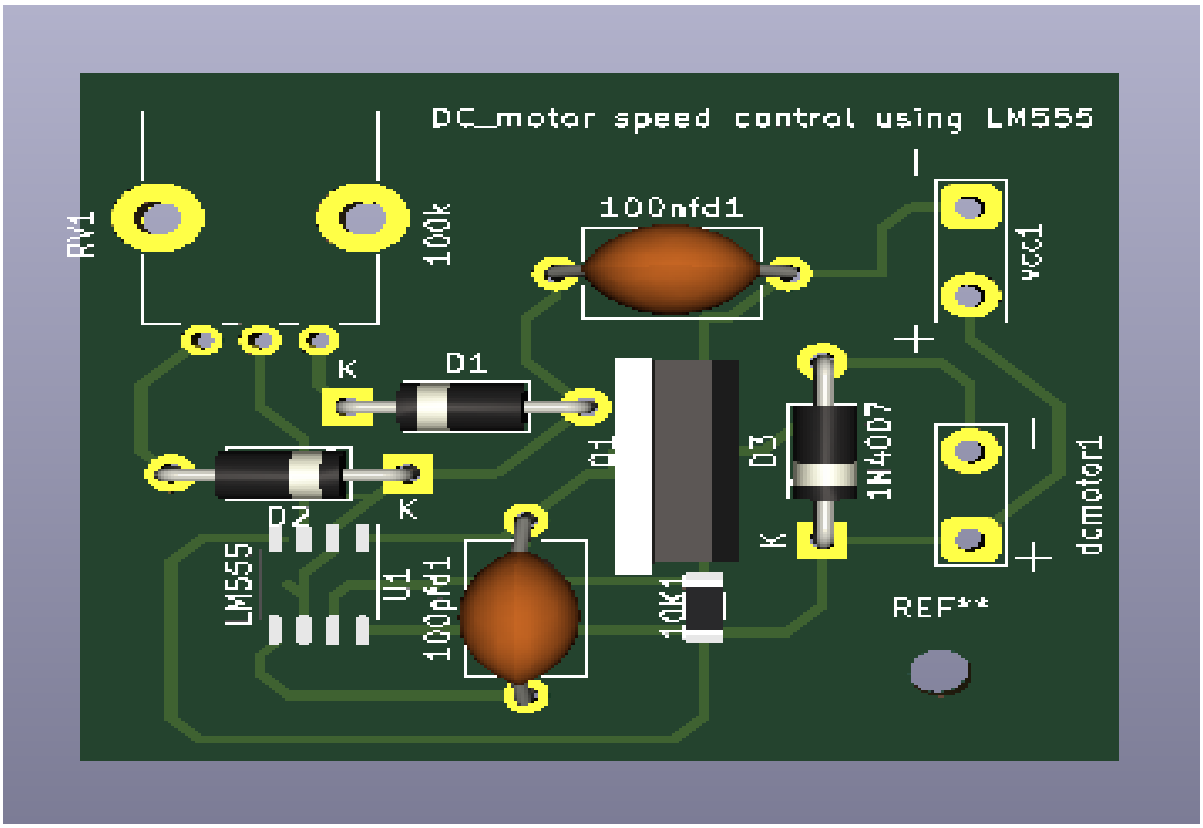
PCB LAYOUT:

Footprints were assigned to corresponding components based on the design requirements to meet the board objective. With the help of component datasheet we can know that the exact dimentions of components which is to be placed over the board. once footprint assignment gets over, then we need to do route mapping which must be dedicated segment and there should not be overlaping of connection. as the end of the process we need to ensure that the route mapping were verified. this will be viewed by 3d viewer.



3D VIEW:

Here, there is a 3D view of the designed PCB board and it shows an exact picture of a board which helps to analyze the dedicated connection to the specified components thus we can conclude that we were designed successfully.


DC_motor speed control using LM555
RV1
100k
100nfd1
vcc1
K
D1
D2
K
D4
D3
1N4007
K
LM555
U1
100pfd1
10K1
REF**
dcmotor1