RAYYAN ABHRAM

FINAL YEAR BENG ROBOTICS ENGINEERING

Portfolio Overview:

This portfolio showcases hardware engineering projects, highlighting hands-on experience and technical skills in designing, building, and testing systems.

NB: For discussions, corrections or advice, please reach out to me via email at *rayyanabhram@gmail.com*

Last updated: 05/08/2024

Contents

INTRODUCTION

This document is intended to present a series of projects produced and designed by myself during my undergraduate studies.

Projects showcased are a mixture of university related coursework and work derived from professionally developed skills. Some projects have been excluded from this document due to NDA restrictions. For each project, all source material can be found on github at: https://github.com/raytriestodostuff/portfolio-projects.git

PROJECT 1: DESIGN OF A DUAL DC MOTOR DRIVER IN ALTIUM DESIGNER

A. Project overview: This project set out to design a simple DC motor driver in Altium designer which is capable of running on a 30V input to drive two independent motors. Each motor is expected to to maintain an approximate current draw of 1A. This project is based on Altiums educational article, with some key changes made to suit more general applications. The PCB is designed to have a compact footprint, with all components selected as SMDs which should be soldered onto the board using a re-flow oven. All production files produced from this project may be found on github.

The board is powered by the A495 Dual full bridge IC and uses logical inputs to specify rotation of the motor. Inputs can be fed into the board using 5 x 2.54mm pitch header pins and PWM is used to actuate the motor. Figure 1 explains motor control, braking, and how to instruct the IC to enter a low-power mode.

PWM Control Truth Table

IN1, IN3	IN2, IN4	$10 \times V_S > V_{REF}$	OUT1, OUT3	OUT2, OUT4	Function
0	1	False	L	H	Reverse
1	0	False	H	L	Forward
0	1	True	H/L	L	Chop (mixed decay), reverse
1	0	True	L	H/L	Chop (mixed decay), forward
1	1	False	L	L	Brake (slow decay)
0	0	False	Z	Z	Coast, enters Low Power Standby mode after 1 ms

Figure 1: PWM Control

B. Component Selection / Schematic Design: The A495 Dual Bridge motor driver was used to control the board due to its ability to handle a peak current of up to 2A. The chip can also handle operating voltages of up to 40V and features in built over-current protection.

The IC also features a few peripheral components to ensure proper functioning. Use of 2 x 100uF electrolytic capacitors and 1 x 0.22uF are strongly recommended by the data sheet. 0.25 Ohm resistors are also recommended, they are placed at the power return pins of the IC.

33 Ohm resistors are used at the input pins to protect the controller from large current spikes should the driver IC break or fail. A trimmer potentiometer at the top leg of each voltage divider at the analog input pins (VREF12, VREF34) is placed to set the current for each motor.

A capacitor and TVS diodes are placed at the motor outputs on the PCB to help prevent damage from ESD and transient flyback voltages.

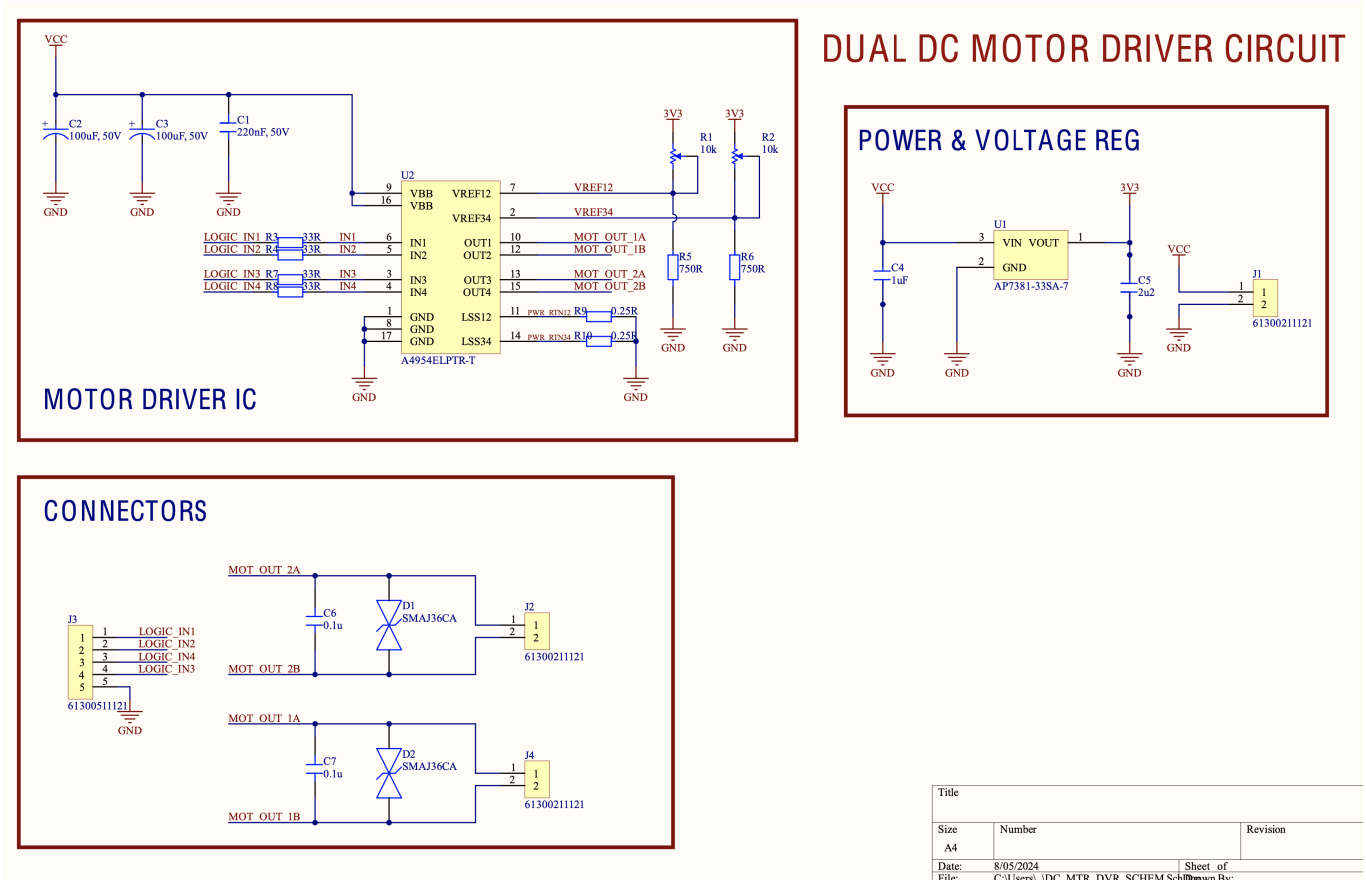

Figure 2: Dual motor driver schematic

C. PCB layout and routing: Figure 3, 4 and 5 show component placement, PCB routing and 3D render of the board.

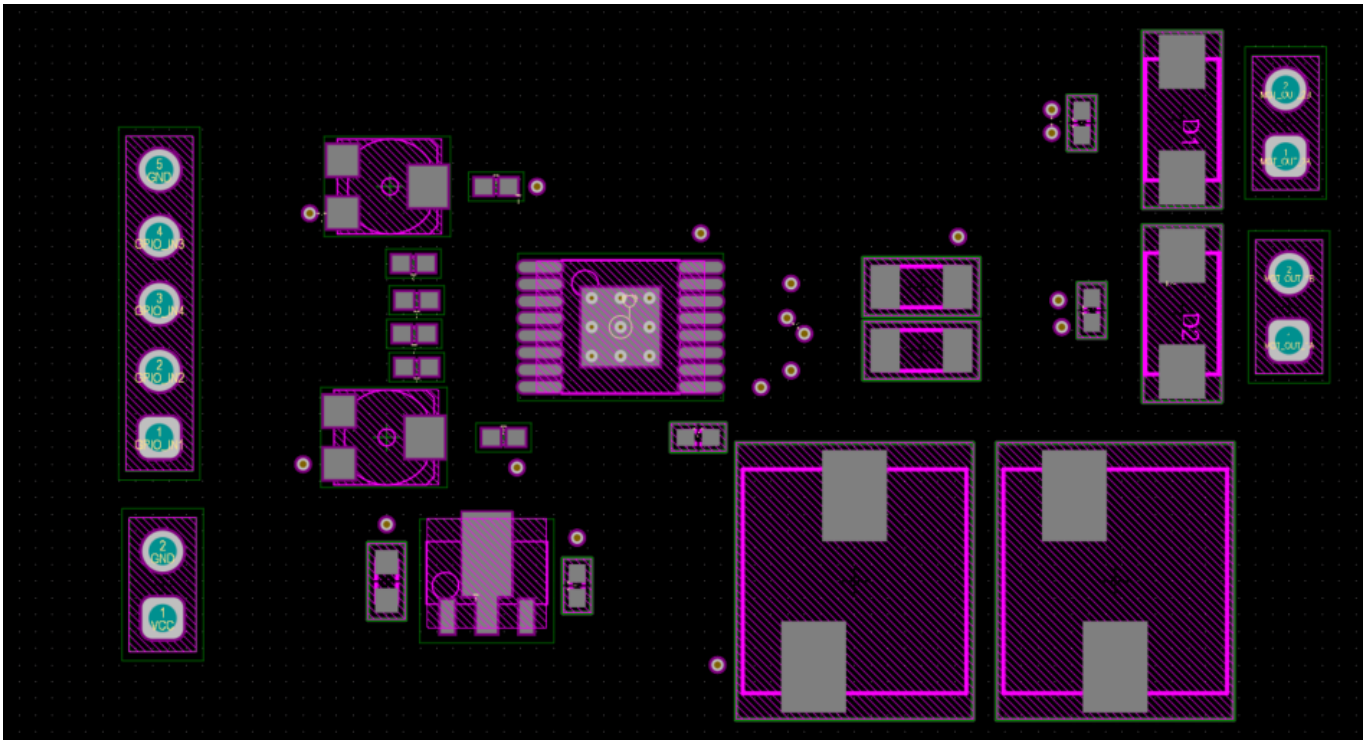

Figure 3: Component placement for the dual motor driver PCB

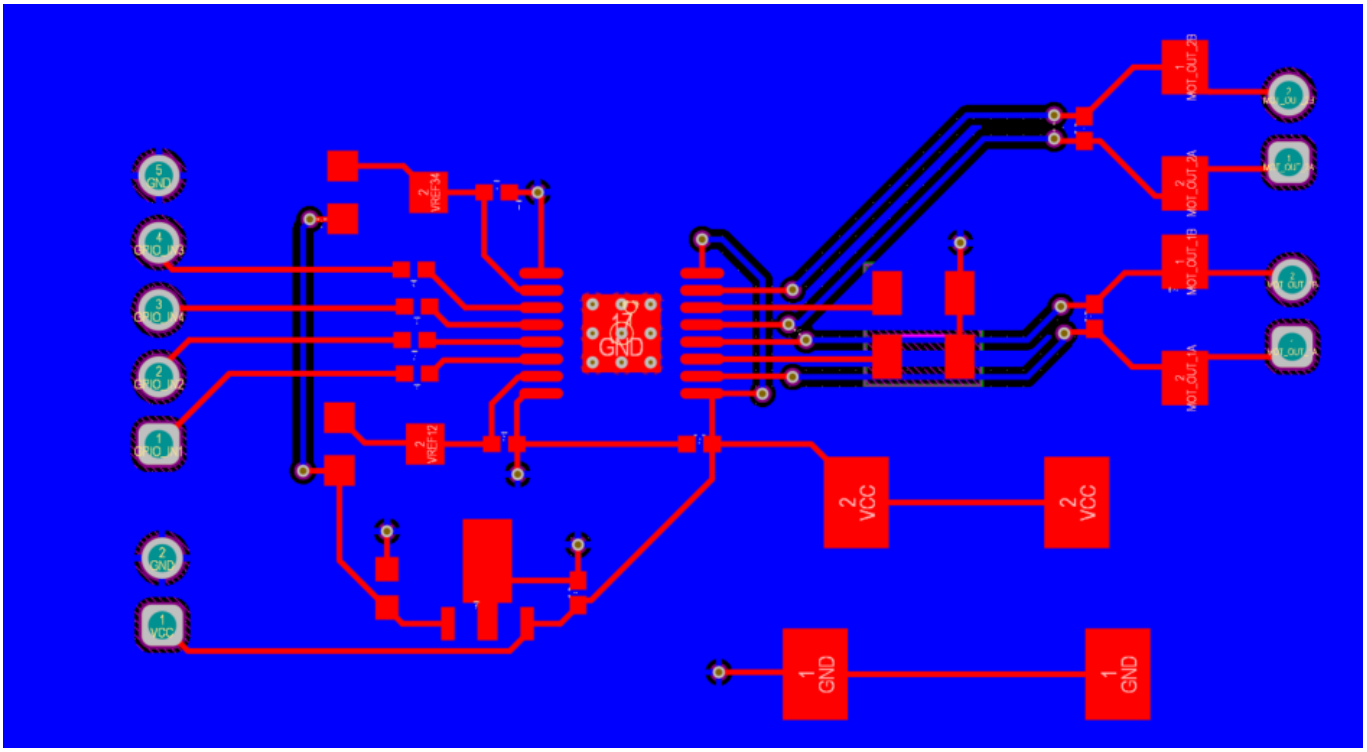

Figure 4: Top and bottom layers with completed routing and ground pores

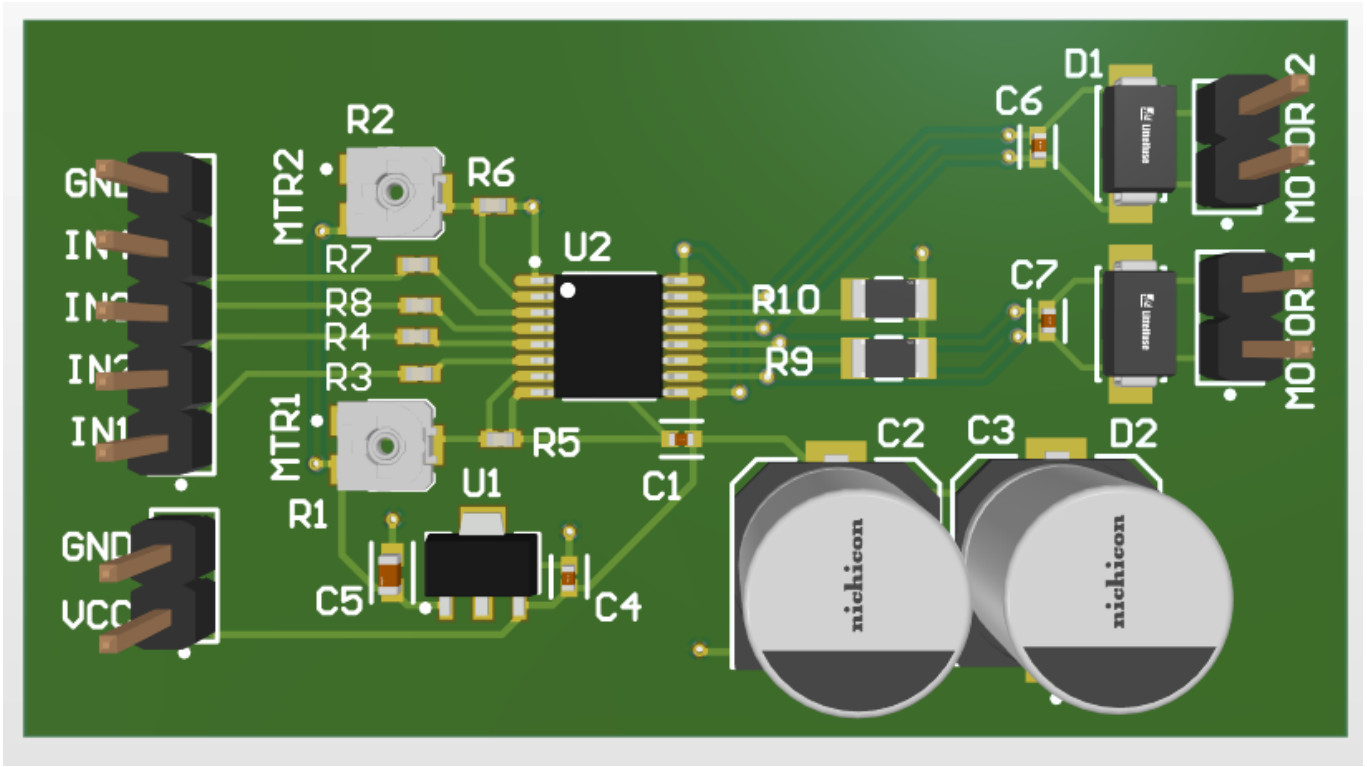

Figure 5: 3D Render of PCB

D. Summary: The produced output presents a simple solution to control two DC motors using PWM with logic inputs. The footprint of the board is 5cm x 3cm which could be made smaller but is nonetheless reasonable for this application. Where possible, 0402 generics have been used. To further reduce board size, silk screen designators can be removed entirely to free up board real estate in addition to arranging components differently. Optimizing poring would be a good next step to ensure robustness in this design. All fabrication outputs can be found on my github. JLC PCB designs rules were used to pass the DRC check.