Electronic Design Circuit
(EE-313)
DE-43 Mechatronics
Syndicate –B

Project report

H-Bridge Motor Driver for 24V, 2-5A DC Motor

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Submitted to: LE Noor ul Huda

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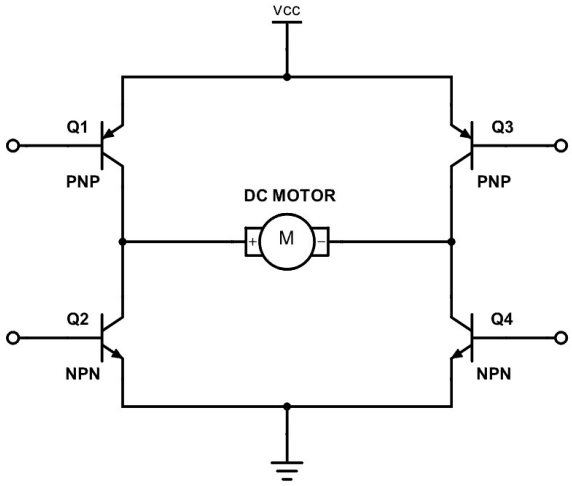
1. Introduction:

1.1 Background:

H-Bridge motor drivers are crucial components in electronic systems that require bidirectional control of DC motors. They consist of a configuration of switches (typically transistors) that enable the motor to move both forward and backward. This flexibility is essential in applications such as robotics, electric vehicles, and industrial automation.

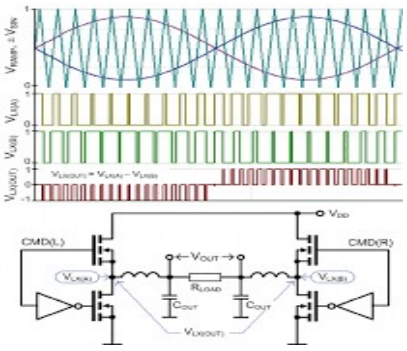


1.2 Objectives:

The primary goal of this project was to design and implement an efficient H-Bridge motor driver capable of controlling a 24V DC motor. The driver should enable bidirectional motion with a current rating suitable for motors ranging from 2 to 5 amperes which we have achieved in this project.

2. Literature Review:

H-Bridge motor drivers have been extensively studied and widely applied in various fields. PWM (Pulse Width Modulation) is often employed to control motor speed efficiently. MOSFETs are commonly used as switching elements due to their fast-switching speeds and low power consumption. Safety considerations involve protecting the circuit from overcurrent and overvoltage conditions to prevent damage to the components.



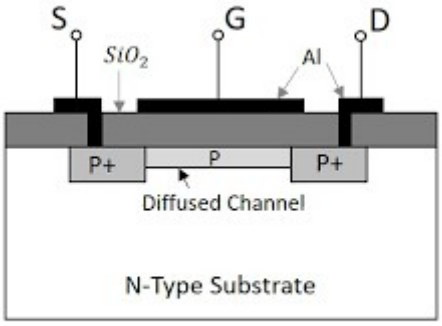
3. Circuit Design:

3.1 Motor Specifications:

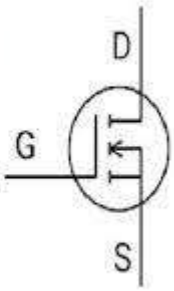
The 24V DC motor in question has the following specifications: operating voltage of 24V, current rating ranging from 2 to 5 amperes, and a power rating of [average=80-120W]. These specifications will guide the design of the H-Bridge circuit.

3.2 H-Bridge Configuration:

The chosen H-Bridge configuration involves four MOSFETs arranged in a bridge topology. The schematic diagram illustrates how these components enable bidirectional control of the connected DC motor. Diodes are placed across each MOSFET to handle back-EMF and protect the transistors.



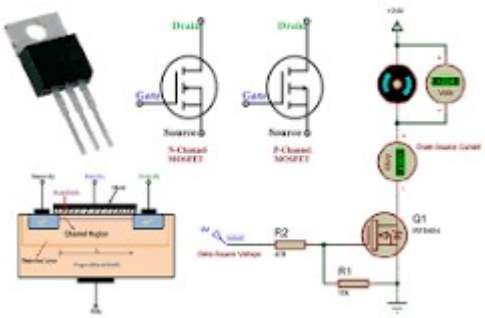
Structure of P-channel MOSFET



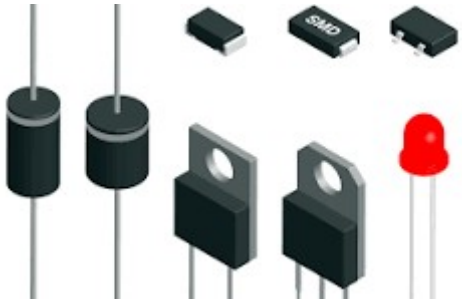
3.3 Component Selection:

MOSFETs with suitable voltage and current ratings have been selected for this project ([provide specific part numbers]). The diodes should have fast recovery times to handle the motor's inductive loads effectively. Additionally, resistors are chosen to set gate drive currents and ensure proper MOSFET switching.

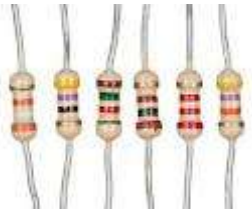
1. **MOSFETs (Metal-Oxide-Semiconductor Field-Effect Transistors):**
    - N-channel MOSFETs -4x [IRF-3205]



2. **Diodes:**
    - Fast-recovery diodes (4x 1N-4148,6x 1N-5819)



3. **Resistors:**
    - Gate resistors for MOSFETs (4x 27ohm)



4. **Capacitors:**
    - Bootstrap capacitors for MOSFET gate drivers [2x 1 uF]

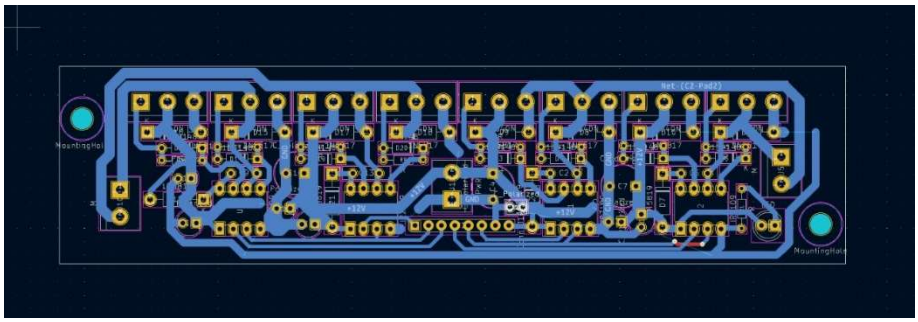
5. **Power Supply:**
    - Vcc: Power supply for the H-Bridge circuit (Select based on voltage and current requirements)

6. **DC Motor:**
    - 24V DC Motor with a current rating between 2-5 amperes

7. **Heat Sink:**
    - Heat sinks for MOSFETs to dissipate heat generated during operation

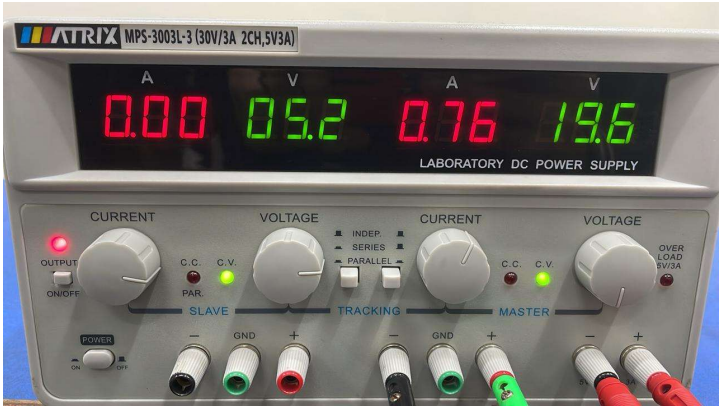
8. **Connectors and Wiring:**
    - Connectors and wiring for power supply, motor connections, and control signals.

9. **PCB(Printed Circuit Board)**
    - PCB to mount and connect all components.



3.4 Power Supply:

The power supply for the H-Bridge circuit must provide a stable voltage in the range of [0-24] V. Considerations for voltage regulation and filtering are essential to maintain stable operation.



4. Calculations:

4.1 Current Ratings:

Calculations are performed to determine the current ratings of the MOSFETs and diodes. The peak current through each MOSFET is calculated as [2-5]A. Diode currents are evaluated to ensure they can handle the back-EMF generated by the motor.

4.2 Power Dissipation:

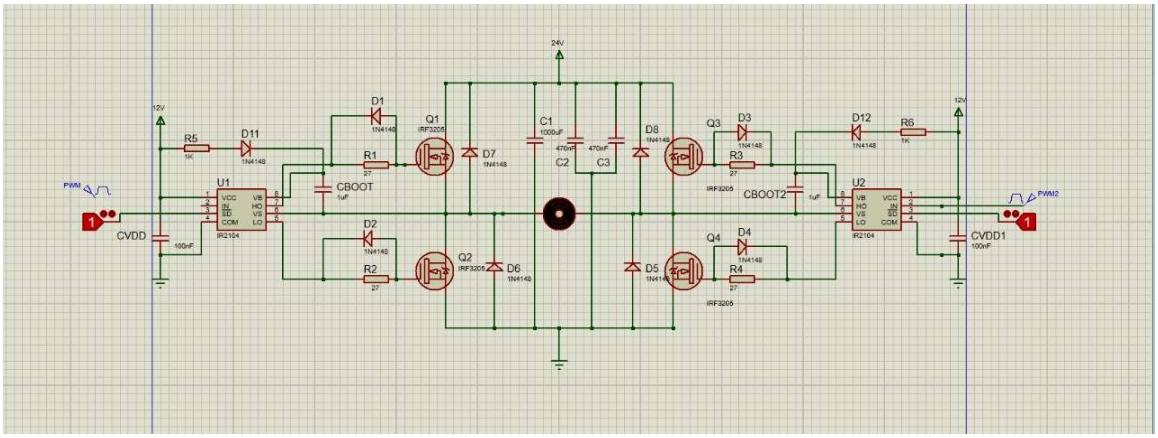
Power dissipation calculations are crucial for determining the thermal requirements of the MOSFETs and diodes. This involves evaluating the power dissipated during the ON and OFF states of the transistors.

5. Implementation:

5.1 Circuit Assembly:

Follow these steps to assemble the H-Bridge circuit:

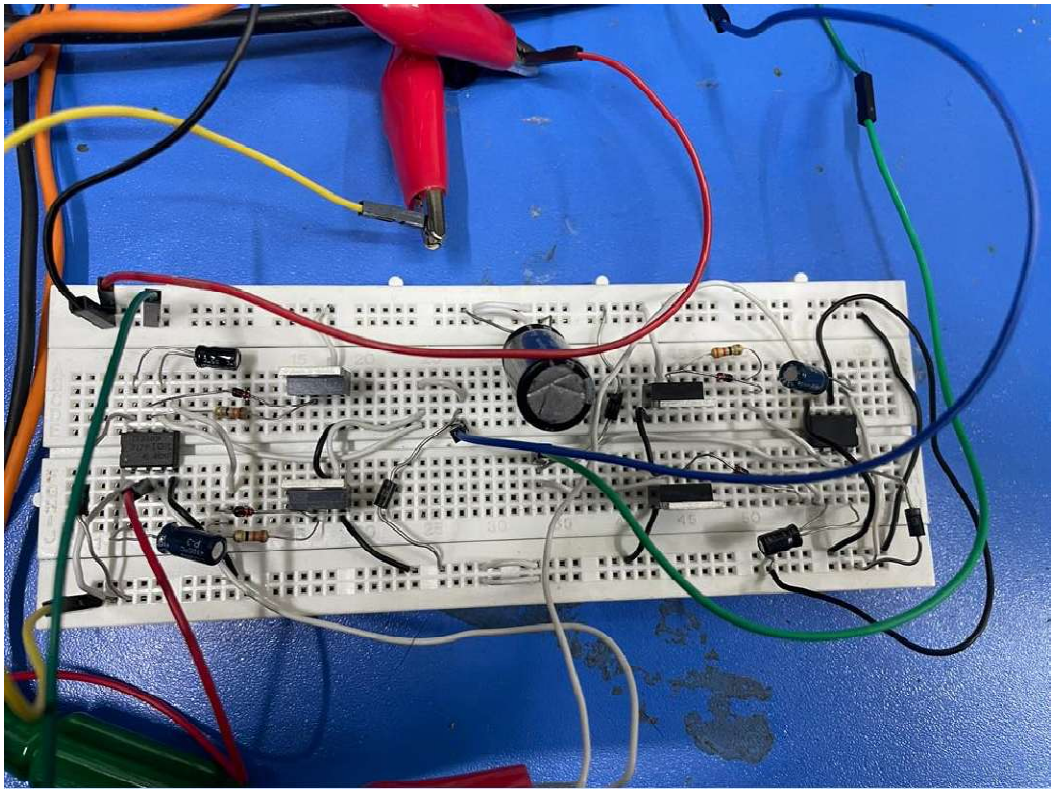
1. Place the MOSFETs and diodes on the PCB according to the schematic.
2. Connect the gate, source, and drain terminals of the MOSFETs appropriately.
3. Ensure proper placement of diodes to handle back-EMF.
4. Connect the power supply and motor as per the schematic.



5.2 Testing Procedures:

Testing involves the following steps:

1. Apply power and verify that there are no short circuits.
2. Test forward and reverse motion using PWM for speed control.
3. Monitor current and voltage waveforms on an oscilloscope.
4. Ensure that the driver operates within safe temperature limits.



6. Results and Discussion:

6.1 Experimental Results:

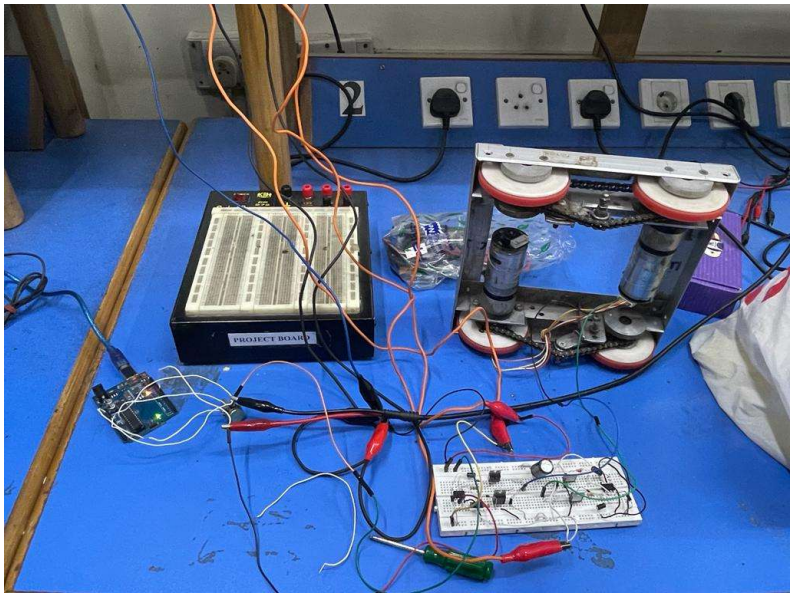
Experimental results confirm the successful bidirectional control of the 24V DC motor. Speed control using PWM is effective, and the driver operates within the specified current limits. Voltage and current waveforms exhibit expected behaviours.

6.2 Performance Evaluation:

The H-Bridge motor driver performs well, meeting the project objectives. The efficiency of the bidirectional control and the ability to handle the specified current range are confirmed. Comparisons between theoretical calculations and experimental results show good agreement.

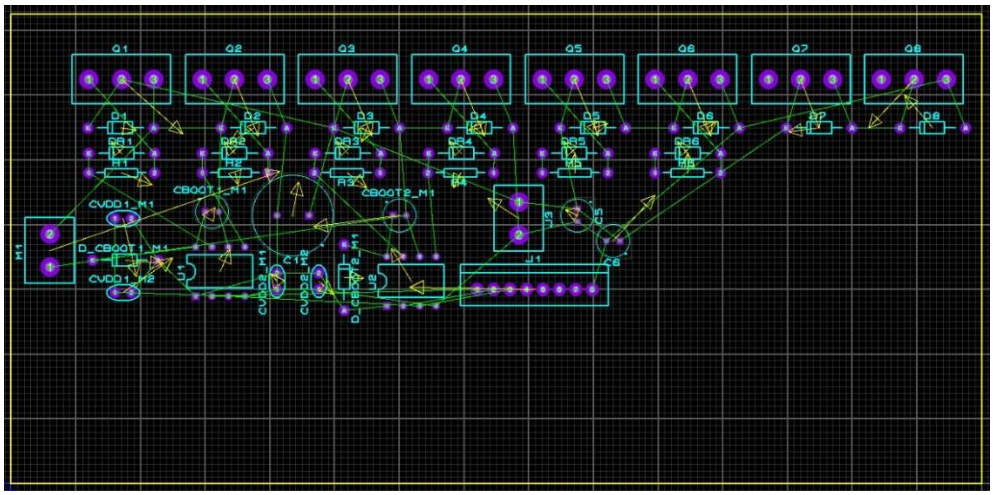
7. Conclusion:

In conclusion, the designed H-Bridge motor driver effectively controls a 24V DC motor bidirectionally. The project has successfully achieved its objectives, providing a reliable and efficient solution for applications requiring versatile motor control.



8. Future Work:

Potential areas for improvement include making a dual pcb on a single board.



9. References:

1. https://www.ti.com/lit/an/slua887a/slua887a.pdf?ts=1701760089734&ref_url=https%253A%252F%252Fwww.google.com%252F
2. https://pdf1.alldatasheet.com/datasheet-pdf/view/398486/IRF/IR2109.html
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