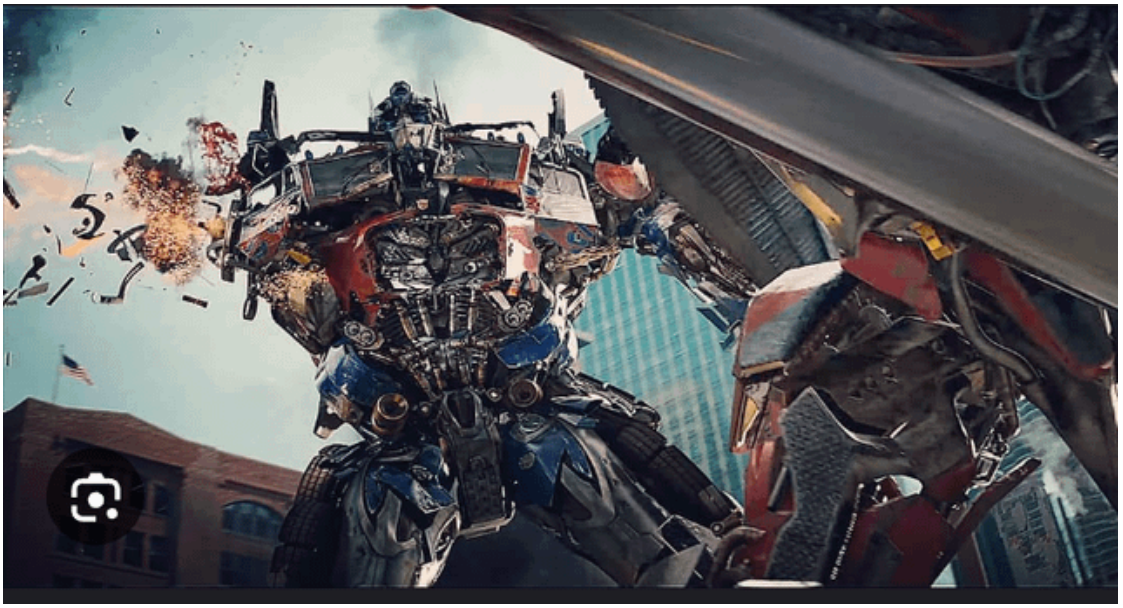
ELECTRICAL TEAM TRAINING

TASK 9

Group Task

Task 9.1



About

The war between the **Autobots** and **Decepticons** has reached a critical point. The Decepticons have unleashed a powerful electromagnetic weapon that shattered the Autobots' internal circuits. Optimus Prime has called upon you and your team to rebuild the Autobots from the ground up.

Each Autobot needs **three vital systems** to be restored before it can transform and return to battle:

1. A **Power Core** to store and regulate Energon.
2. An **Actuator System** to move, transform, and fight.
3. A **Sensor Board** to perceive the world and detect enemies.

Requirements

It is required to develop **the following 3 boards** in Altium, do note that each team member must understand their team member's **design philosophy of each board**

There is a large bonus if you made the PCB multilayered

1-Actuators board

The Actuator Base Board provides the core functionality for controlling mechanical components. It is designed to be compatible with multiple actuator types, such as pistons and servos, making it suitable for diverse applications where precise movement control is needed.

- **STM32 Microcontroller**
- **Piston Control Circuit:**
  - 12V control for a high-power piston.
  - **Indicator LED:** Shows piston open/closed status.
- **Servo Motor Connectors:**
  - Two connectors for 8.4V servo motors.
  - Independent control with stable 8.4V power delivery.
- **Power Indicators:**
  - **STM32 Power LED:** Illuminates when powered.
  - **Piston Status LED:** Indicates piston activation.
- **4-Pin USB High-Speed Differential Pair Connector:**
  - For programming STM32 with minimized noise.
- **STM32 Pin and Timer Considerations:**
  - Proper selection and mapping of STM32 pins and timers to ensure efficient control of servos and piston

without conflicts.

- **Power Management:**
  - Stable power regulation with decoupling capacitors near key components.
- **Compact and Efficient Layout:**
  - Optimized for space and minimal interference.

2. Sensor Base Board

About: The Sensor Base Board is engineered for integrating various sensors into a single platform. This board supports different types of sensors for motion, orientation, and environmental sensing, making it adaptable for numerous applications where data collection and analysis are crucial.

Components and Requirements:

- **STM32 Microcontroller**
- **MPU6050 Sensor**
- **BNO055 Sensor**
- **Ultrasonic Sensor**
- **Limit Switch with Debounce Circuit:**
  - Detects physical endpoints; debounce circuit filters out mechanical noise for reliable signal input.
- **ESD Protection for I2C Lines:**
  - Protects I2C connections for MPU6050 and BNO055 from electrostatic discharge.
- **4-Pin USB High-Speed Differential Pair Connectors:**
  - For programming the STM32 and ensuring reliable data communication.
- **Power Management:**
  - Stable power regulation with decoupling capacitors near key components.

- **Status Indicators:**
  - LEDs for power and sensor activity monitoring.
- **Compact Layout:**
  - Optimized for minimal interference and efficient space use.

3. Power Distribution Base Board

The Power Distribution Base Board ensures stable and reliable power delivery for various components. It is designed to handle multiple power requirements and provide protection against electrical issues, making it a critical component in any high-tech system.

It is required to create a power board that takes 12 volt and outputs 5v and 8.4v, it should also contains all the circuit protections discussed in the session and contains the circuit design of 2 different buck converters

Components and Requirements:

- **2 Buck Converter circuits:**
  - Steps down 12V to 5V for stable power delivery.
  - Steps down 12V to 8.4V for stable power delivery.
- **Overvoltage Protection:**
  - Shields the board from voltage spikes.
- **Over-Current Protection:**
  - Prevents damage from excessive current.
- **Reverse Voltage Protection:**
  - Guards against incorrect polarity connections.
- **Indicator LEDs**:
  - Shows power status and operational health of each .

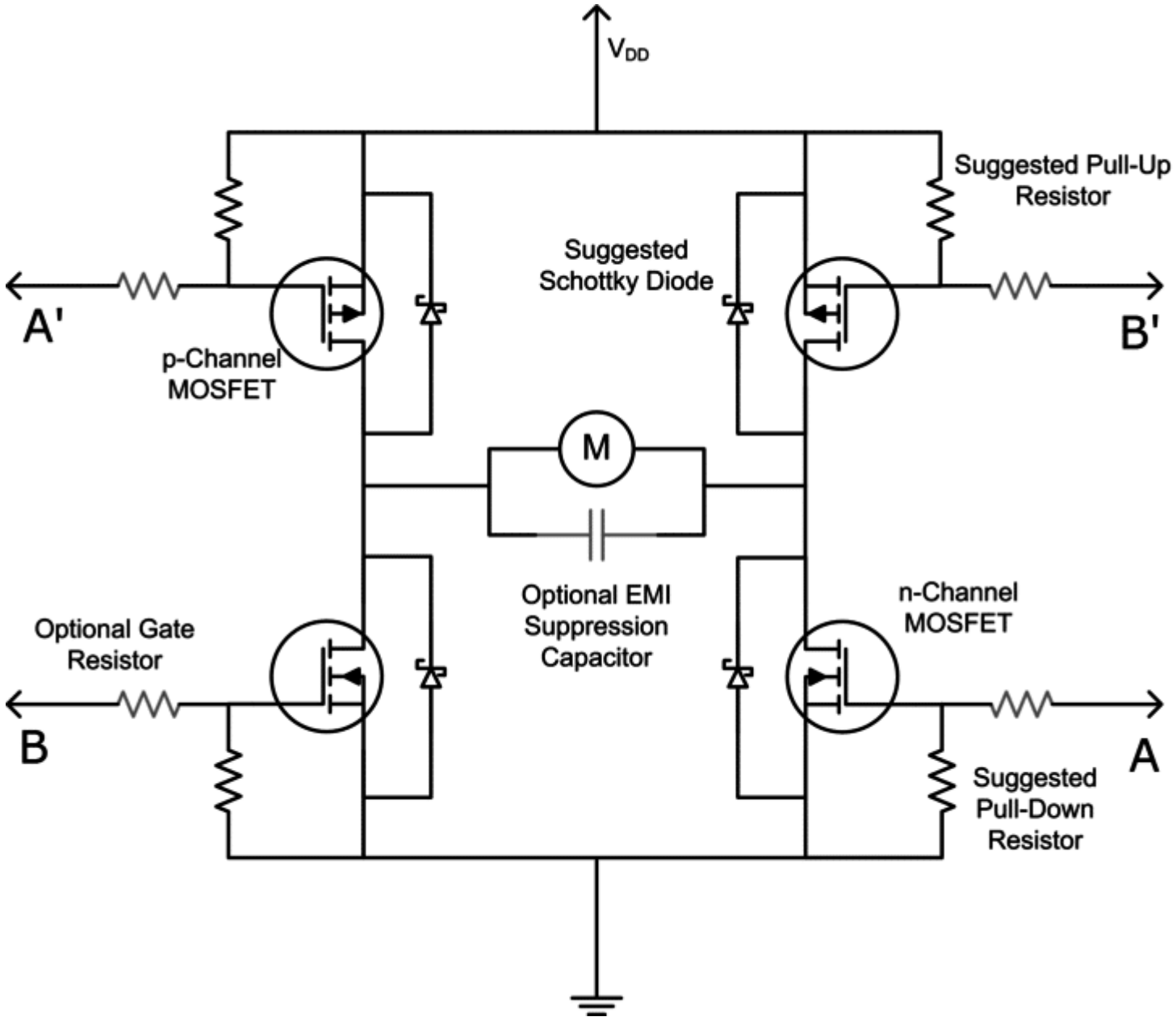
- **Compact and Reliable Layout:**
  - Efficient design to handle power safely and minimize space.

Note: You should add any extra components yourself for protection or converting voltages levels

Individual Tasks

Task 9.2

It is required to create an **H-Bridge motor driver PCB,** the following image is the schematic , where a and b are 2 different 5 volt signals and the motor is **a two-pole terminal** connected to a motor



The **Motor Driver Board** is designed to control a DC motor using an **H-bridge configuration**. The PCB accepts a **12 V supply (VCC)** and **two 5 V logic control signals** from an external controller, using **Two-pole terminal**.

The H-bridge switches the 12 V supply to the motor according to the control inputs, allowing **forward**, **reverse**, and **brake** operation.

The **motor output** is provided through a **two-pole terminal block**, where the 12 V drive is delivered to the motor leads.

The motor takes 10 ampere, and the maximum trace width allowed in this task is 80 mil, so using **Soldier Masking** is essential

To improve safety and reliability, the board also integrates:

- **Reverse voltage protection** (to guard against incorrect supply connection).
- **Over-voltage protection** (to protect both the circuit and the motor).
- **Indicator LEDs**:
  - **Power LED** (shows 12 V supply present)
  - **Motor Activity LED(s)** connected **in parallel with the motor outputs** to give a visual indication when the motor is being driven.

You must make the board as small as possible

Submission

- **Submit** a drive link containing the board and schematic for each of the 3 circuits in task 9.1
- **Submit** a drive link containing the board and schematic for task 9.2
- The Task's deadline is 29/8 11:59 PM.
- https://forms.gle/79bNdBKZjPVNoiBx6