University of Engineering and Technology, UET Taxila.

Electrical Engineering Department

Subject:EMC_L (Project)

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بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ

Objective:

Our target is to build anH-Bridge circuit which can control the motor direction. Motor should be able to spin and change directions depending on the path which we provide. Path will be control using push buttons, also build circuit of DC supply that will provide power to the circuit and motor.

Equipment:

Dc Supply

- L7408 IC Transistor
- 1000uf Capacitor(polarized)
- 1uf Capacitor
- Step Down Transformer (220-12V)
- IN4007 Diodes

H bridge

- Tip127
- Tip122
- Terminal blocks
- Resistors(1k ohm ,5.6k ohm)
- Push buttons

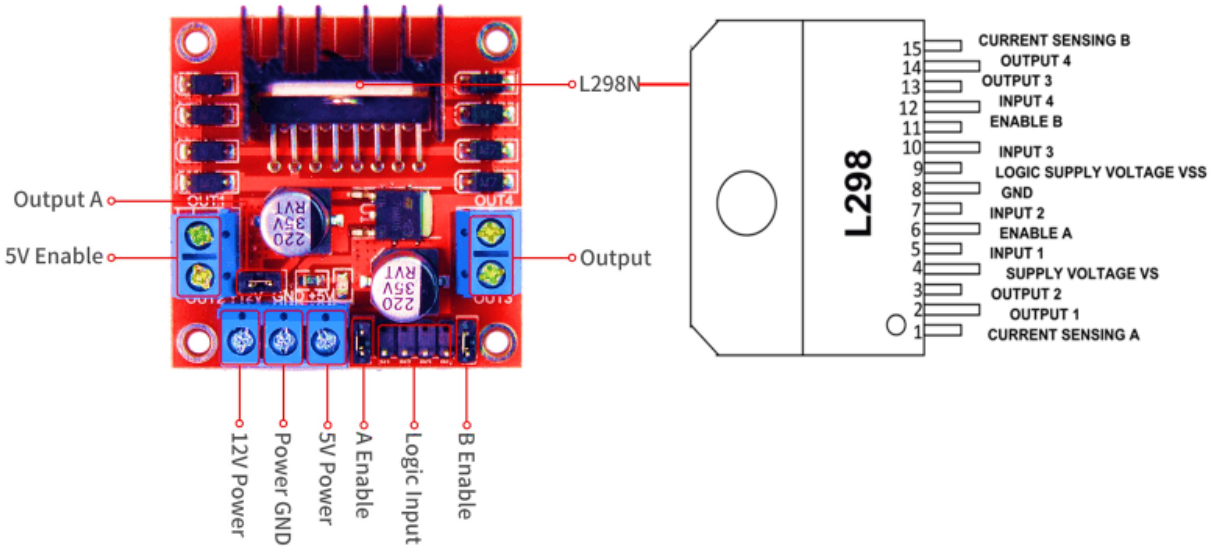
- DC motor
- AC supply
- Connecting wires

Theory:

H-Bridge

H-bridge is a simple electronic circuit which enables us to apply voltage to load in either direction. By using H Bridge we can run DC Motor in clockwise or anticlockwise directions.

In general an H-bridge is a rather simple circuit, containing switching element, with the load at the center, in an H-like configuration.

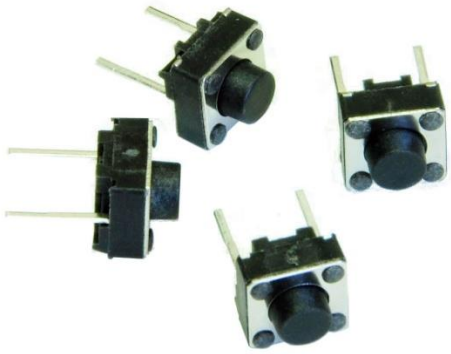


Resistors

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses.

Push Buttons

A push-button (also spelled pushbutton) or simply button is a simple switch mechanism to control some aspect of a machine or a process. Buttons are typically made out of hard material, usually plastic or metal.

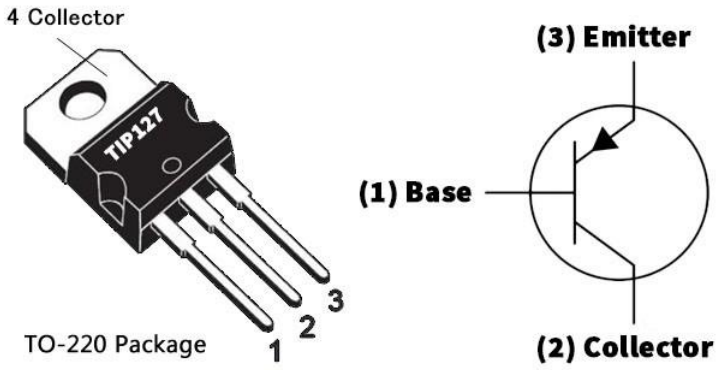


Terminal block

A terminal block is a modular, insulated block that secures two or more wires together. Factories use terminal blocks to secure and/or terminate wires. In their most basic form, terminal blocks consist of several individual terminals which are arranged in a long strip.

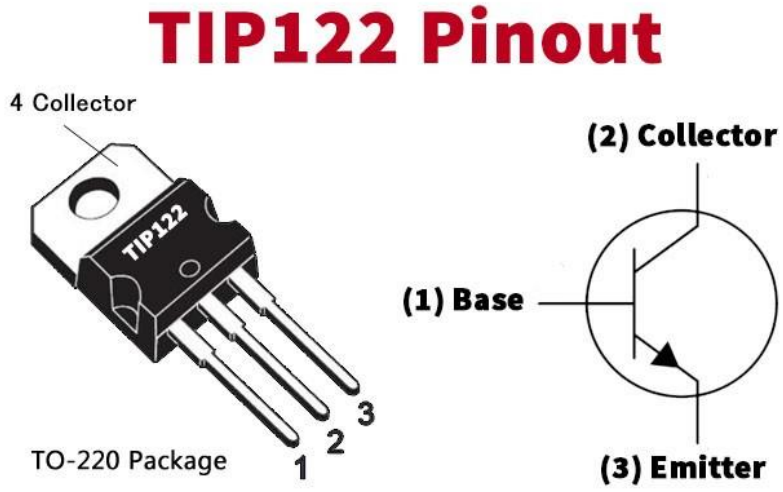
TIP-127

The TIP127 is a PNP type Darlington pair transistor. It is manufactured for universal drive amplifications and less velocity swapping submissions. It is existing in TO-220 kind of cascading.



TIP-120

The TIP120 is an NPN Power Darlington Transistor. It can be used with an Arduino to drive motors, turn lights on, and drive other high power gadgets



Data Sheet of both Transistors is given below

MOSPEC

PLASTIC MEDIUM-POWER
COPLEMENTARY SILICON TRANSISTORS

...designed for general-purpose amplifier and low speed switching applications

FEATURES:

* Collector-Emitter Sustaining Voltage-
  $V_{CEO(sus)}$ = 60 V (Min) - TIP120,TIP125
  = 80 V (Min) - TIP121,TIP126
  = 100 V (Min) - TIP122,TIP127
* Collector-Emitter Saturation Voltage
  $V_{CE(sat)}$ = 2.0 V (Max.) @ I_C = 3.0 A
* Monolithic Construction with Built-In Base-Emitter Shunt Resistor

NPN	PNP
TIP120	TIP125
TIP121	TIP126
TIP122	TIP127

5.0 AMPERE
DARLINGTON
COMPLEMENTARY SILICON
POWER TRANSISTORS
60-100 VOLTS
65 WATTS

TO-220

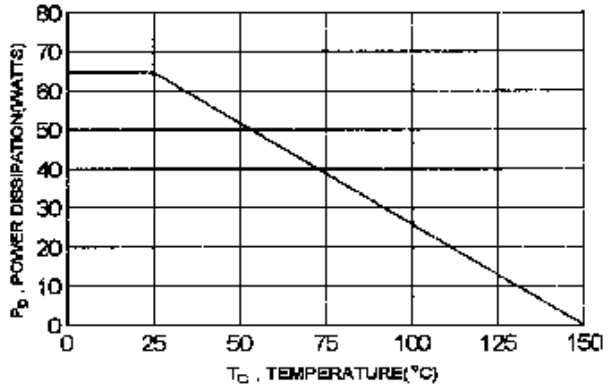
MAXIMUM RATINGS

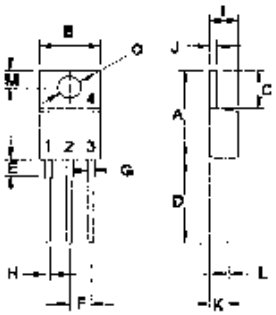
Characteristic	Symbol	TIP120 TIP125	TIP121 TIP126	TIP122 TIP127	Unit
Collector-Emitter Voltage	V_{CEO}	60	80	100	V
COllector-Base Voltage	V_{CBO}	60	80	100	V
Emitter-Base Voltage	V_{EBO}	5.0			V
Collector Current-Continuous -Peak	I_C I_{CM}	5.0 8.0			A
Base Current	I_B	120			mA
Total Power Dissipation @T_C= 25°C Derate above 25°C	P_D	65 0.52			W W/°C
Operating and Storage Junction Temperature Range	T_J , T_{STG}	- 65 to +150			°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance Junction to Case	Rθjc	1.92	°C/W

FIGURE -1 POWER DERATING





PIN 1.BASE
2.COLLECTOR
3.EMITTER
4.COLLECTOR(CASE)

DIM	MILLIMETERS MIN	MAX
A	14.68	15.31
B	9.78	10.42
C	5.01	6.52
D	13.06	14.62
E	3.57	4.07
F	2.42	3.66
G	1.12	1.36
H	0.72	0.96
I	4.22	4.98
J	1.14	1.38
K	2.20	2.97
L	0.33	0.55
M	2.48	2.98
O	3.70	3.90

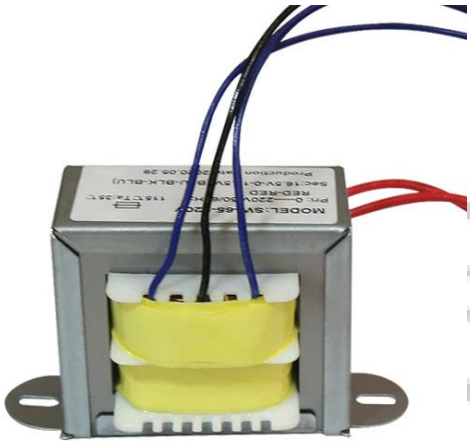
DC Power supply

In order to create a circuit (DC power supply) that could output a usable DC power; the circuit was built in three different parts. The first part of the circuit was two full-wave rectifiers, the second part of the circuit was the filter capacitor, and the third part of the circuit was the voltage regulator followed by H-Bridge Construction was fairly simple as the project had many ties to the previous lab

Transformer

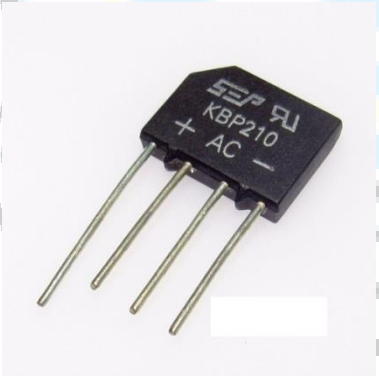
The simple element of thetransformerconsists of two coils having mutual induction and a laminated iron core insulated from each other by a thin layer of vanish which when dried adheres to the metal. The aim of laminating the core was to reduced eddy current loss induced by alternating magnetic flux. This type of configuration gives two phases through the two parts of the secondary coil. Additional wire was connected or grounded across the middle point of the secondary winding of the transformer. The wire was adjusted such that it falls in the exact middle point of the secondary winding thus at zero volt, forming the neutral point for the winding which

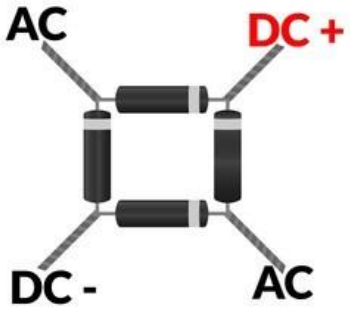
allows the transformer to provide two separate output voltages which are equal in magnitude but opposite in polarity to each other.



Rectifier

A rectifier is used to convert alternating voltage to a pulsating direct voltage follow by a filter which comprises of capacitors, resistors that smooth most of the pulsation ,a process known as rectification A full wave rectifier was used to design the dual polarity (±) power supply. This converts both the positive and negative halves of the input waveform to a single polarity (positive or negative) at its output .The second pair of diode to produce the negative polarity with respect to the transformer.
We can also make rectifier using 4 diodes. The diodes D1, D2, D3, and D4 served as the full wave rectifier that converts the 220 AC V to about 12V DC across the secondary coil of transformer providing DC.





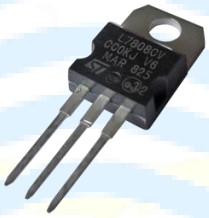
Filter (Capacitor)

In power supplies, capacitors are used to smooth (filter) the pulsating DC output after rectification. The pulsating output of the rectifiers has an average DC value

and an AC portion that is called ripple voltage. Filter capacitors reduce the amount of ripple voltage to a level that is acceptable. In a filter circuit the capacitor is charged to the peak of the rectified input voltage during the positive portion of the input. When the input goes negative, the capacitor begins to discharge into the load. The rate of discharge is determined by the RC time constant formed by the capacitor and the load's resistance.Here we use 2 Electrolytic Capacitor (1000µF&1µF)

Voltage Regulator

The voltage regulators has internal feedback regulating and current passing element. Regulators come in a variety of designs according to their purpose of use. For our power supply, we used L7408CT voltage regulator.



Direct current (DC) motor

A direct current motor is a type of electric machine that converts electrical energy into mechanical energy. DC motors take electrical power through direct current, and convert this energy into mechanical rotation.

Connecting wires

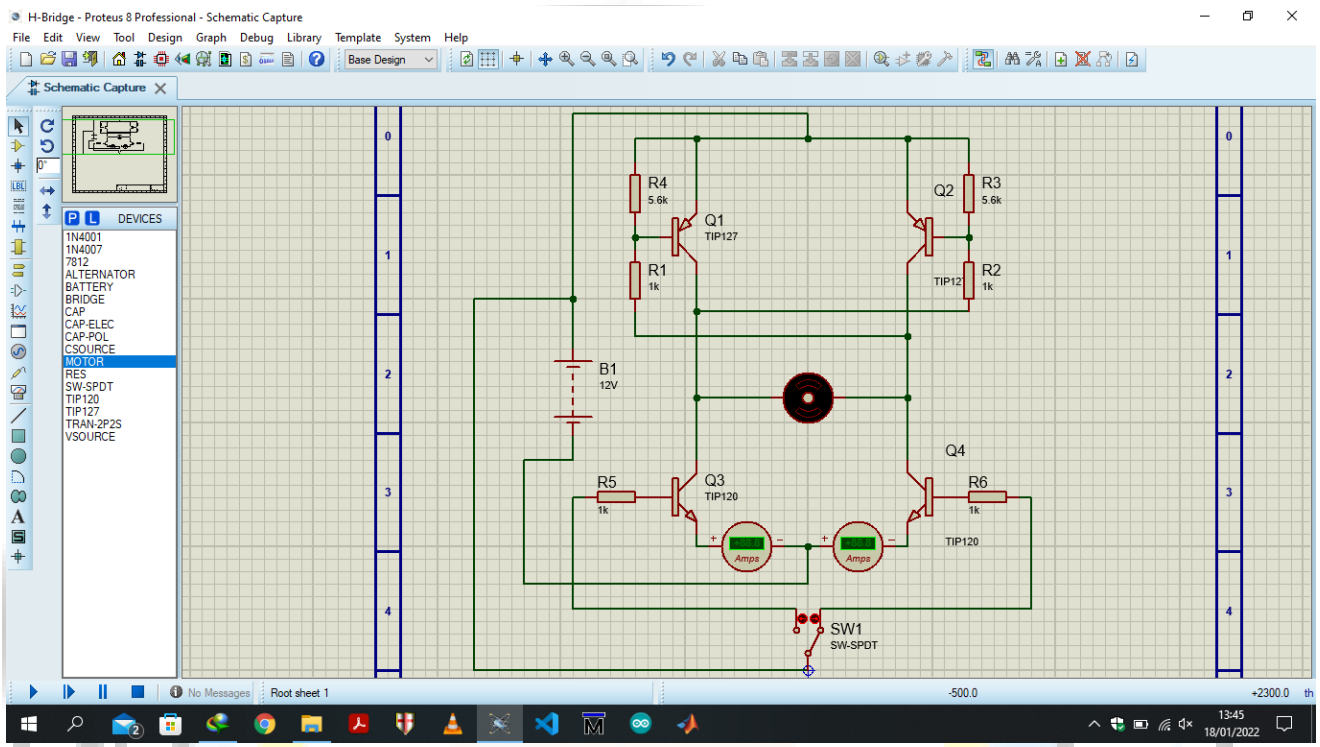
Wires are used for establishing electrical conductivity between two devices of an electrical circuit. They possess negligible resistance to the passage of current.

Construction:

H-Bridge

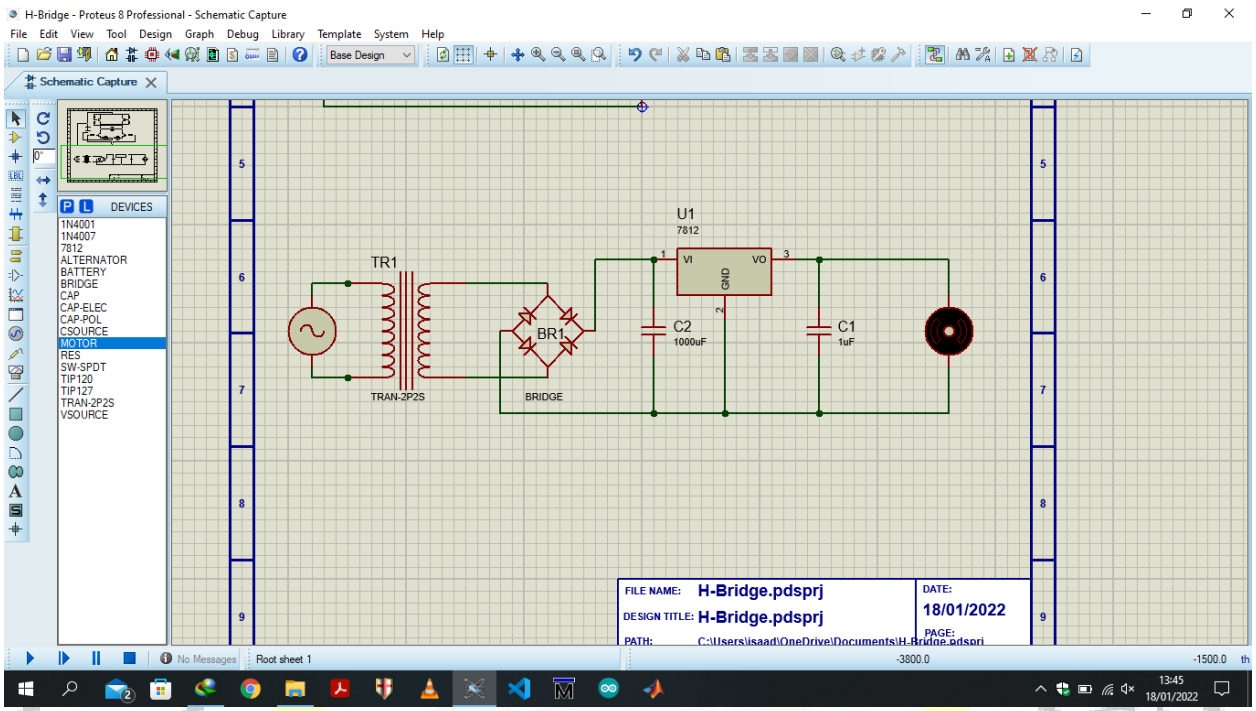
DC supply is connected to the Emitter of two tip-127 transistors and also to their base through 5.6k ohm resistors. The collector of these two transistor is connected to the collectors of two tip-122 transistors, separately. The motor terminals are between these two emitter-collector sets. DC supply is also connected to the base

of tip-122 transistors through push buttons. On pushing the buttons will complete the circuit and the circuit will be completed. The emitter of tip-122 transistors is connected to the negative terminal of the DC supply.



DC Supply

AC supply is connected to the primary side of the step-down transformer and the secondary side is connected to the bridge rectifier terminals. The DC terminals of the rectifier are connected to the filter capacitor. The positive terminal of the rectifier is connected to Vin pin of the voltage regulator and negative terminal is connected to the Ground pin of the voltage regulator. There is another capacitor of small value connected in between the Vout and Ground pin of voltage regulator. The output pins of the DC supply are also connected from the Vout and Ground pin of voltage regulator.



Working:

- The current will flow from the positive terminal of the DC Power Supply to the Emitters of both Tip 127 transistor and also flow to their base through 5.6k ohm resistors. This base current will switch ON the transistors and emitter and collector of both tip 127 transistors are connected now. The emitter current will now flow to the collector.
- There are two push buttons of which one terminal is connected to DC supply and other terminal is connected to the base of tip 122 transistors. These push buttons are used to control the base current for tip 122 transistors that will allow the current from the DC Motor to flow back to the source.
- Both buttons will provide opposite paths that will allow the motor to rotate in clockwise & anticlockwise directions.

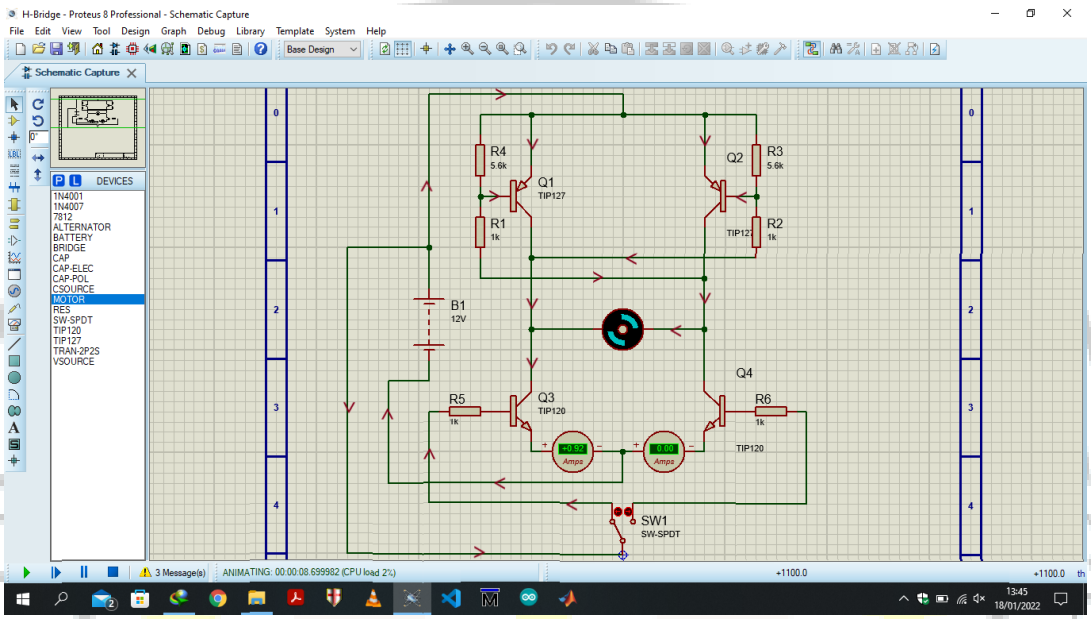
- For right to left it would move clockwise. For the left to right the motor would move counter clockwise.

- The collector of both tip 127 transistors is connected to the collectors of two tip 122 transistors, separately. The motor is connected between these two collector-collector sets.

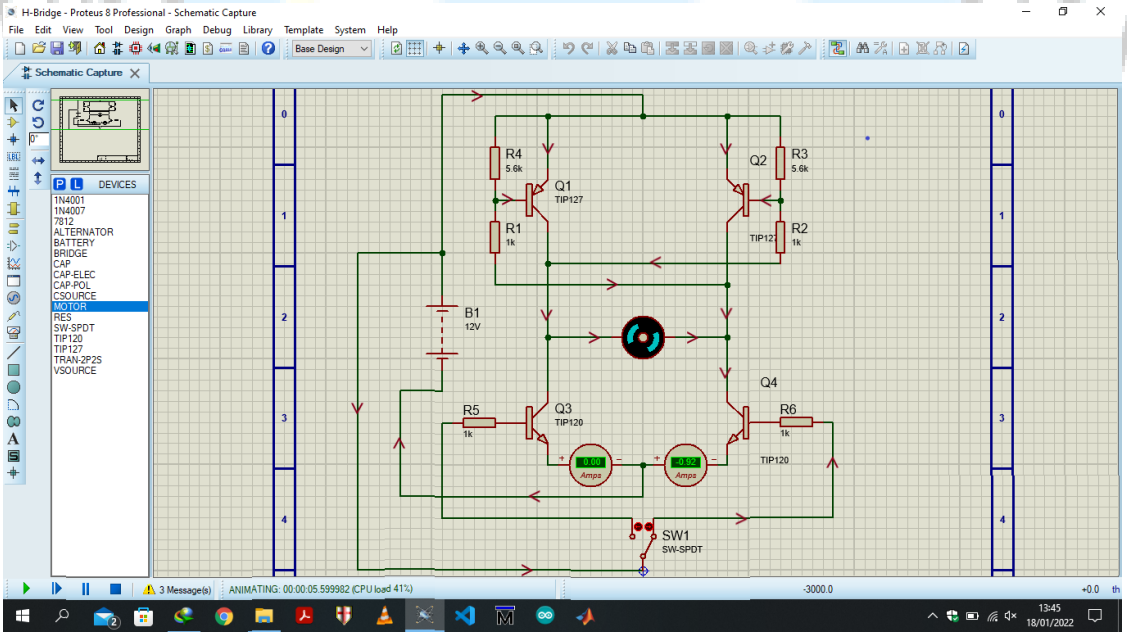
- On pushing one button the current from the supply will travel to the base of respective tip 122 transistor through 1k ohm resistor and switch it ON,

providing an emitter-collector connection. This connection will complete the circuit and allow the current flowing through the motor to travel back to the negative terminal of the DC Supply.

Anticlockwise Direction



Clockwise Direction



Applications:

- The most important application of the H-Bridge circuit as the motor driver circuit.
- In Robotics Technology, H-bridge circuits are used.
- H-Bridge circuit is also used as Inverter-circuits.
- In modern battery charger for electrical vehicles, H-bridge circuits are used.

Conclusion:

We made H-Bridge circuit which is able to rotate the motor in clockwise and anti-clockwise direction according to the give input. We used two push buttons to control the direction which can be replaced by Arduino controlled relays or directly by Arduino signals.