# Ahsanullah University of Science and Technology

## Department of Electrical and Electronic Engineering

## Project Report

Course No : EEE 4154

Course Name : Power System-II Lab

Project Name : Cost-effective variable frequency drive

Section : C2

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**Objective:**

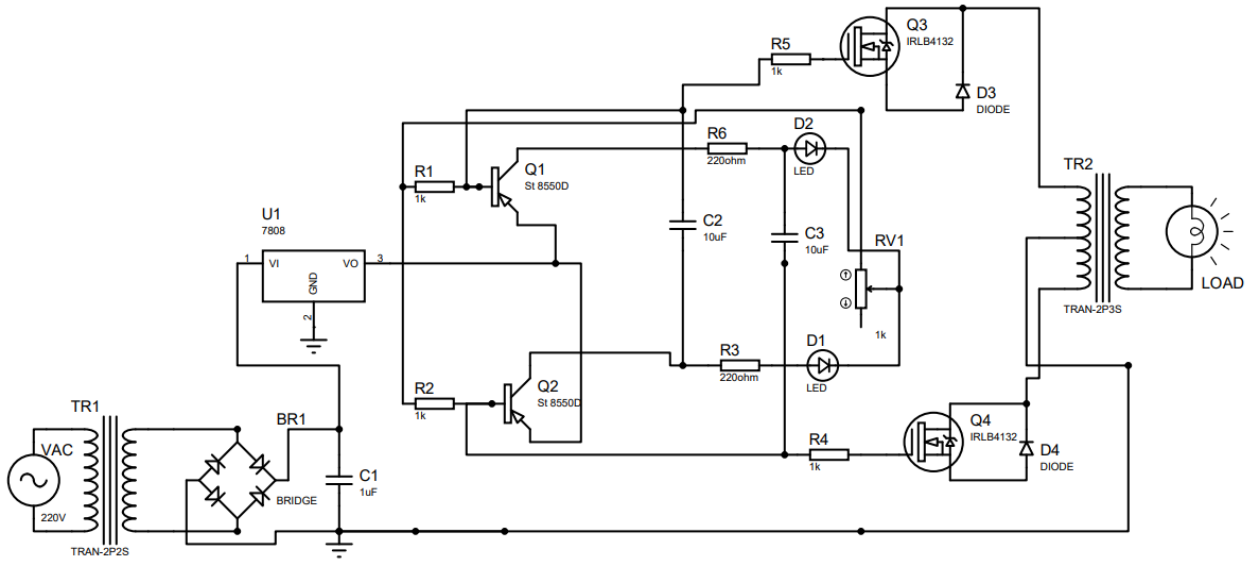
The objectives of this project are following:

- Find a cost-effective way to develop VFD
- To vary the frequency between 17-250 Hz
- To observe the output at load

**Equipment's:**

- 2 pin plug
- Center-tapped (220V-12V) step-down transformer
- Resistance
- Bridge Rectifier (4 diode)
- Capacitor (2200uF, 10uF)
- IC 7808 Voltage regulator
- 100K Potentiometer
- ST8550D p-n-p BJT
- IRLB4132 MOSFET
- Diode, LED
- Center-tapped (9V-220V) step-up transformer
- Load (Bulb)

**Circuit Diagram:**




**Description of Elements:**

- **2-Pin plug:** 2-pin plugs consist of two flat or round pins with one called “live” and the other called the “neutral”.
- **Center-tapped (220V-12V) step-down transformer:** There is a center tapped single-phase step-down transformer. This will take 220V (AC) as input and will give 12V(AC) as output. Its tapping level is 12v-0v-12v
- **Resistance:** Resistance is a measure of the opposition to current flow in an electrical circuit
- **Bridge Rectifier (4 diode):** This is a type of full wave rectifier and uses 4 diode configurations to convert AC voltage to DC voltage.
- **Capacitor (2200uF, 10uF):** We have used a capacitor of 1000µF and 10uF. This will reduce the ripple of rectified output.

- **IC 7808 Voltage regulator:** This regulator will take 12V DC as input and will give 8V DC as output.
- **100K Potentiometer:** Used for vary the frequency
- **ST8550D p-n-p BJT:** The ST8550D is a p-n-p bipolar junction transistor (BJT) commonly used in electronic circuits for amplification and switching purposes.
- **IRLB4132 MOSFET:** The IRLB4132 is a type of N-channel MOSFET (Metal-Oxide-Semiconductor Field-Effect Transistor) used for switching applications in electronic circuits due to its high current-handling capability and low on-resistance.
- **Diode:** It is commonly used in electronic circuits for rectification, voltage regulation, and signal modulation
- **Center-tapped (9V-220V) step-up transformer:** A center-tapped step-up transformer with input windings rated for 9V and output windings capable of producing up to 220V provides a means of increasing voltage levels while maintaining electrical isolation between the primary and secondary sides.

**Working Principle:**

A supply of 220V single phase AC supply as a line voltage to 2 pin socket. By step down transformer, we convert the voltage to 12V AC line. A bridge rectifier used to convert this AC voltage to DC voltage. For a pure DC voltage, we have used a capacitor. This capacitor will eliminate the ripple. To operate ST8550D BJT we have used IC 7808 as a voltage regulator to produce 8 V DC supply. By 100K potentiometer, we varied the frequency and voltage as base voltage for BJT. As IRLB4132 MOSFET

need gate driver circuit, we have used St 8550D transistor for switching and control this MOSFET. Two IRLB4132 MOSFET use for positive and negative half cycle of AC current. These variations will be observed in multi-meter, Load and oscilloscope.

**Advantages:**

- **Energy Savings**: One of the primary benefits of using VFDs is energy efficiency. By varying the frequency and voltage supplied to the motor, VFDs enable precise motor speed control according to the load requirements.
- **Process Control:** VFDs offer precise control over motor speed, which is particularly useful in applications where precise control of processes is required. This can result in improved product quality and consistency.
- **Reduced Wear and Tear**: VFDs can reduce mechanical stress on equipment and extend the lifespan of motors, belts, gears, and other components
- **Improved Efficiency:** Traditional methods of controlling machines, can be inefficient and result in energy losses. VFDs provide a more efficient way to control without wasting energy.
- **Smooth Start and Stop:** VFDs allow for smooth and controlled starting and stopping of motors, minimizing mechanical shocks and reducing stress on the electrical network.

**Disadvantages:**

- **Harmonics**: VFDs can introduce harmonics into the electrical system which might require additional filtering to avoid it.
- **Electromagnetic Interference (EMI):** VFDs can generate electromagnetic interference that might affect the total system.
- **Maintenance:** Dust and contaminants can affect cooling and electronics over time.
- **Overheating:** If not properly sized or ventilated, VFDs can generate heat during operation, leading to overheating and reduced lifespan.

**Applications:**

- **HVAC (Heating, Ventilation, and Air Conditioning):** VFDs are extensively used in HVAC systems to control the speed of fans and pumps.
- **Industrial Manufacturing:** VFDs are used in manufacturing processes to control conveyor belts, mixers, pumps, and other machinery.
- **Water treatment plants:** VFDs are used in water treatment plants to control pumps, blowers, and other equipment.
- **Agriculture:** VFDs are used in irrigation systems, handling equipment, and other agricultural machinery to control motors based on crop and equipment requirements.
- **Renewable Energy:** VFDs play a role in renewable energy systems, such as wind turbines and solar trackers.
- **Automotive Manufacturing:** VFDs are used in assembly lines and material handling systems in automotive manufacturing companies.
- **Elevators and Escalators:** VFDs are used in elevators and escalators to control motor speed and provide smooth starts and stops.

**Discussion:**

We have developed a system where frequency can be varied from 17-250Hz. We couldn't make sufficient improvement to produce pure ac when frequency at 0Hz. By potentiometer control, over 250Hz frequency can't be determined. By using LEDs, we have verified current flow in the circuit. At inverter output portion, we couldn't produce precise frequency because of non-negligible rippling. Using single phase supply, we have reduced the uses of inverter circuit. In this way, the system become cost-effective.