

# Variable Frequency Drive (VFD) Using Arduino

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## ABSTRACT

Now days, most of industries are working on automation (advanced system). The main intention of automation to monitor system or device automatically till the requirement is satisfied, This paper also help to operate the three phase induction motor automatically. This paper describes the design structure of three phase variable frequency drive (VFD), this project contains two parts first is AC-DC convertor and second is DC-AC converter, The motor operates based on the input of three phase pulse width modulation (PWM) having the rang of operating frequency 0Hz to 13KHz. The frequency is control through arduino Uno based on the IC ATMEGA328

**Keywords:** Arduino, ATMEGA328, Inverter (DC-AC), Rectifier (AC-DC), three phase driver, Pulse width Modulation (PWM) module

## ARTICLE INFO

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## I. INTRODUCTION

This paper document describes the design structure when looking at a three phase variable frequency drive (VFD). This project is designed as driver for conjunction with a three phase induction motor. Typically the induction motor operates only on/off state that time VFD (variable frequency drive) is needed to operate the induction motor in multiple state (Like controlling speed ,voltage, on/off) etc. A part from speed selection, the efficiency of the overall system is increased because the motor takes the necessary amount of input power to achieve the desired output power. Also it eliminates large start up current spikes and motor can be start slowly with increasing the speed for simplicity purpose the motor VFD (Variable frequency driver) is divided into two parts AC-DC and the DC-AC convertors.

The first stage of this project creates DC source which is required to stage two of project. In the second stage, the PWM (pulse width modulation) is used to reconstruct the original AC signal. The DC-AC convertor (H-Bridge) is controlled through arduino Uno microcontroller with PWM.

In this case, the fully controlled by directional MOSFETs are used as a H-Bridge function. In this case, the

PWM signal is produced based on the toggling of switch on/off.

The output of motor driver is fluctuating frequency with PWM signal. This frequency changes according to the input to the arduino Uno. The frequency of output power changes with potation meter (Analog control). The PWM signal helps and allows the less switching time for the switch (MOSFETs) and less power loss at output. PWM signal acts as a low pass filter when fed to the motor because there is no slipping in the current and operates smoothly.

## II. METHODOLOGY

### A. System Overview

The code used for construction of PWM sine wave is based on the potentiometer. The potentiometer divides the voltages. Look up table is used to read program fastly and produce series of pulses high and low.

The program is occurred when keeping the transistor in the ON state. The solution of this problem is to use MOSFET driver.

The pulses come from new PWM signal directly given or fed in the driver and driver circuitry takes logic level input and control the output which goes to the MOSFET gate.

### B. Block Diagram-

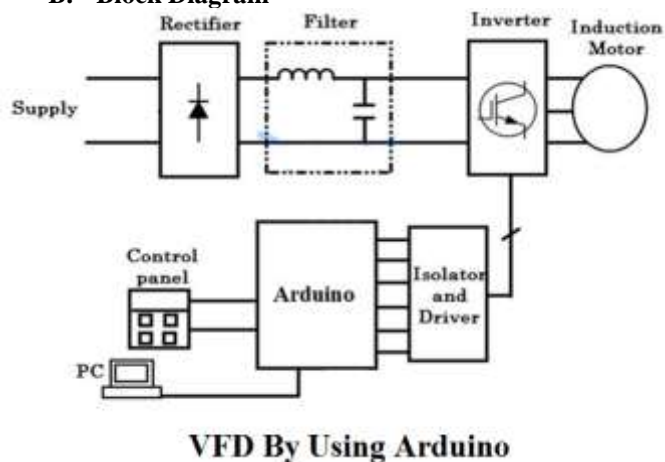


Figure 1: Block Diagram of System

### a. AC – DC Converter

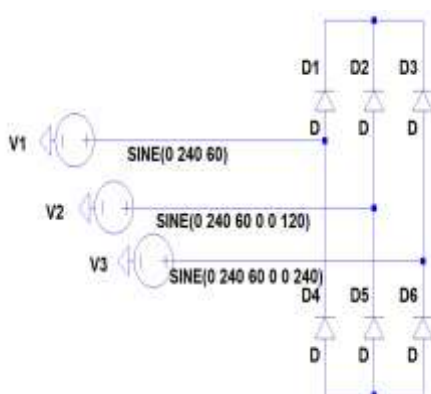


Figure 2: AC – DC Converter

The first stage of VFD is to convert ac signal into dc signal and send positive signal to capacitor bank. The full wave rectifier is connected as shown below.

The rectifier contains the semiconductor device having rating 240 volts and this signal is given to the capacitor bank having 340 volts.

### b. DC – AC Converter

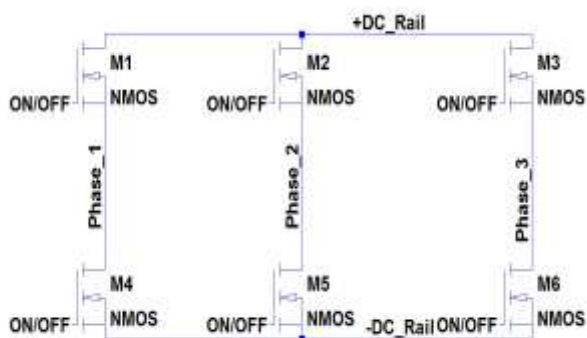


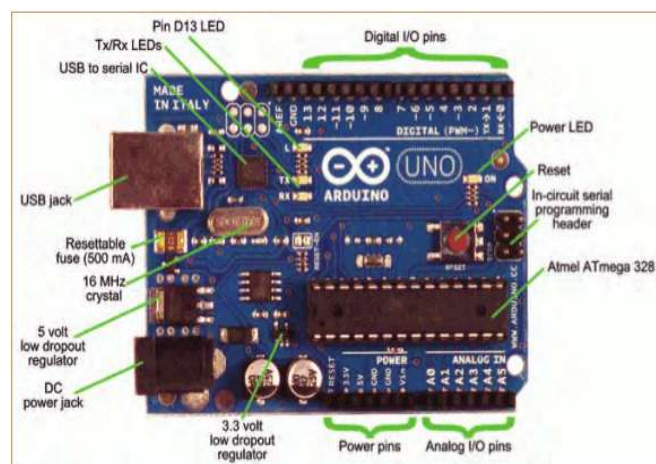
Figure 3: DC – A.C Converter

The dc-ac converter circuit or H-bridge converter using six N-channels MOSFET is used to convert dc signal into PWM ac signal the circuit is as shown in below figure. The PWM signal from driver is given to the gate of MOSFET. Each MOSFET has gate connection and connected separately.

### c. DC – AC Controller

The circuit is operated on the triangular wave having frequency 1 kHz and a sine wave having frequency 40 Hz, 60 Hz and 70 Hz through a comparator circuit. The comparator having the output of PWM signal.

### d. Arduino UNO



Arduino UNO microcontroller is used to operate gate MOSFET with logic output of 5 volts. The turn on time of signal is determined by the look up table. The device arduino UNO is as shown in figure.

### e. Implementation



In this project the advanced technique Arduino Uno is used which is different from past VFD (Variable Frequency Drive). The Disadvantage of past VFD is to only turn ON/OFF motor. This problem is overcome through this

project. In this case, the VFD can Change speed, increase efficiency, and save power.

#### **f. Result**

In this system, for controlling the speed of motor the arduino software is used. The PWM signal is controlled through code and driver. The speed of motor changes according to the user and potentiometer displacement.

### **III. CONCLUSION**

The circuitry is designed and developed as per needed for the driver. The difference between the H-bridge in text book and actual one is ability to select the frequency output.

In this the microcontroller provide the initial control signal as digital and analog circuit processes the original signal into control signal.

The VFD drive circuit drives the bridge rectifier, capacitor bank and H-bridge inverter.

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