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Variable Frequency Drive For Speed Control Of Single Phase Induction Motor

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Abstract - In this project frequency is used for controlling the speed of Induction Motor. The variable frequency drive controls the frequency which is faded to the Induction Motor. The multi speed operation and multi purpose operation are provided by controlling the speed of the Induction Motors. This project paper presents analysis of single phase induction motor using Arduino and IGBT at the inverter power stage with frequency control as a controller. The inverter is one of the basic requirements for induction motor speed control by variable frequency method. The inverter traditional control methods is modulated using Arudino which control the whole operation of the proposed scheme, a good control of frequency and smooth speed control been conducted from the scheme. The cost of modulated scheme is less.

Keywords: Arudino ,IGBT, Opto isolator, rectifier, diode, inverter, Mosfet Drive, Speed control, Induction Motor, Software.

1. INTRODUCTION

A single phase induction motor is inherently not self-staring are often shown easily. When power supply for the stator is switched on, an AC flows through the stator winding. This sets up an alternating flux. By electromagnetic induction e.m.f.'s are induced within the rotor conductors. Since the rotor forms a loop , currents are induced within the rotor bars. thanks to interaction between the rotor induced currents and therefore the stator flux, a torque is produced. it's readily seen that if all rotor conductors within the upper half come under a stator N pole, all rotor conductors within the lower half come under a stator S pole. Hence the upper half the rotor is subjected to a torque which tends to rotate it in one direction and therefore the lower half the rotor is acted upon by an equal torque which tends to rotate it within the other way . the 2 equal and opposite torques wipe out , with the result that internet driving torque is zero. Hence the rotor remains stationary. Thus the only phase motor fails to develop starting torque.

Induction control is complex thanks to its non linear characteristics. However there are different methods for control, Variable Voltage Variable Frequency (VVVF) or V/F is the most common method of speed control in open loop. This method is most suitable for applications without position control requirements or need for high accuracy of speed control. V/F control can be implemented by using low cost PIC micro controllers rather than using costly Digital Signal Processors (DSPs). In this application we will generate a PWM using software, using a general purpose timer and an I/O pin resource that are readily available on **Arduino Uno ATmega328P.**

2. OBJECTIVES

The variable frequency drive and all the induction motor can controlled simultaneously by connecting these

motors to the drive. However many applications need variable speed operations. where input power is directly proportional to the of motor speed. This means that the motor user can replace an energy inefficient mechanical motor drive and control system with Variable Frequency Drive (VFD). The VFD not only controls the motors speed but can improve the motors dynamic and steady state characteristics as well. Although various induction motor control techniques are in practice today.

The most popular technique is by generating variable frequency supply which has constant frequency ratio. This technique is popularly known as VF control. An induction motor's speed empowers influenced by the supply frequency, alter the number of motor stators, alter the control input. The drive can vary the frequency to be higher than the normal line frequency, meaning the speed can be increased beyond what the motor. The circuit required for this method is simple to implement and cost effective.

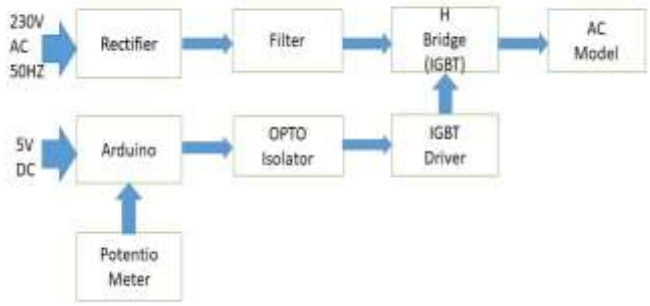


Figure1 : Block Diagram

VFD are often wont to operate the motor at different levels smoothly. Depending upon the appliance , we will use a manual system through a potentiometer, through PLC or controller. we will also fix the speed at an equivalent level. The Variable Frequency Drive comes with many safety features for Motor and VFD itself. just in case of any problem with the motor, it forces the operation to prevent , until the fault is gone. This ability not able to safe working without spending on additional safety components.

3. OVERVIEW

3.1 Operation System :

The idea is to first get two 230VAC to 12VDC converters and by obtain two 12V supplies (12V_1 and 12V_2). Once we've 12VDC, we will take a glance a the rectifier.

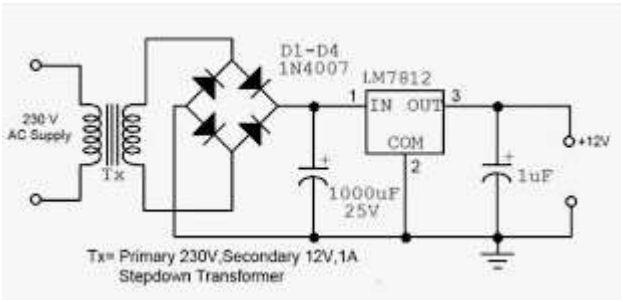


Figure2 : 230vac to 12vdc convter

employing a full bridge rectifier we get 330V and store that within the U8 capacitor This must be a high voltage capacitor. Once we've 330VDC stored, we use the IGBT bridge to make high voltage AC square waves at the output. To control the IGBTs, we use the MOSFET drivers and to separate the signal from the Arduino and the drivers, I want to use the optocoupler.

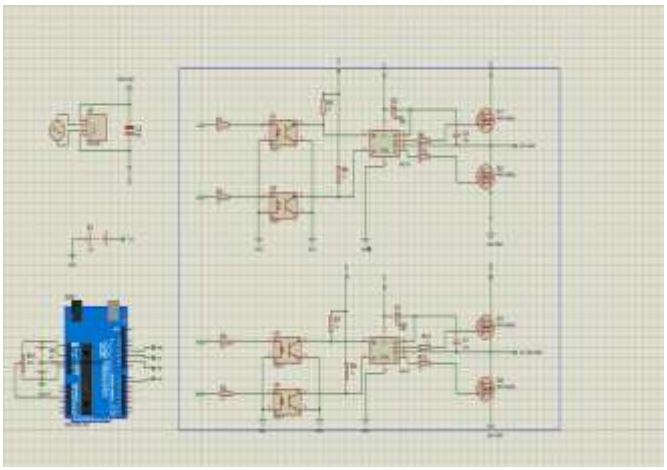


Figure3 : Circuit Diagram

So why rectify the voltage then make it AC again? Well, during this way, we are on top of things of the output frequeny because we'll control the inverter IGBTs bridge. just in case of the 230VAC from our home outlet is simply a hard and fast frequency, on 50 and60Hz.

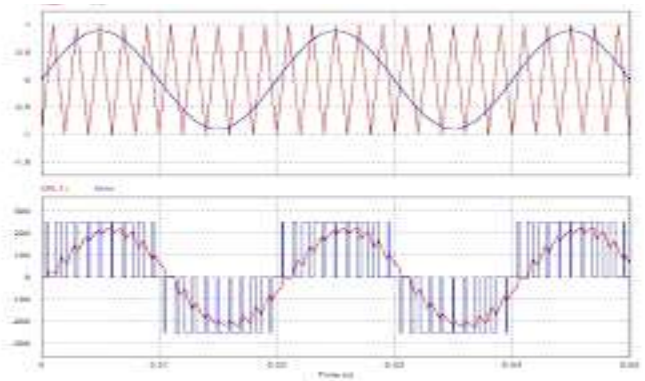


Figure4 : SPWM Signal

the thought is straightforward but to urge good results isn't . This circuit has both rectifier and inverter circuits and for that see the on inverters and find out how the work. But basically, we've 230VAC input and that we first rectify that and obtain DC voltage of 330V and store it inside capacitors of high voltage. Then we use the inverter circuit and make AC voltage from that 330V DC. The output might be a square wave or even a wave just in case of using SPWM signals. For that see more on this.

3.2 V/F Control Theory:

As we will see with in the speed- torque characteristics, the induction motor draws the rated current and delivers the rated torque at the bottom speed. When the load is increased (over-rated load), while running at the base speed, the speed drops and the slip increases. As we have seen in the earlier section, the motor can take up to 2.5 times the rated torque with around 20% drop in the speed. The torque developed by the motor is directly proportional to the magnetic flux produced by the stator. So, the voltage applied to the stator is directly proportional to the product of the stator flux and angular velocity. This makes the flux produced by the stator proportional to the ratio of the applied voltage and frequency of supply by varying the frequency, the speed of the motor are often varied. Therefore, by varying the voltage and frequency by an equivalent ratio, flux and hence, the torque are often kept constant throughout the speed range.

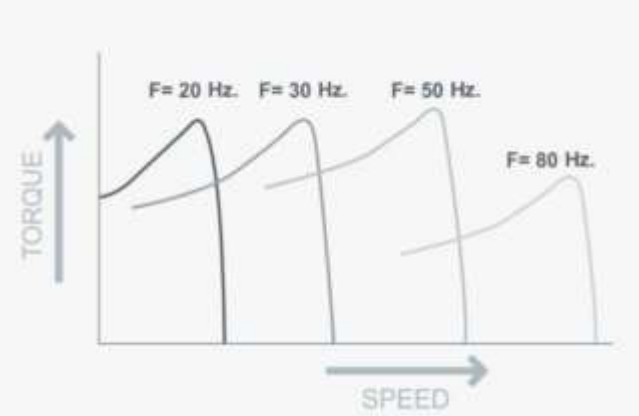
$$\textit{Stator voltage (V)} \propto [\textit{statorf lux}]\times[\textit{AngularVelocity}(\omega)]$$

$$V \propto \varphi \times 2\pi f \varphi$$

$$\propto V/f$$

his makes constant V/f the foremost common speed control of an induction motor. Figure shows the relation between the voltage and torque versus frequency. Figure 3 demonstrates voltage and frequency being increased up to the bottom speed. At base speed, the voltage and frequency reach the rated values as listed within the nameplate. we will drive the motor beyond base speed by increasing the frequency further. However, the voltage applied can't be increased beyond the rated voltage. Therefore, only the frequency are often increased, which ends up within the field weakening and therefore the torque available being reduced

Hence, the torque curve becomes nonlinear with respect to speed to speed or frequency.



4. ADVANTAGES

- The Variable Frequency Drive can be advantageous in many ways depending upon the particular application in which it finds its application.
- Variable Frequency Drive can perform many functions for the motor.
- External Potentiometer: External potentiometer is used to control the VFD's output, which directly controls the motor's speed.
- We can replace the VFD without any substantial and time-consuming procedure.

5. CONCLUSION

This project attempts a new speed control technique for the single-phase ac induction motorThe PWM operation is controlled by a Arudino. PWM generated in software and output to a port pin. Voltage to an AC output voltage.V/f Control used a Proportional Controller to process the error between the actual rotor speed and reference speed and used this to vary the supply frequency

6. REFERENCES

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