# Microcontroller based Six pulse Bridge converter fed DC motor drive.

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**ABSTRACT:-** *The thyristor based three phase bridge converter is use in high-power requirement in industry as well as transmission . A six pulse open loop bridge converter fed ½ HP,220V, 3Amp DC shunt motor drive is designed, hardware implemented and tested. The experimental results obtained are shown to be in good fulfillment with theory. This is smooth and adjustable speed control scheme can solve the problems of zero crossing miss by experimental test.*

*Keywords— DC motor drives, Microcontroller, Speed control, Temperature control*

## 1. INTRODUCTION

Thyristor based three-phase bridge converter is widely used in the industry for controlling dc motor drives and HVDC. Controlled rectifiers offering power conversion from ac to dc are reliable and have higher lifetime compared to other converters. DC motors have higher torque than ac motors and hence are suitable for variable speed applications. By controlling the firing angle we can control the speed. Although the operation of controlled rectifier is simple, the realization of the converter control circuit is complex in nature. The control circuit needs the basic functionalities like (i) Six state pulse generation and gate drive isolation, (ii) Synchronization of the control pulse to the power frequency or zero crossing, (iii) Smooth transition in phase angle control, (iv) Startup control.

## 2. THE BRIDGE CONTROLLED RECTIFIER

The bridge converter is designed with silicon-controlled-rectifier (SCR) modules. voltage. The structure of the bridge converter is shown in Fig.1. Three phase mains are connected to the ac inputs A,B and C for phase-A, phase-B and phase-C respectively.
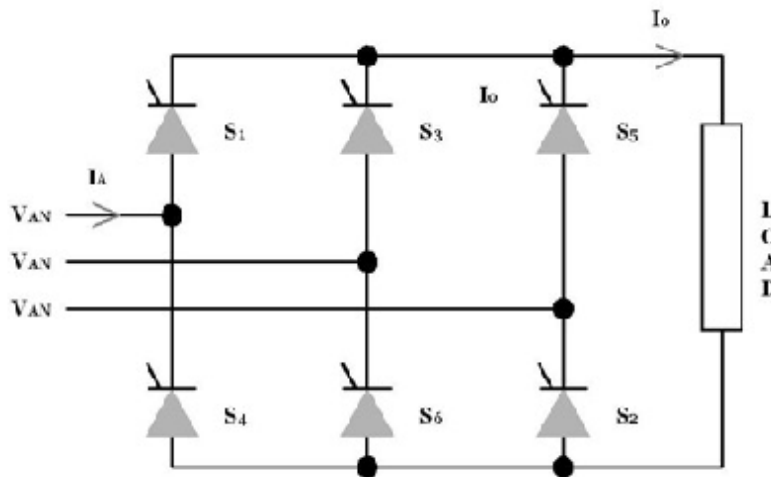


Fig.1 Thyristor based bridge converter structure

Here three phase bridge rectifier structure is shown as above. For initial base of testing I put resistive load like lamp and checked variation of its intensity by varying input voltage. Then connect dc shunt motor as load and by varying firing angle we can control speed of motor. This is open loop drive. At a time two scr are fired and they are turn off by force commutated using microcontroller programming. Here for different firing angle waveform shown below.
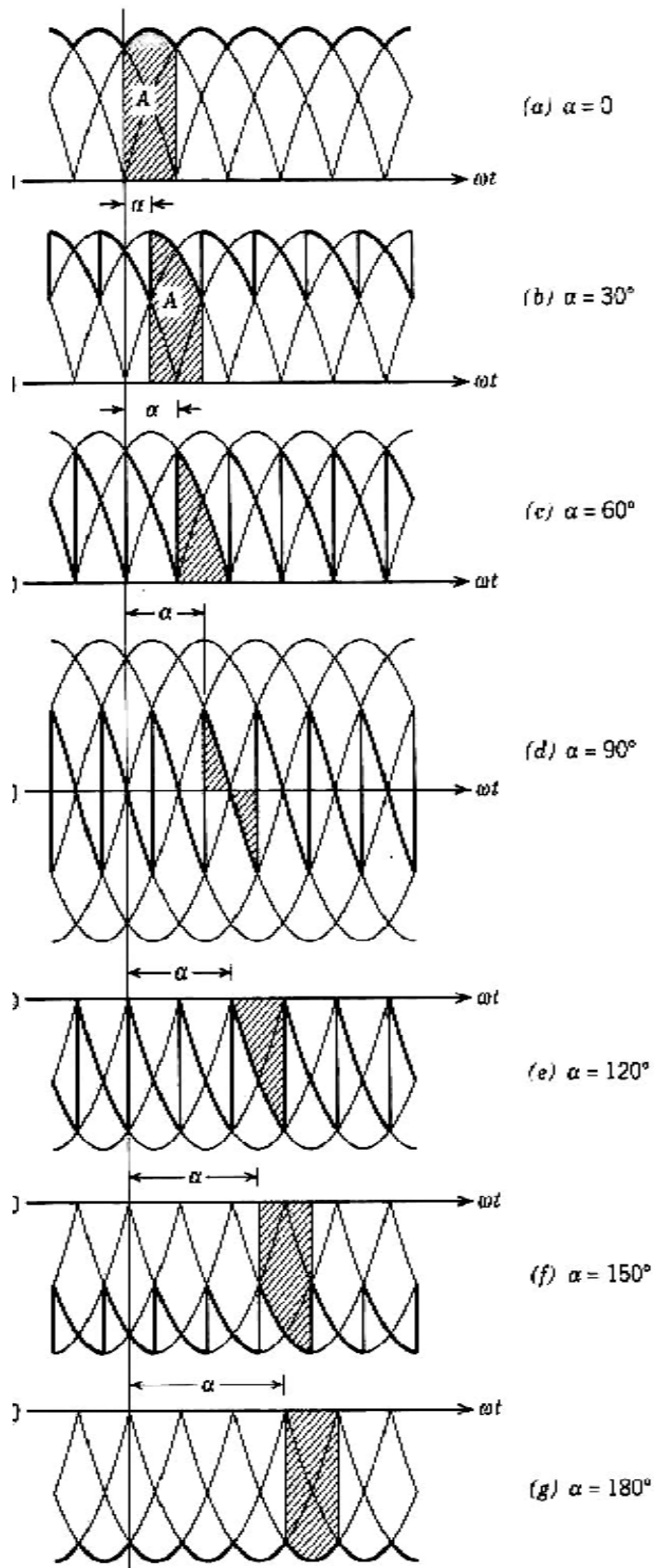
Fig 2 Voltage wave form of bridge converter

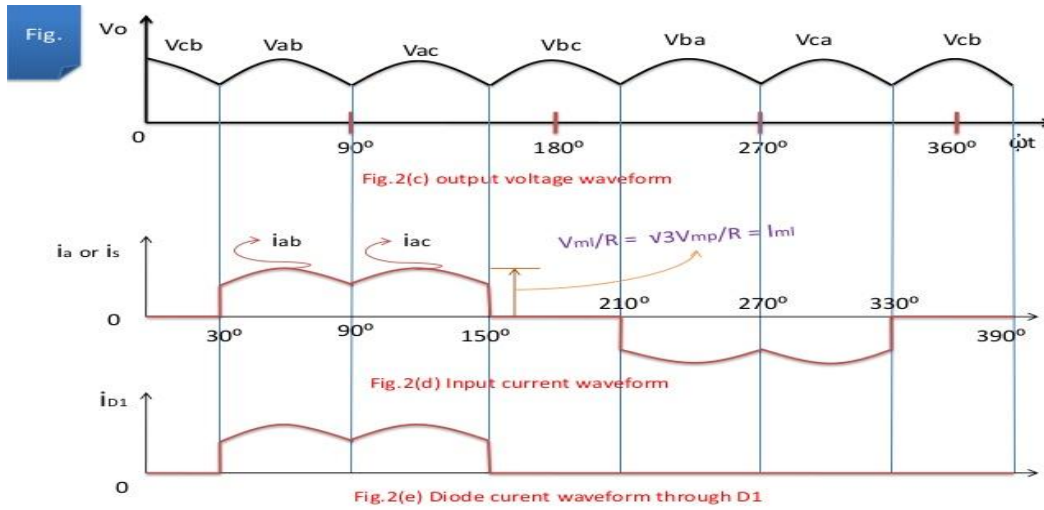2.2 Current waveform of bridge converter.



Fig 3 Current wave form of bridge converter

Torque speed characteristics of dc shunt motor is shown below. Here starting torque is not high and as we know that armature torque is directly proportional to armature current. As motor run from no load to full load speed reduces very less. So generally this motor use as constant speed drive.
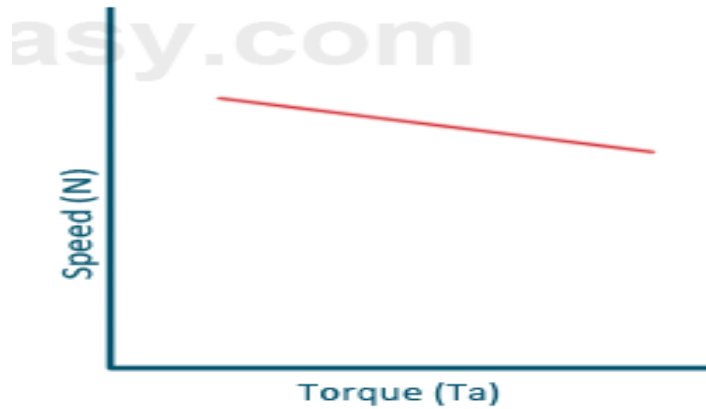


Fig 4 Torque speed characteristics of dc shunt  motor
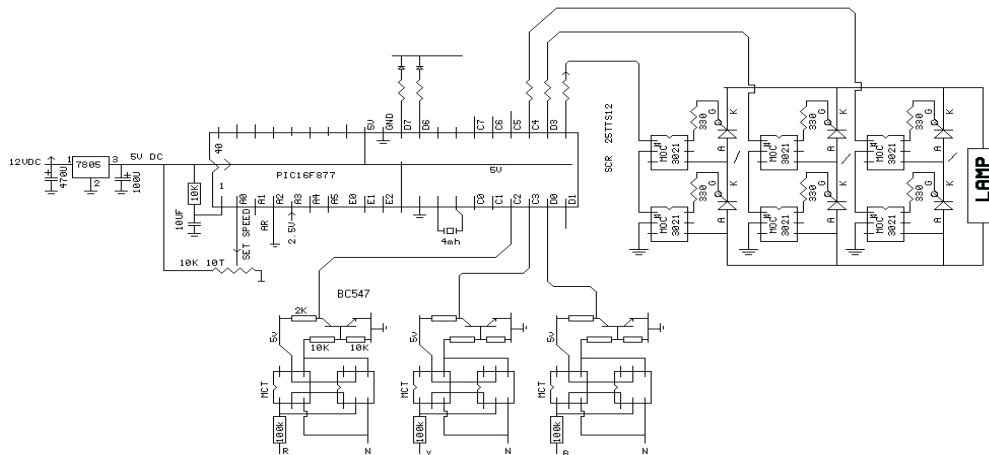
2.3 Schematic diagram of dual converter



Fig 5 Schematic diagram of dual converter

Above schematic diagram shows the open loop speed control of dc shunt motor drive.By varying variable port we can control output voltage.The hardware control system includes the DC motor, power circuit, PIC16F877A microcontroller. In this paper, a new approach is proposed where a MOC 3021 IC work as drivers for Converter and provide isolation. Micro controller is continuously firing 12 SCRs and firing angle is varied by the variable port. Three references are fed to the microcontroller. MCT is used to provide isolation from the line and it converts the sine wave to square wave, so zero crossing is done. It is observed that PIC16F877 is driven from a 20MHz clock because it continuously fires 12 SCRs. So high frequency crystal is required.Here dc shunt motor is half HP,220V and 3 Amp rating.

There are two methods of speed control of dc shunt motor.Emf equation of motor is

$E_b = {}^{P\text{Ø}NZ}\!/_{60A}$

$N \propto E_b$

$N \propto 1/\text{flux}$

1. Flux control method
2. Armature control method

Flux in dc shunt motor is constant so I applied armature control method.As we know that

$E_b = V - I_aR_a$ Where I and R is armature current and armature resistance. Drop is very small which is 5% to 15% of full load speed so its value is very less.so we neglected it. From this we can say that E directly proportional to V. Variable voltage applied and we can control the speed. Here voltage can be varied by variable port.
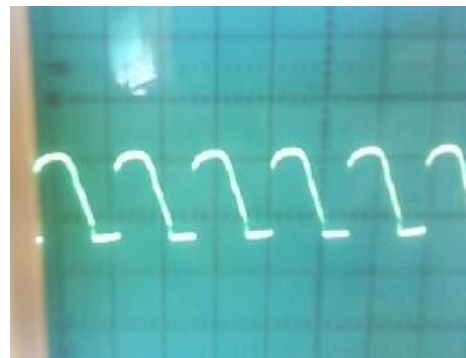
## 3. FLOW CHART

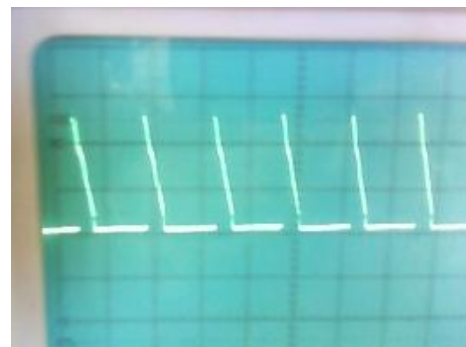3.1 Flow chart of  fully controlled bridge rectifier:-
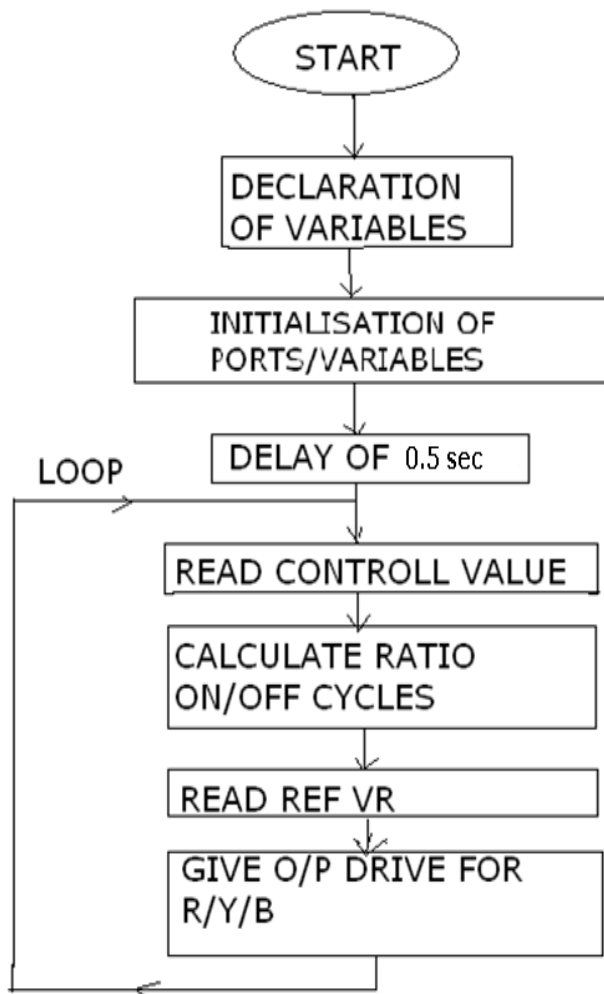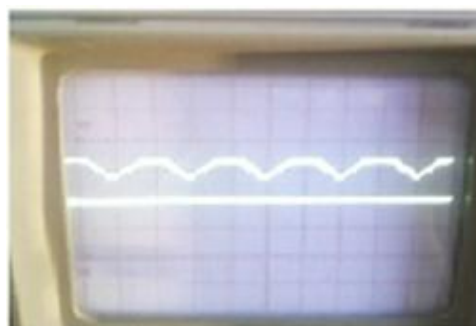
**RESULT**
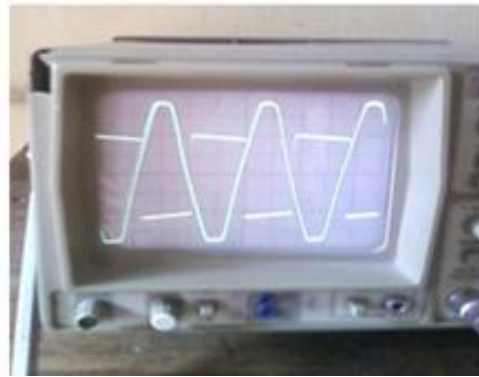


Zero crossing detection.



Increased value of firing angle



more Increased value of firing angle



Output voltage of rectifier

**RESULT WITH LOAD:**

| NO. | FIRING ANGLE | O/P VOL | SET SPEED | MES SPEED |
|---|---|---|---|---|
| 1 | 0 | 210.19 | 220 | 220 |
| 2 | 30 | 181.19 | 220 | 218 |
| 3 | 45 | 149 | 220 | 215 |
| 4 | 60 | 105 | 220 | 211 |

The proposed converter and the controller are built and tested in the laboratory . The converter is also tested as part of the ½ HP dc shunt motor drive. The controller functions properly as per theoretical expectations and offer smooth operation increase or decrease of speed and constant motor speed operations are also tested and verified at no load conditions. The rectifier output voltage is shown above.

## CONCLUSION

 The 16F877A microcontroller can control speed of a DC motor accurately with minimum hardware at low cost. The microcontroller based adjustable open-loop DC motor speed controller using bridge converter system has been developed. The results showed that the microcontroller is a reliable instrument to control the motor. Thus it can be concluded that the present system is a reliable adjustable drive system for DC motors.

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