

# Hardware Implementation of Single Phase Rectifier Fed to Motor

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## ABSTRACT

Hardware implementation of single phase rectifier with reduced harmonics using force commutated power electronic semiconductor switch that is Insulated Gate Bipolar Transistor (IGBT) and diode is reported in this paper. This rectifier has feature of providing a variable DC output voltage with less harmonics and fluctuation.hence we able to run different equipment which are connected in output by varying voltage. Here we use the arduinouno microcontroller to provide a gate pulse.The output signals which we get across the arduinouno get fed to lcd through the data transfer pins and output gets displayed on lcd

**Keywords :** Single phase rectifier,Pulse Width Modulation, Total Harmonic Distortion.

## I. INTRODUCTION

The selected topology is IGBT based full bridge configuration using PWM technique. PWM technique rectifier is used to achieve unity power factor and reduce the generation and also the effects of harmonics. Mainly single phase rectifier consists of a second order harmonics and fluctuation in voltage level. The problem of voltage fluctuation affects the high power consuming applications such as railway traction drives. Traditionally rectifiers using diodes are used in industries but that rectifiers contains high harmonics and low power factor and also has a fluctuation in DC output voltage. In order to overcome these disadvantages, the diode rectifier is replaced by IGBT rectifier using PWM technique.

Conventional diode bridge rectifier has poor power factor because of peaky current drawn from the utility. This current contains large harmonics

components which are injected into utility supply. If vast number of such converters having high value of THD were to be used in industries. The harmonics that would be injected in the utility would be quite leading to increase volt-ampere ratings of the utility equipment. In this topology the main advantage of PWM technique is that the power loss in the switching devices is very low. When the switch is off, there is almost no voltage drop; hence the power loss is less because power is product of voltage and current. DC source are mostly used in the industries for the different machine applications. The DC appliances are mainly microelectronics, electronic ballasts, DC motor drives, battery charging and power conversions, fuel cells, wind mills, wind turbines that have permanent magnet alternator etc. Rectifier should provide an output voltage that should be as smooth as possible. The AC component is made up of several dominant harmonics. It is more so in single phase rectifier with R load. Harmonics are reduced by

capacitor filter (C-filter), inductor filter (L-filter), inductor capacitor filter (LC-filter).

## II. SYSTEM BLOCK DIAGRAM

A 230V AC is applied to the input to the system. IGBT is used as a switch which is used to provide a variable voltage output. A rectifier is convert correspondence AC into DC. Arduino controller read the output voltage from feedback circuit. A feedback circuitis convert output high voltage into low voltage as per define. Gate triggering circuit is used to amplify and coupling the signal from controller to IGBT.16x2 alphanumeric LCD is used to display the output voltage. A variable resistor is used to define or required output voltage as per rotation/resistance.

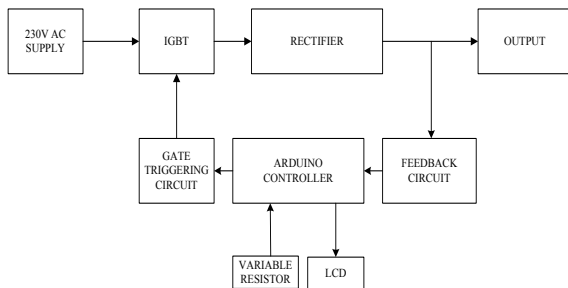


Fig.1. System block diagram

## III. HARDWARE CIRCUIT DIAGRAM

The working of hardware circuit is basically divided into four different parts

1. Supply circuit for LED.
2. Arduinouno circuit.
3. Main supply and switching circuit.
4. Voltage and current sensor circuit.

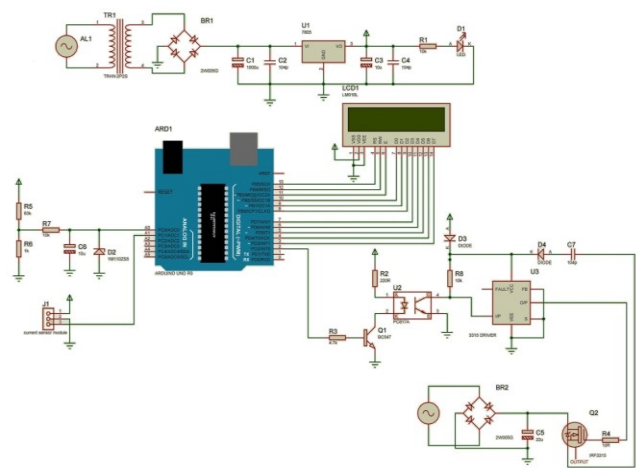


Fig.2 Hardware circuit diagram of Single Phase Rectifier

### 1. Supply Circuit for LED

A 230 V AC voltage is given to the 0-12V step down transformer which converts 230V into 12V AC. Then 12V is given to bridge rectifier which consists of 4 diodes in bridge form. Bridge rectifier is used to convert AC to DC voltage then voltage flows through capacitors C1,C2,C3 and C4. Where C1 and C3 are used to filter out fluctuation in voltages and C2 and C3 are used for noise filtration and radiation .Then after 7805 IC is used to convert 12V to 5V which is given to 10KΩ resistor to resist the flow of current which in result glow the LED which require 100mA current. LED shows that the supply circuit is properly running.

### 2. Arduino Uno Circuit

Arduinouno is the microcontroller which contains IC Atmega 328. Arduino is the open source development kit which is usually available to integrate both hardware and software part. Arduino is 14 pin IC which consists of 6 PWM,6 analog/digital and 2 input output pins.Arduino is linked to LCD. We have done programing in ARDUINO IDE software to display current and voltage that we got across the output on LCD.

### 3. Main Supply and Switching Circuit

A 230V main supply is given to bridge rectifier which converts AC voltage to DC voltage. That DC voltage is

fed to 22 $\mu$ f capacitor which is used to smooth out pulsating voltage into pure DC voltage. A DC voltage is given to optocoupler which emits light energy to secondary and provide electrical signal to IGBT driver and the output signal gets combined with the main supply part signal and combined signal drives the IGBT. IGBT provide variable DC output voltage.

#### 4. Voltage and Current sensor circuit

The output which we get across IGBT in form of voltage and current is sensed by using voltage and current sensor unit. Voltage divider circuit which consist of arrangement of resistor is used so that voltage across the microcontroller arduino should not exceed the limiting value to protect arduino. Finally the voltage and current sensed by voltage and current sensor unit is displayed on

#### Controller

The ArduinoUno is a microcontroller board based on the ATmega 328. It has 14 digital input/output pins (of which 6 can be use as PWM outputs), 6 analog input, a 16MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the micro controller, simply connect it to a computer with a USB cable or power it with a AC to DC adapter or a battery to get started. The UNO differs from all preceding boards in that it does not use the FTDI USB- to- serial driver chip. Instead, it features the ATmega16U2(ATmega8U2 upto version R2) programmed as a USB-to-serial converter. TO ENSURE A HIGH-QUALITY PRODUCT, DIAGRAMS AND LETTERING MUST BE EITHER COMPUTER-DRAFTED OR DRAWN USING INDIA INK.



*Fig.3. Arduino Uno*

#### Specifications

- Microcontroller ATmega328p
- Operating voltage 5V
- Input voltage 7-12V
- PWM input pins 14 pin
- Flash memory 32kB

#### IV. RESULT

The variable output of single phaserectifier is between the range of 90V to 280V DC. So that one can run any dc motor between this voltage rating. And the result of hardware on Digital Storage Oscilloscope (DSO) is given below.

1. Gate pulses at minimum voltage( 90V)
2. Gate pulses at medium voltage (180V)
3. Gate pulses at maximum voltage (280V)

#### V. CONCLUSION

From the above result that we got on Digital Storage Oscilloscope (DSO) we found that the total harmonic distortion is less as compared to available single phase rectifier in market. We also compared the THD results our rectifier with THD of other rectifiers of different company which is given in the table below.

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