

Control of Wind Turbine with Induction Generators

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Abstract: *The recently increasing of energy demands from Asian countries and world face the problem of energy due to many undesired effects; Primary, the world economy is based on fossil fuels and mainly oil prices have double in last five years and Secondary, environmental threats and greenhouse gas effects are increasing then we have to focused on the renewable energy like wind energy. This paper provides the controlling of wind turbine with induction generators interfaced to grid with power electronics converters is best for the wind turbine power because the induction generators provides constant frequency and voltage to grid with power electronics converter technology. It also improves the power performance of the wind power turbines for grid because it reduces the all harmonics and noise from the grid. In this project, using of PWM technology with transformer topology to convert DC voltage to AC voltage to grid, simulation of wind turbine interfaced to induction generators by use of variable speed dc motors, combining power output of induction generators to charge common dc bus bar and also using feedback mechanism to sense output ac voltage and control by PWM technology with duty cycle correction.*

Keywords: microcontroller, wind generator, induction generators, induction motor, MOSFETs etc.

1. Introduction

The recently increasing of energy demands from Asian countries and world face the problem of energy due to many undesired effects. Primary, the world economy is based on fossil fuels and mainly oil prices have double in last five years, increasing the price of oil from 60USD/barrel in 2008 to 110USD/barrel in the beginning of 2014. In addition, this is a forecast that the fossil fuels will still be available in 2030 to 2050. But due to imbalance between energy supply and energy demand that will eventually lead to exhaustion of fossil fuels and these issues could lead to a higher economic crisis. Secondary, environmental threats and greenhouse gas effects are increasing then renewable energy is the best option to reduce these problem like wind energy, solar energy etc. This system is specially made for the wind energy to controlling of wind turbine with induction generators interfaced to grid with power electronics converters.

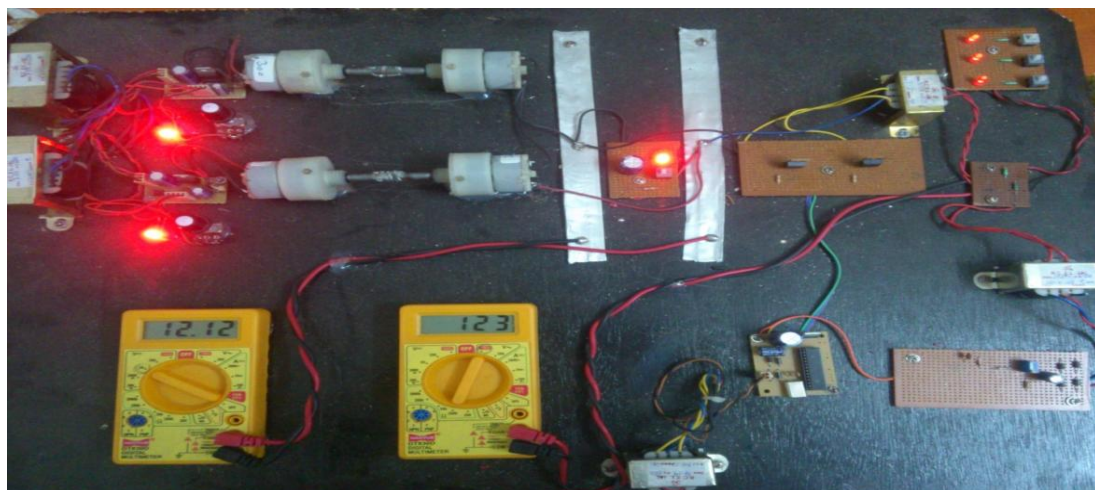
2. Literature Survey

From this paper, the electrical energy consumption rising recently and increasing the energy demand of power capacity. The power distribution, production and using of

energy should be new technology efficient equipment, which are save the energy from distributor to end users. In this paper, discussed about the power electronic applications for the wind turbines technology and this paper provides the modern power electronics technology has been developed and received with very briefly. The power electronics applications use in various wind turbine power generating systems, offshore wind farms and also showing that the performance of wind turbines and improvement of the wind turbines performance by using power electronic technology. The power electronics technology has been able to contribute to the voltage control and frequency by means of reactive power control and active power control. This paper also provides the power scanning of this wind turbines and it is important to reduce the energy cost level of the wind turbine power generating systems.

3. Experimental Setup

The aim of this experiment is to use the Wind energy as an power source because nowadays the demand of fossil fuel is become gradually increased and other sources are on hike such oil price and non-conventional sources of energy.



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4. Methodology

In this paper, we have discussed about the working of this system from starting the system takes power from ac main supply and it converts ac to dc power with the help rectifier, which is converted ac to dc voltages for the variable speed dc motor and the speeds of motors can be varied from variations of variable resistors. Dc motor takes power from mains and runs as a variable wind turbine and dc motors are connected to dc induction generators with help of shaft of dc motors. Both Dc Generators generates dc 12V voltage, which are connected in series to constant dc bus bar and bus bar's voltage connected to Digital Multi Meter which is showing 12V dc. The bus bar's positive terminal is connected to transformers and other terminals of this transformer are connected to microcontroller for the controlling of ac voltage with the help of MOSFET IRF540. The step up transformer boosts the 12V dc to 220V ac voltages, which is showing on the Digital Multi Meter. Again step up transformer is connected to step down transformer AC voltage 220v to 12V voltage DC and this 12v dc voltage is connected to PIC16F73 microcontroller's port PA0 with the help of potential divider and variable resistors for the protection of microcontroller and this voltage again connected to MOSFET to step up transformer to grid with the help of power electronics converters. The power electronics converters most efficient device for the wind power conversion system and in this project capacitors are used for the working as filters and reductions of noise of this system. In this system or project we have also used feedback mechanism to sense AC output voltages and control by PWM technology with duty cycle corrections. The simulation of wind turbine interfaced to induction generators by use of variable speed DC generators and the block diagram of the controlling wind turbines with induction Generators interfaced to Grid with power electronics a system, which is shown in below

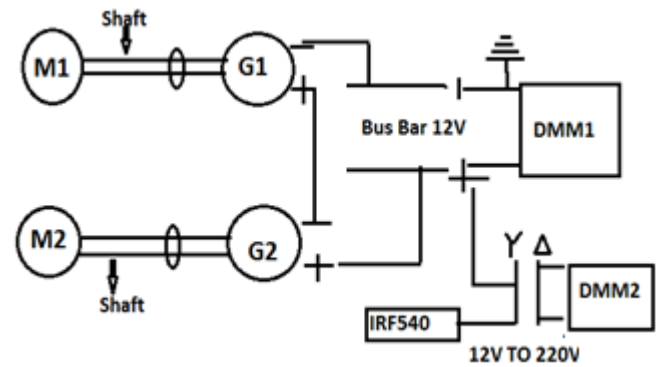


Figure 1: Block diagram of this system

5. Waveform and Discussion

Output Waveform and Discussion of Control of Wind Turbine with Induction Generators Interfaced to Grid With Power Electronics Converters with PWM Technology

This chapter provides the waveform and discussion of control of wind turbine with induction generators interfaced to grid with power electronics converters and also provides the duty cycle waveform which was taken from the CRO with pulse- with- modulation PWM technique.

First, we have taken graph between the voltages vs. time in seconds from PWM switching device to controlling over loading condition and variation of duty cycle show the fluctuation of voltage with time for the different places or different conditions.

Conditions 1

In this condition, we have taken both Generators of the voltage which are connected in series and each generator provides voltage 7.110v with duty cycle is 8.6%. both generators provides 12V in series connection and they are moving with help of dc motors which are connected to the shaft and these motors are variable dc motors, the speed of this motor can be varied with the help of variable resistors and motors takes power from mains supply which is AC voltage but it is stepping down by step down transformer and it is converted ac voltage to dc voltage with the help of rectifiers. The waveform of this condition shown in below



Figure 2: Voltage of the each dc generators
 Condition 2

In this condition we taken voltage of bus bar which is 12.9V and these voltages comes from both dc generators which are connected in series and also the percentage of duty cycle

with the respect of time. The waveform of this condition shown in below

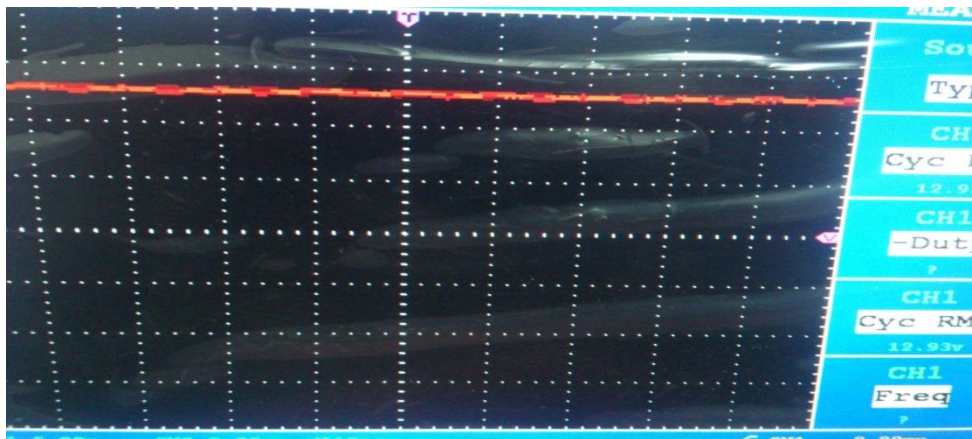


Figure 3: Voltage of the bus bar

Condition 3

In this condition we have taken rms voltage of loading which is taking more voltages and the voltage is one single

load 2.609V and duty cycle of this condition 74.9% and frequency of this condition 50.13. The wave form of this condition shown in below

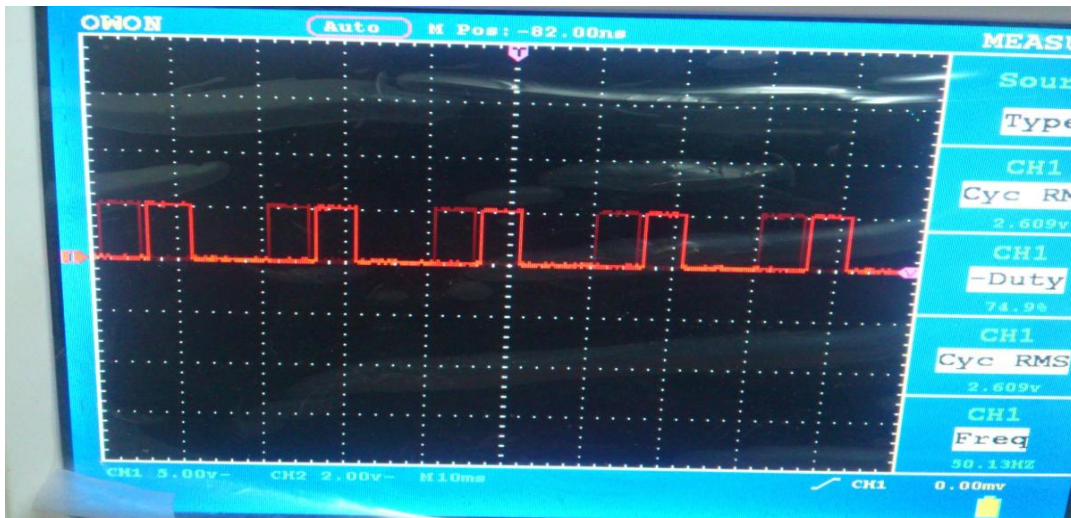


Figure 4: Voltage of load of this system

Condition 4

In this condition we have taken the voltage of variable resistors, MOSFET voltage regulators diodes which is

1.309V and the duty cycle of this system -12.8%. The waveform of this diodes or voltage regulators shown in below



Figure 5: voltage of this MOSFETs and diodes

6. Results

This paper provides the results from all above waveform and discussions; we have found the results of control of wind turbine with induction generators interfaced to grid with power electronics converters are the best for improvement of performance of wind power turbine because the power electronic converter technology reduce the harmonics and noise of this system. The variable speed induction generators provide constant voltage on the bus bar and the DC voltage show on the Digital Multi Meter and the positive terminals of bus voltage is connected to transformer and generates ac 220V for the grid with reduction of noise from line. The ac voltage of grid is show on the Digital Multi Meter which is connected to load with the help of switch and the microcontroller controlling the voltages and frequency of this system. We have taken wave form of this system with the help of PWM technology with CRO and it show the voltage, duty cycle and frequency of this system with respect to time. The power electronics converter also provides the feedback mechanism to sense the output ac voltage and it is controlled by PWM technology with duty cycle correction.

All these noises and harmonics of power supplies are controlling and reducing by microcontroller with the help of other power electronics equipment. So, this system is the best for the wind power turbines to grid.

7. Conclusion

This paper provides the conclusion from all above waveform, discussions and results; we have found the conclusions of control of wind turbine with induction generators interfaced to grid with power electronics converters is best for the wind turbine power because the induction generators provides constant frequency and voltage to grid with power electronics converter technology. It also improves the power performance of the wind power turbines for grid because it reduces the all harmonics and noise from the grid. In this project, using of PWM technology with transformer topology to convert DC voltage to AC voltage to grid, simulation of wind turbine interfaced to induction generators by use of variable speed dc motors, combining power output of induction generators to charge common dc bus bar and also using feedback mechanism to sense output ac voltage and control by PWM technology with duty cycle correction.

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