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Analysis of harmonics in three phase inverter drive with input power generation by Wind Driven Stand-Alone Six-Phase Self-Excited Induction Generator

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Abstract: Harmonics are major problems in PWM drives due to the effects of EMI and High ripple factor derived from the converters, in this paper a study of harmonics and total harmonic distortion of a 3 phase PWM drive has been studied with the power generation by simulation model 6 phase wind turbine, A 6 phase converter converts the power generated by the wind turbine with low ripples, and minimize the effects of power factor. This model is recommended to drive the 3-phase induction motor.

Keywords:

I. INTRODUCTION

Power generation using wind turbine is economical and high efficient than other renewable other energies like solar cells, fuel, etc. The power generated from all sources are very effectively must be utilized for the applications, in power electronic system most of the 60 percent energy is wasted since various conversion of energies for different applications, therefore the use of converters and inverters in transforming energies to the load will generates additional harmonics with fundamental harmonics that does not contribute an extra energy for the load instead it is simply dissipated as heat in the devices, and loads. Therefore the efficiency is deteriorates. In this work a 6-phase wind turbine is configured for the generation of power, the power is effectively utilized to drive the 3 phase PWM inverter drive, the analysis of harmonics at the output of the PWM drive with R and RL load has been done. The use of 6-Phase Converter in the system will deteriorates the ripple factor and hence the Harmonic distortion is less, and also the power factor will be improved.

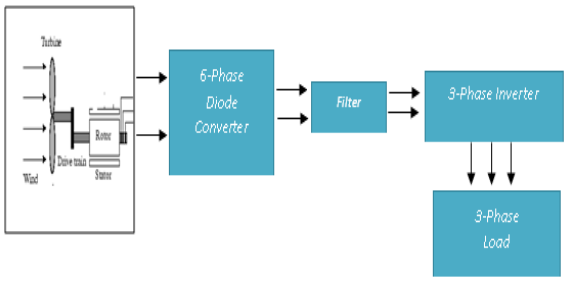

Fig.1 Block diagram of 3-phase PWM inverter drive with 6-phase generator

Power Generation by 6-Phase wind turbine: A model of 6-phase wind turbine parameter is created to drive the system for R load, and RL load, the aim of the work is to study and analyze the harmonics, and total harmonic distortion of 3-Phase PWM drive. The power factor measurement is also done with various R-load and RL-load values.

For experimental purpose the 6-Phase generator with output voltage and frequency has been created.

1. Input voltage= AC 100 V
2. Frequency= 50Hz

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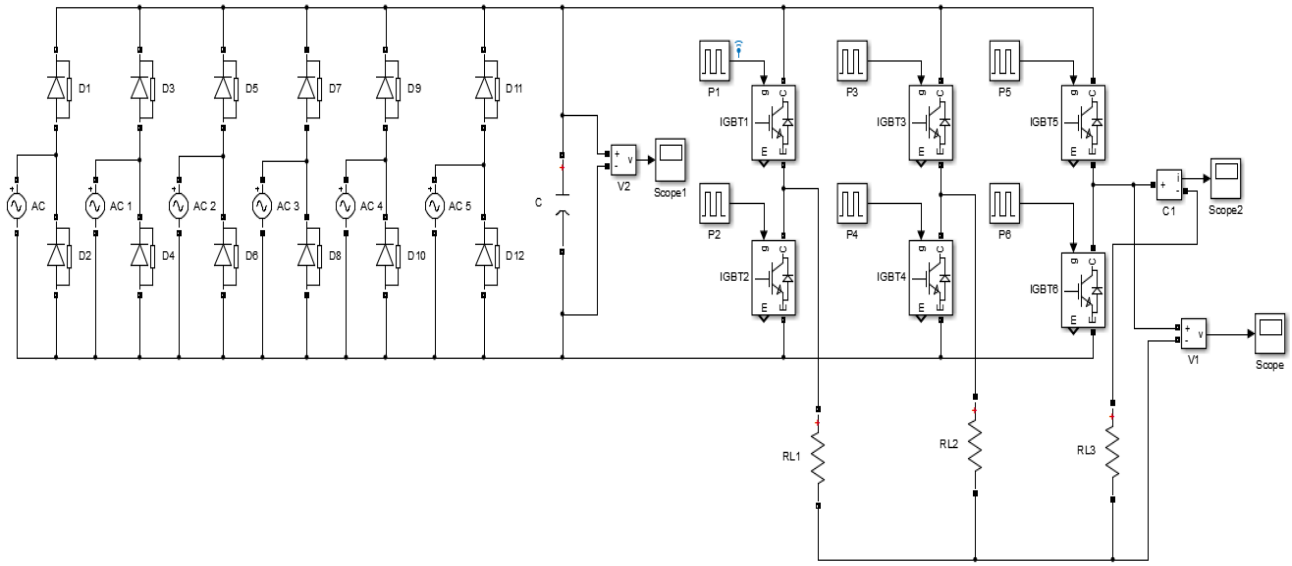

Fig.2 Circuit diagram of 6-phase converter with 3-phase PWM inverter drive

II. SIX PHASE CONVERTER

A six phase converter is constructed with Power Diodes with 6 leg in each leg two diodes are employed to convert the ac voltage generated by wind turbine to a DC output voltage with low ripple, however the power generated by the 6-phase generator has high EMI noise and harmonic content, these parameters are sever in poly phase converters and inverters, this may cause the device vibration and high current, hence the excessive heat is generated in the devices and loads. Therefore it is required to be minimized using many techniques, a filter technique, modulation technique and multilevel inverter techniques. The practical use of wind turbine is complex for the power electronic system in generation of power, since the power generated by the wind turbine is depends on the capacity of the wind, if the wind is less the speed of rotation of wind turbine is less, hence the power generated by the wind turbine is also minimum hence in power electronics it is most challenging situation to operate instantaneously with loads, therefore this situation can be over come by designing buck boost converters and inverters. In this work the model has been created and simulated with simulink software for three phase PWM inverter drive, and also the study has been carried out to measure number of harmonics generated at the output of the PWM inverter for R-load and RL-load. Output voltage of 3-phase PWM inverter is also obtained, the harmonic barograph is obtained to identify the dominant harmonics, the power factor is also calculated.

Simulation Circuit Performance and parameters measured: Generation of harmonics and Total Harmonic Distortion has been measured 5^{th} harmonic whose magnitude is 22.66% of fundamental harmonics, also 7^{th} harmonic whose magnitude is 11.29% of fundamental harmonics, these two harmonics are dominant harmonic does not contribute as an extra voltage or current instead it is simply dissipated as heat in the devices and loads, therefore the devices and load is getting heated up, if the load is a Induction motor these dominant harmonics cause many other problems like vibration of rotor and increases the stator current, hence leads to copper loss which intern increases heat in the windings of Induction motor. Therefore these dominant harmonics can be filtered out using low pass filters. This work is to be extended for studying torque speed characteristics and stator temperature analysis of three phase induction motor experimentally.

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III. RESULTS

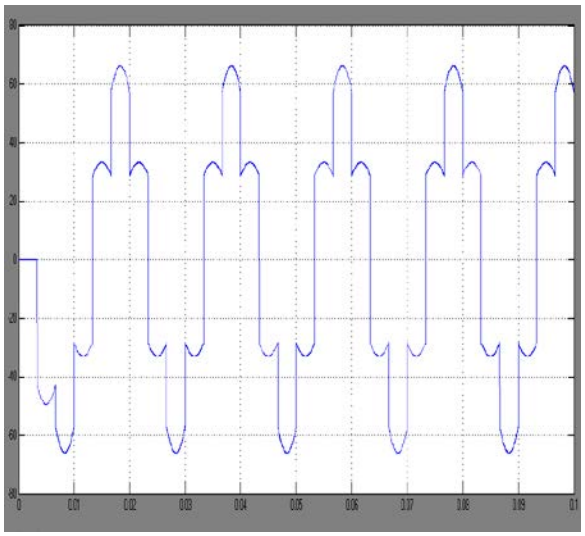

Fig.3 Single phase output voltage of 3-phase PWM drive

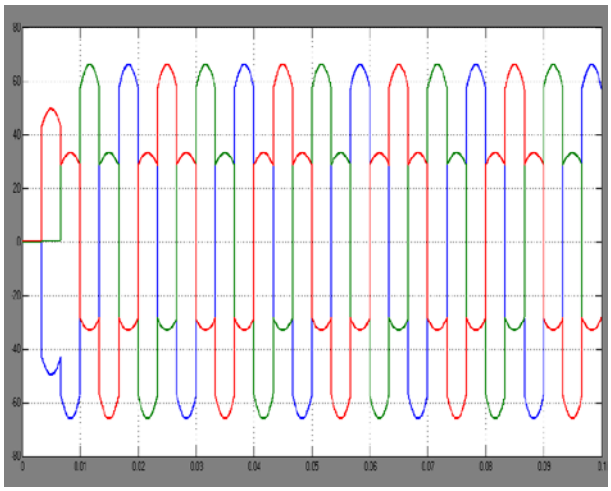

Fig.4 Three phase output voltage of 3-phase PWM drive

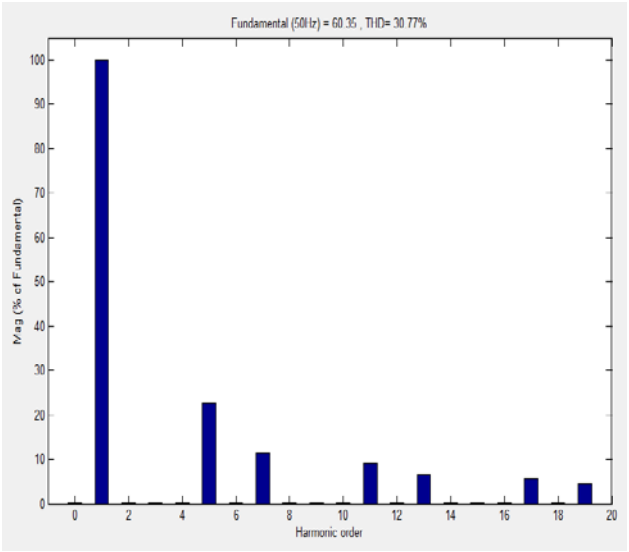

Fig.5 Harmonic Bar graph of 3-phase PWM drive

Table1: Indi Three phase output voltage of 3-phase PWM drive individual Harmonic percentage

Harmonic Order	Percentage presence (%)
1	100
2	0
3	0
4	0
5	22.66
6	0
7	11.29
8	0
9	0
10	0
11	9.05
12	0
13	6.46
14	0
15	0
16	0
17	5.66
18	0
19	4.72

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IV. CONCLUSION

The output response of a three phase PWM drive has been simulated by creating a power source 6-phase generator. The harmonic analysis and total harmonic distortion is also studied and the percentage of dominant harmonics have been determined, this experimental work is utilized to construct and study the stator winding temperature of a three phase induction motor for future work.

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