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INVESTIGATION AND PERFORMANCE ANALYSIS OF MULTI INPUT CONVERTER FOR THREE PHASE NON CONVENTIONAL ENERGY SOURCES FOR A THREE PHASE INDUCTION MOTOR

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Abstract: This paper presents the analysis of hardware And software of a multi input converter for connecting three renewable energy sources to the three phase induction motor. Wind energy, Solar and Ultra/Super capacitors are the three energy sources used as the input. PV cells and the ultra capacitor voltages are boosted before feeding to an inverter which carries to an induction motor. The wind power is an alternating voltage therefore it is rectified and then fed to an inverter. This MIC can deal and control with the wind, solar and ultra capacitor .The proposed circuits validated through the simulation results are shown in MATLAB and hardware results are included.

Keywords: Multi input converter, renewable energy, pv cells, ultra capacitors.

INTRODUCTION

Earlier only few renewable energy sources are used but now in order to meet the demand hybrid systems are used with the renewable energy. In the renewable resources, wind and solar is highly used because they are easily available and non polluting .in both wind power and solar energy generation converters are used to conversion process . In literature [1–6] PV converters are presented while wind power converters were presented in [7–10].this converters are used only for single input and single output system. Some researchers are proposed the multi input converters.[11].with this multi input converter we can use solar, wind and ultra capacitor as input. With this single boost configuration is used to step up voltage to high voltage applications [12-18].

The transformation strategy of MIC was analyzed [12]-[16],which is simple controller and easily implemented to the system. In order to regulate the MIC's operating point, pi microcontroller are used. A multiple-input buck-boost converter technique is implemented without any losses. Like boost-type converter, this type of configuration is still non-isolated electrically. To combining the renewable energy in electricity, the magnetic flux additively concept is proposed to design a multi-input isolated converter, but the design is complex [13]. The forward derived

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configuration was proposed to simplify the power stage configuration. It cannot trap the energy in the inductor leakage and it is not used for high power application [14].

This paper a MIC with three input sources viz. Ulra capacitor, wind and solar is proposed. The proposed design is simple and offers bi-directional current flow to charge and discharge the battery and ultra capacitor. This MIC can deal with solar, wind and ultra capacitor individually or simultaneously.

THE PROPOSED SYSTEM

The block diagram of the proposed system was shown in Figure 1. Three renewable energy sources were used. The power from PV cells and Ultra capacitors is directly fed to the MIC whereas the wind power is alternating current, therefore it is rectified and fed to the MIC . The power is modulated in this converter and fed to an inverter which drives AC load or this power can be injected to the grid [18]. The detailed circuit diagram is shown in Figure 2. In wind power generation, a induction motor is widely used. Therefore induction generation is used instead of wind power . The alternating voltage is rectified by an uncontrolled bridge rectifier. Switches S1 and S3 are turned on and off complementarily to discharge and charge the Ultra capacitor is the another voltage source. Similarly switches S2 and S4 are turned on and off alternately to get the supply from solar cell and recharge the solar cell which is the third source of energy. These three renewable energy can give to the grid or individually can give depends upon the load. Switch S5 is used as a boost converter switch to step up the supply voltage during feed forward mode where as switch S6 is used as bucking switch during recharging of PV cells and Ultra capacitor. This modulated DC is fed to the inverter. This inverter is used to feed three phase squirrel cage induction motor [18].

Block Diagram

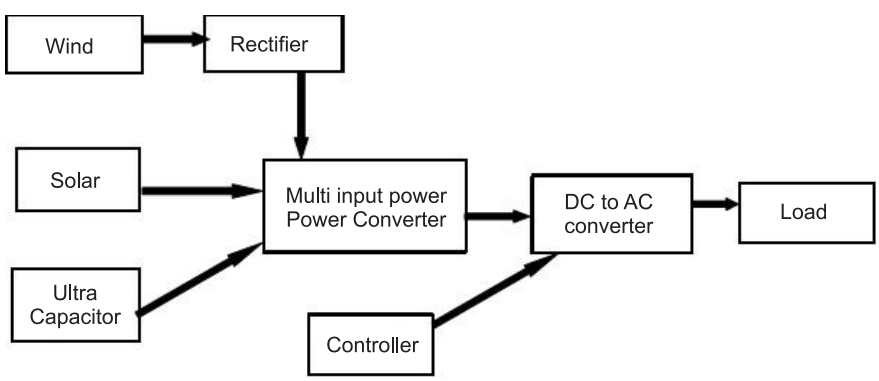

Figure 1: Block Diagram

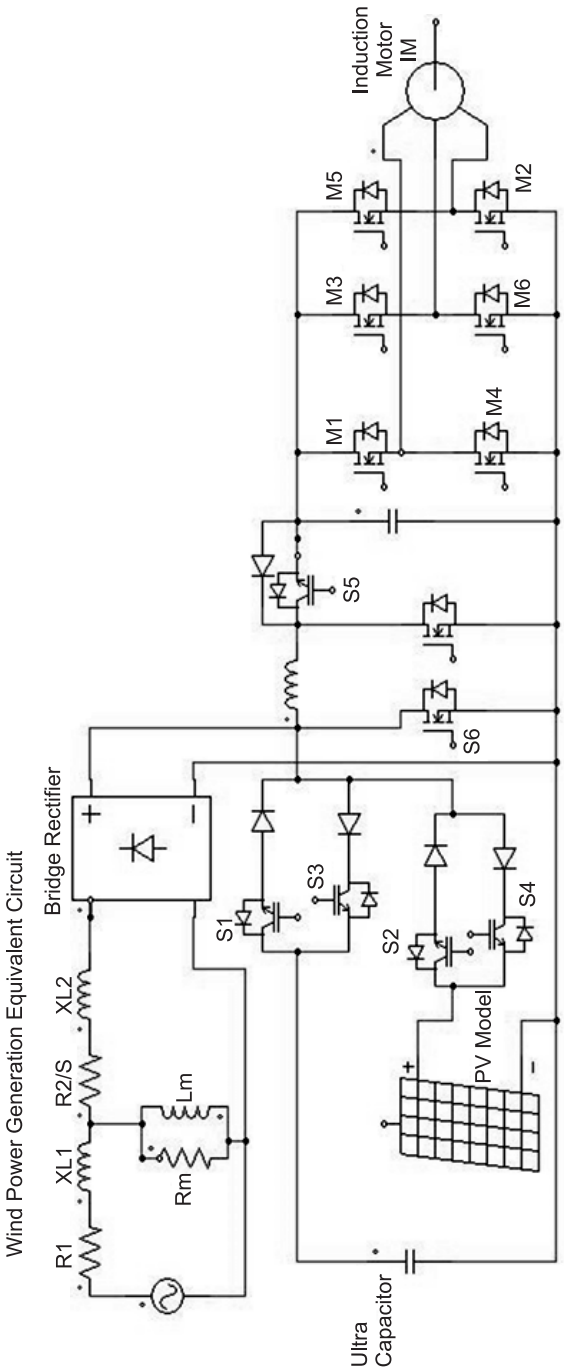

Figure 2: Circuit Diagram of Multi Input Power Converter

SIMULATION RESULTS

The simulation was done by using Matlab Simulink. The simulation circuit is shown in Figure 3. The PV battery voltage is 24 V. The ultra capacitor voltage is 48 V. Output voltage required from an inverter is 430 V (304 V Peak).

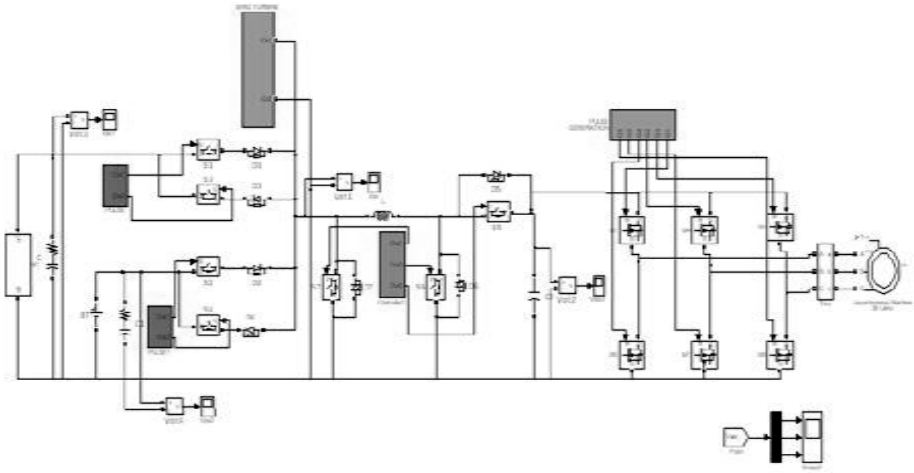

Figure 3: Simulation Model

The solar voltage and ultracapcitor voltages are shown in Figure 4 (a) & (b) respectively. The first stage output i.e. output from Multi input DC-DC converter is shown in Figure 5. The inverter switching pulses (for switches M1-M6) are shown in Figure 6. The inverter output voltages (line) are shown in Figure 7. The line currents are shown in Figure 8. This inverter feeds a three phase induction motor. The motor speed is shown in Figure 9. The FFT analysis is carried out and the results are presented in Figure 10.

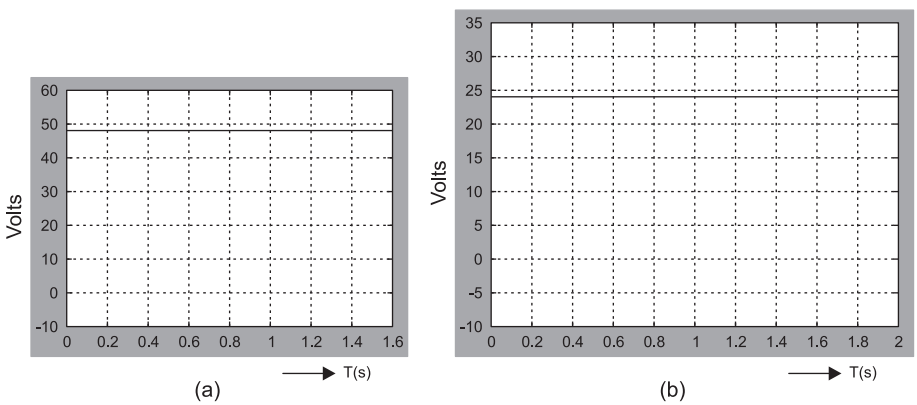

Figure 4: (a) Volatge Across The Ultra Capacitor and (b) Volatge Across The Battery

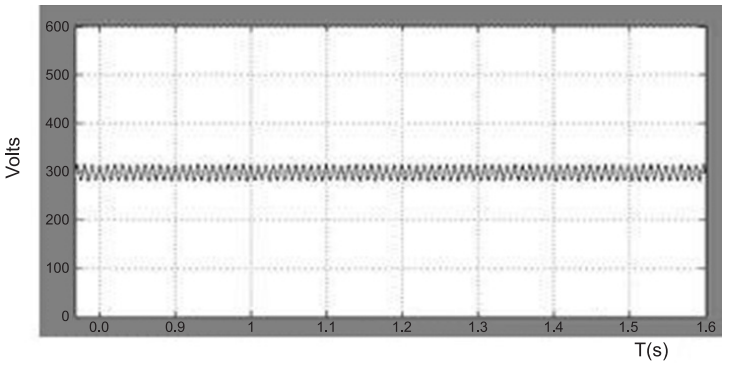

Figure 5: Multi input converter Output Voltage

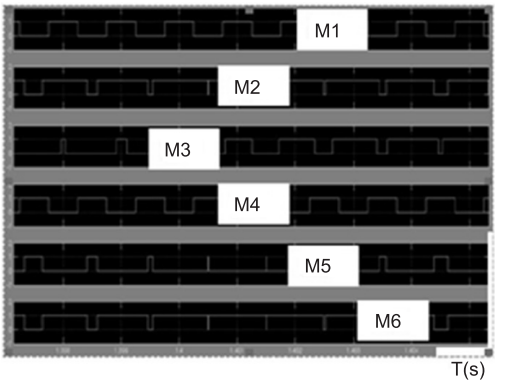

Figure 6: Inverter Switching Pulses for the switches M1-M6

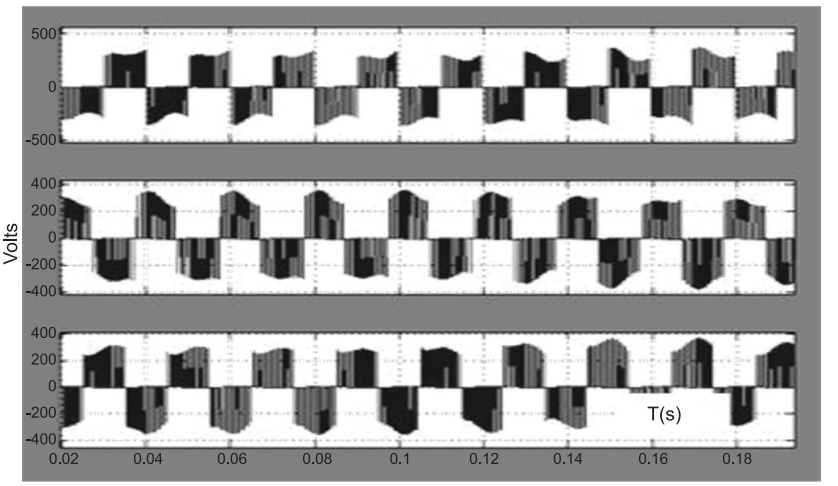

Figure 7: Inverter Output Voltage

From Figure 6, it is observed that when all three sources are acting, the output from boost stage is 304 V. The line voltages are 430 V(RMS). The induction motor runs at the rated speed of 1480 RPM. From Figure 10, FFT analysis of currents, it is found that THD is 7.5%.

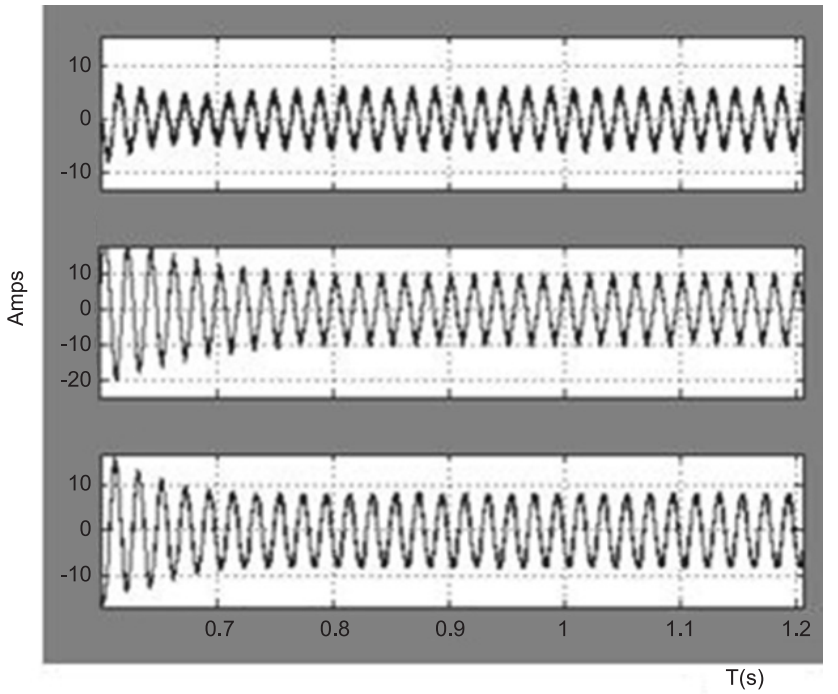

Figure 8: Line Currents

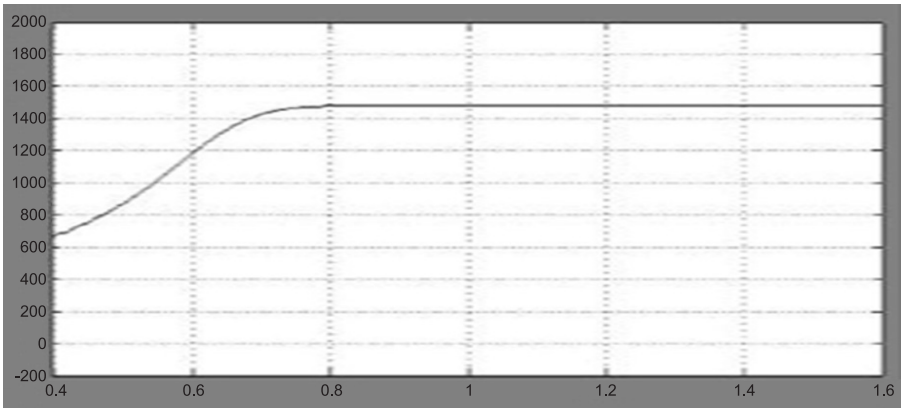

Figure 9: Induction Motor Speed

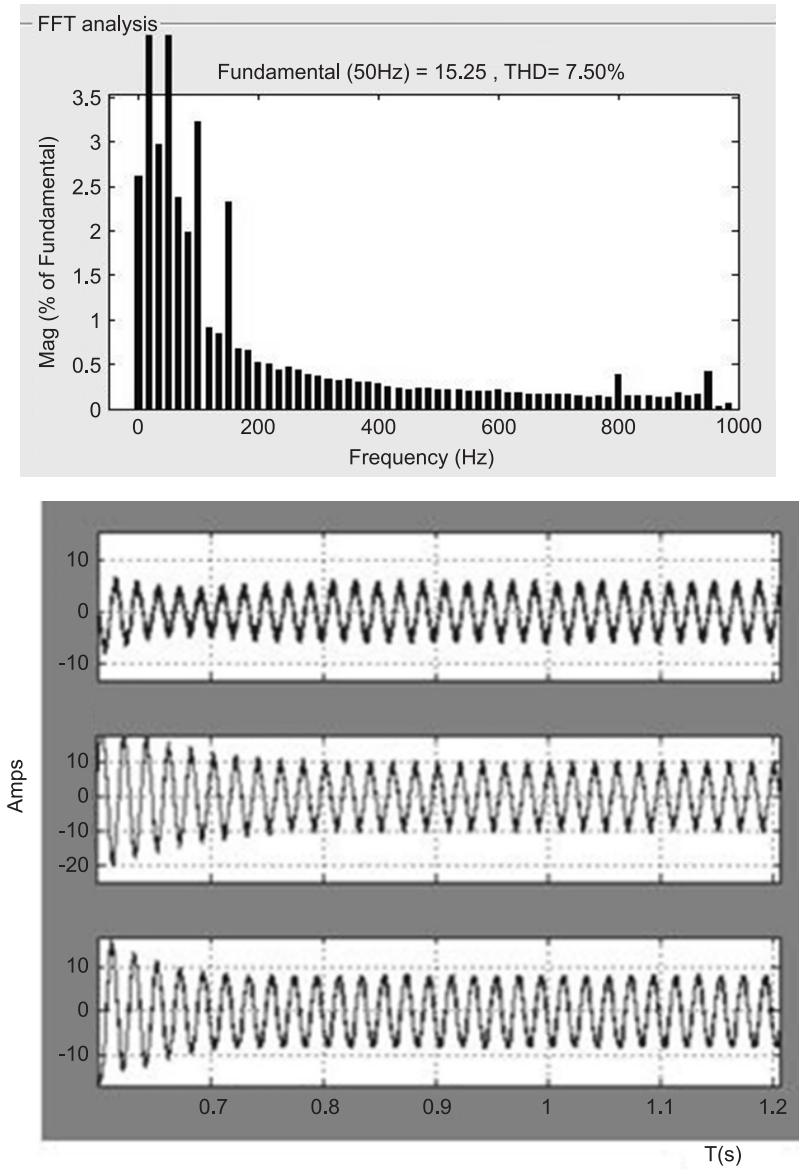

Figure 10: FFT Analysis of Line Currents

HARDWARE RESULTS

The hardware results represents with the output waveform of wind ,solar and converter with different voltage levels and ultimately ultracapacitor has high voltage levels 48 V. The inverter output is maximum of 430 V.

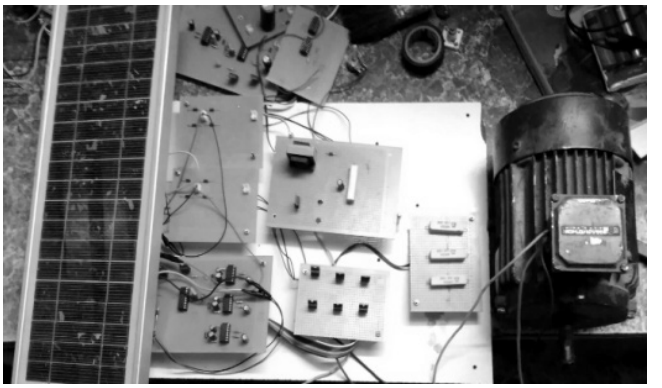

Figure 11: Hardware assembly

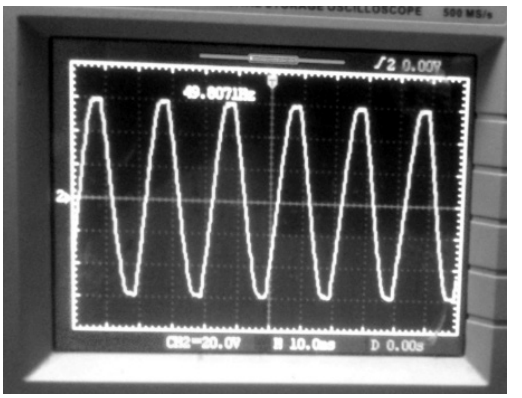

Figure 12: Output voltage of wind

From the Figure 11 the output voltage of wind is nearly a sine wave obtained by multi input converter and the frequency of wind is 49.8071 hz

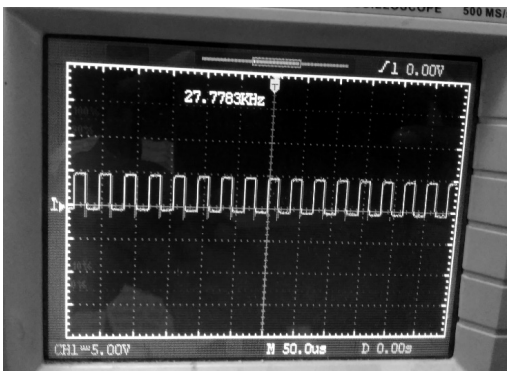

Figure 13: Output voltage of switching converter

From the Figure 13 the switching converter output is square waveform with some distortion

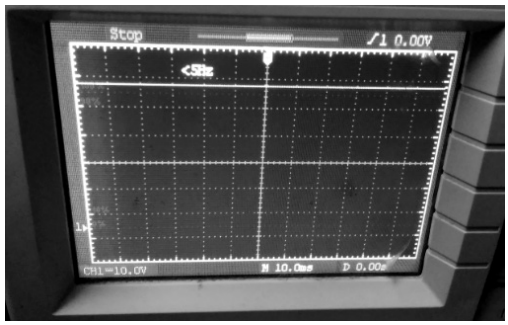

Figure 14: Output voltage of converter

From Figure 14 the output voltage of converter is pure dc supply with the voltage of 10 V.

CONCLUSION

A three input power converter was designed to handle three renewable energy sources such as wind, solar, and ultra capacitor. The three renewable energy sources are independent on load which is used to drive the required voltage and power for three phase induction motor. Therefore proposed converter offers better efficiency. This paper presents the analysis of hardware and software of a multi input converter and both the hardware and software results are equal and similar.

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