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Single Phase Online UPS Design Using Three Leg Converters

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Abstract
The single phase online UPS integrate with the three leg type converter which operate with battery charger and the inverter. The first leg controls the ability of charging battery. The third leg controls the output voltage. The common leg is used to control the line frequency. The battery charger has the ability of making the correction of power factor during the battery charging. The inverter is used to maintain the output voltage and to limit the output current. The main feature of the three leg converter is used to reduce the number of switching devices. So that the system has the low value of power loss and low cost.
Index terms: battery charger, uninterrupted power supply, power factor correction.

I. INTRODUCTION

The uninterrupted power supply is used to provide the pure sinusoidal voltage with less voltage distortion and uninterrupted power to loads such as computer, communication system, and medical support system etc. nowadays, increasing in the demand of using nonlinear load caused by the serious problem of power quality and the disturbance are dominated by the electronic loads.

A single phase four leg converter consist of four leg, in which two legs are used for rectifying and charging purpose, and the other two legs are used for inverter purpose. The proposed three leg converter has the feature of power losses reduced by using the common leg for both PWM rectifier and inverter, and the system can have excellent input and output characteristics.

The proposed three leg converter has such a feature of high efficiency, high power factor, and fast response of input and output disturbances. The disturbances of input voltage caused by over voltage and under voltage can cause a system trip and failure of hardware. In order to overcome this problem of input voltage disturbance a compensation technique is needed to achieve good output voltage regulation.

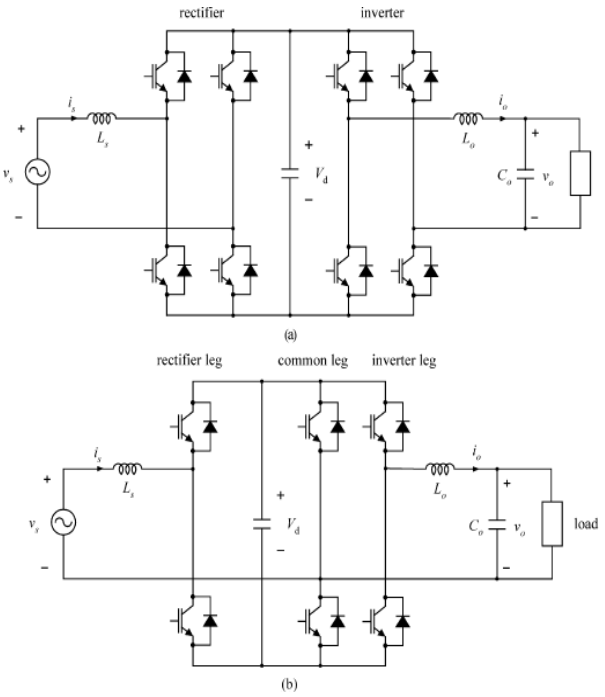

Fig.1. Single-phase converters. (a) Conventional converter with four legs. (b) Three-leg-type converter.

II. SYSTEM DESCRIPTION

The proposed single phase UPS using a three leg converter having the leakage transformer in order to reduce the cost. The leakage inductance of the leakage transformer is utilized as an LC filter without using additional inductor and the value of leakage inductance is designed with reasonable value. Otherwise an additional inductance must be connected in series with transformer.

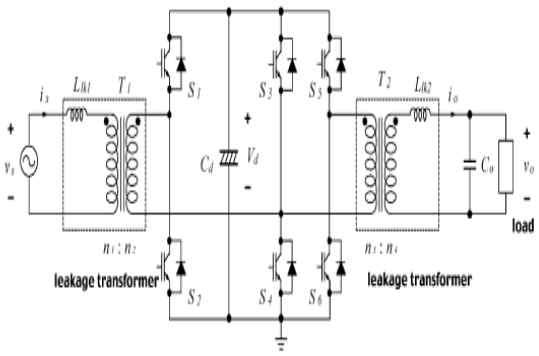

Fig.2. Three leg converter with leakage transformer.

By placing the capacitor at input and output side are utilized LC filter for the charger and inverter. Three leg converters consist of three leg, the rectifier leg and common leg act as PWM converter like boost converter. Similarly the common leg and inverter leg act as PWM inverter like buck converter. The use of common leg is to reduce the one switching leg compared with four leg converter.

The proposed UPS can be operated in eight different modes. When the supply voltage is normal, the operation is divided into four modes. The other four modes are operated in inverter and backup mode.

III. MATLAB Simulink model of proposed converter.

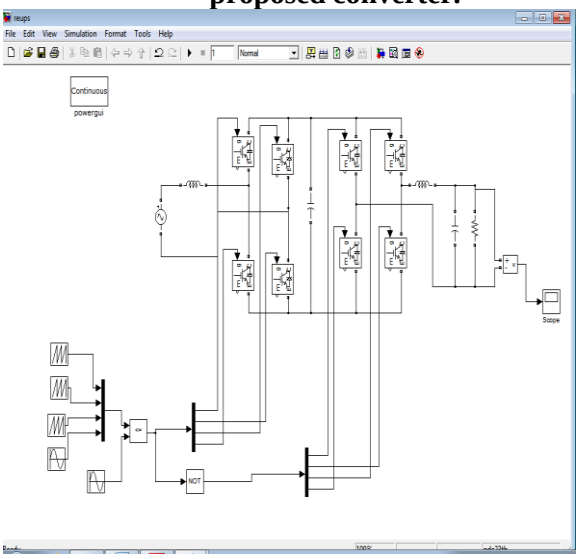

Fig.3. MATLAB model of four leg converter.

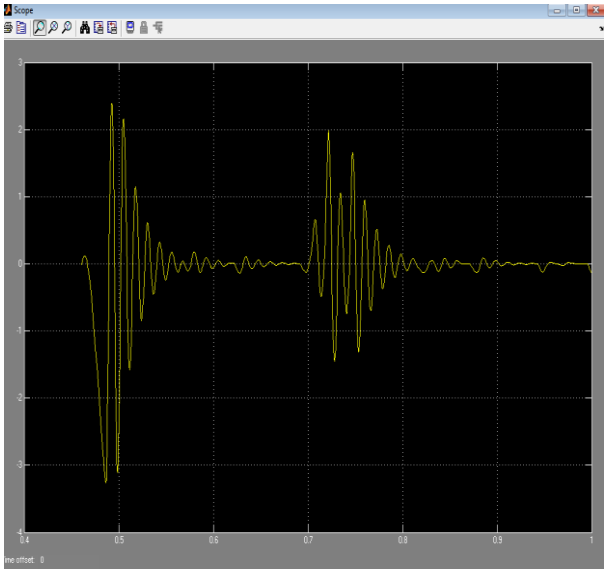

Fig.4. output voltage for four leg converter.

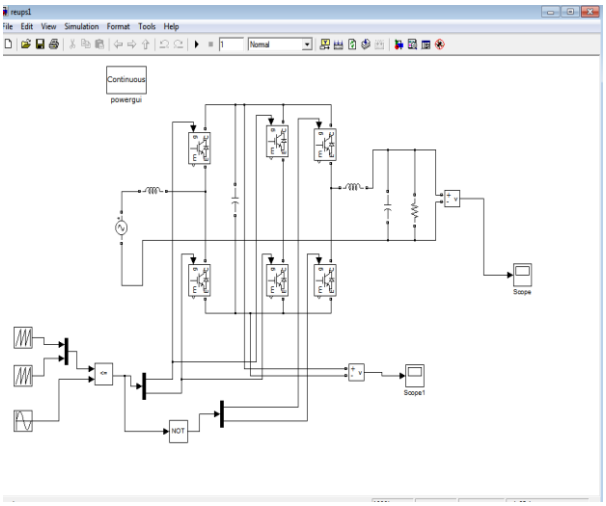

Fig.5. MATLAB Simulink model of three leg converter.

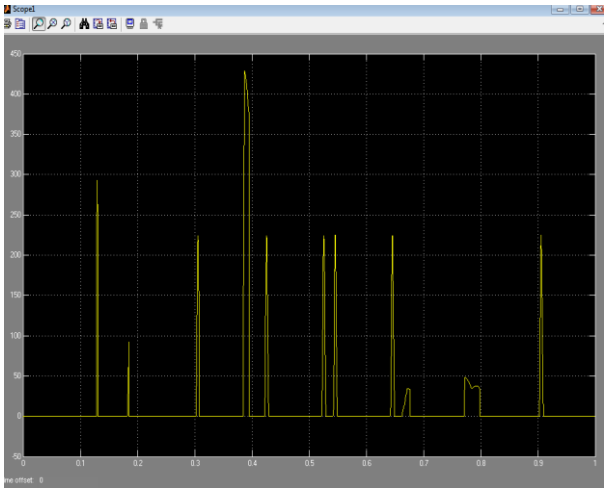

Fig.6. output voltage at rectifier leg for three leg converter.

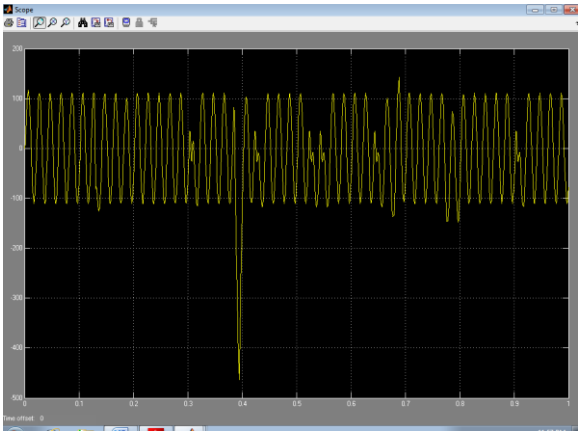

Fig.7. Load voltage for three leg converter.

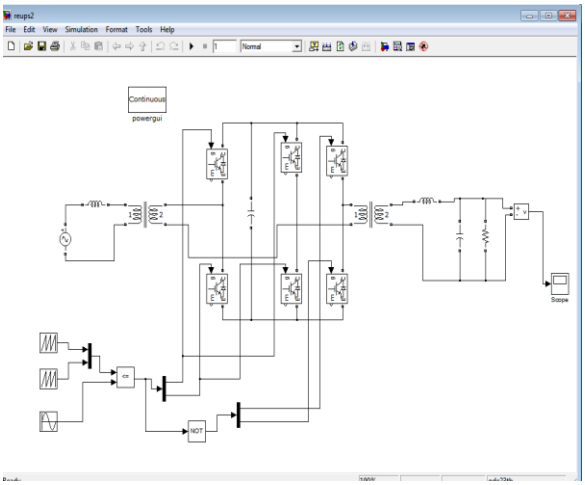

Fig.8. MATLAB Simulink model three leg converter with leakage transformer.

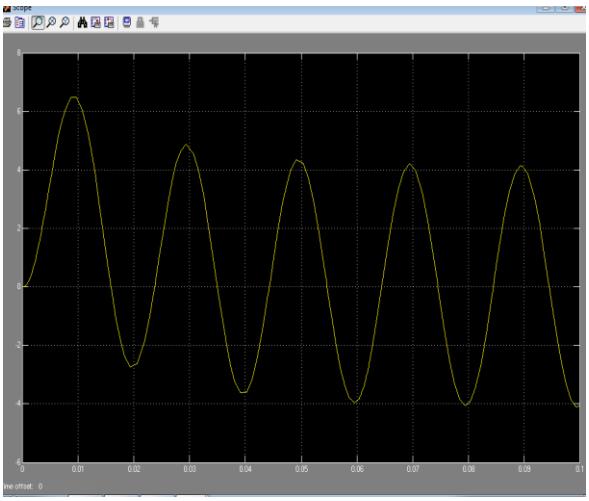

Fig.9. Load voltage at three leg converter with leakage transformer.

IV. CONCLUSION

Thus the proposed single phase online UPS consist of three leg converter. The proposed UPS combines low cost with good performance. The inverter generate output voltage independently to the online voltage from the battery and the UPS transfer uninterrupted power to loads. The converter improve the dynamic response of output voltage. The experimental result shows that the propose UPS gives good performance and steady state performance.

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