# A Novel Hydro Powered Online Power Converter for Marine Lighting Applications

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**ABSTRACT**

This paper presents a new hydro energy based dc-dc PFC sepic based buck converter for marine lighting applications. The major advantage of the proposed power converter is high power factor and low THD with higher efficiency. SEPIC converter produces continuous smooth ripple free current because of two inductors in series in line in its circuit. Sepic converter produces lower switching losses because of lower voltage stress on power switch employed compared to other buck-boost converter topologies. Tidal wave energy is converted into mechanical energy with the help of a hydro turbine which drives a permanent magnet synchronous generator to produce three phase ac output voltage. It produces a low ac voltage which is converted into DC using passive diode rectifier and fed to sepic converter for voltage regulation as well as to improve quality of power supply such as high power factor, low THD. The proposed sepic based power converter for marine lighting application is simulated in MATLAB/Simulink environment for verifying the performance of proposed scheme.



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## 1. INTRODUCTION

Single source renewable energy based buck boost converters cannot supply a load or a drive if produced output from source is very less. Hence if more than one source is used for a converter operation of inverter is possible with either of the source. Power factor corrected power electronic converter has integrated one or more sources like solar with maximum power point tracking based boost converter and PMSG hydro turbine based three phase sepic based power-factor-correction buck-boost rectifier can improve power factor and achieve less total harmonic distortion (THD) power converter.

### Problem Description

Power supplies designed for lighting applications suffers from poor power factor and higher order harmonics in the line. Hence it degrades power system quality.

### Background

[1] Proposed a control system for permanent magnet synchronous generator based wind energy system. [2] Presented a PFC rectifier for PMSG based wind system. Multiport dc-dc converter with three inputs PV, battery, super capacitor for reliable operation [3-5]. [6] Discussed modeling of photovoltaic system with converter topology for grid fed operations. A reactive power controller for power quality enhancement of wind energy conversion systems. Bidirectional multiport dc-dc converters are required for double side energy transfer applications such as energy storage systems including battery, super conducting energy storage systems. The paper [7] portrayed grid connected renewable energy conversion systems were

designed to analyze an impact of parameter variations on the steady state behaviour. A Study on 3-phase Interleaved DC-DC Boost Converter Structure and Operation for Input Current Stress Reduction [8]. Hardware Implementation of Solar Based Boost to SEPIC Converter Fed Nine Level Inverter System [9]. Transformer Less Voltage Quadrupler Based DC-DC Converter with Coupled Inductor and PI Filter for Increased Voltage Gain and Efficiency [10]. Solar Photovoltaic Array FED Water Pump Riven by Brushless DC Motor using KY Converter [11].

## 2. PROPOSED PFC SEPIC CONVERTER

Figure 2 Shows Block Diagram of proposed PFC SEPIC converter for marine lighting applications. Single ended primary inductor converter (SEPIC) is sort of DC-DC converter permitting the electrical potential (voltage) at its yield to be more noteworthy than, not exactly, or square with to that at its info; the yield of the SEPIC is controlled by the obligation cycle of the control transistor. The standard Sepic Rectifier is appeared in figure 1. This topology is like the bridgeless lift power factor correction rectifier. In spite of the specified preferred standpoint, in contrary with the ordinary SEPIC converter, this converter has three more inductors and capacitors (passive elements) which add to the size and cost of the converter. Another significant issue with this converter is that it pairs the yield voltage which extensively expands the span of yield channel. To overcome the above mentioned problems associated with SEPIC converter, another power factor corrected SEPIC is presented in this paper. The proposed converter does not require any additional (inactive or dynamic) components in comparison with established SEPIC PFC.

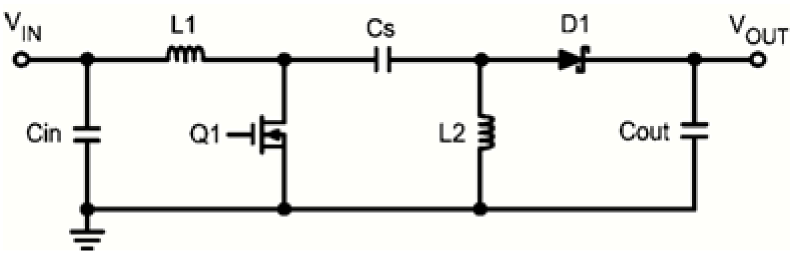


Figure 1. Circuit Diagram of PFC SEPIC Converter

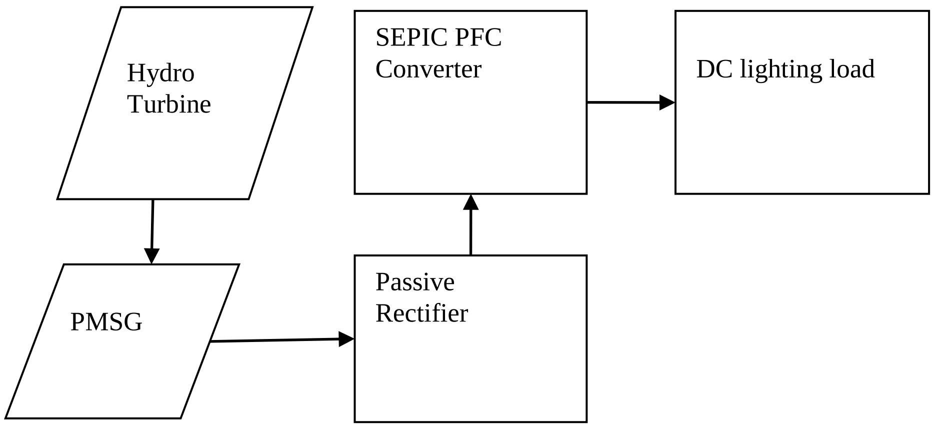


Figure 2. Block Diagram of Proposed PFC SEPIC Converter for Marine Lighting Applications

## 3. SIMULATION RESULTS AND DISCUSSION

The proposed solar and PMSG wind based multiport port dc-dc converter is implemented in MATLAB/Simulink platform and results are presented here. Figure 3 Shows simulation implemented circuit of proposed PFC sepicconverter for marine lighting applications. Figure 4 Shows Voltage response of proposed PFC sepic converter. Figure 5 to 7 shows performance of proposed PFC sepic converter, PMSG hydro turbine output of single phase, power factor correction response and total harmonic distortion values. Table1.Shows simulation parameters of proposed circuit used in Simulink platform.

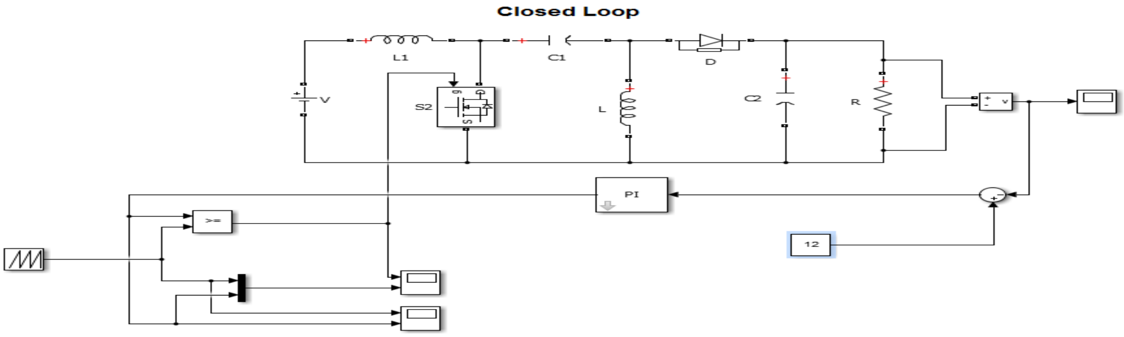


Figure 3. Simulation Implementation of Proposed Multiport DC-DC Converter

Table 1. Simulation parameters

| | |
|---|---|
| Resistance R1 | 10k ohms |
| Inductance L1 | 1ou H |
| Capacitance $(C_1, C_2 C_3)$ | 220uF |
| Output Capacitor$(C_{01}, C_{02})$ | 1000uF |
| Load resistor | 1 ohms |

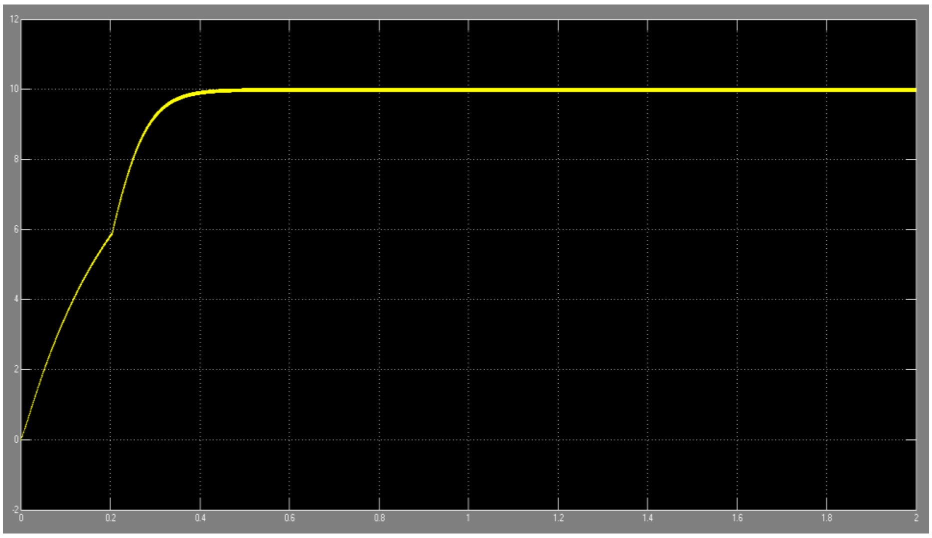


Figure 4. Voltage Response of Proposed PFC Sepic Converter

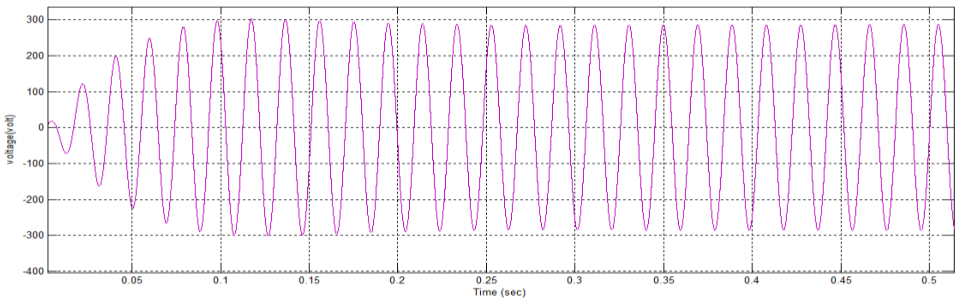


Figure 5. PMSG Hydro Turbine Output of One Phase

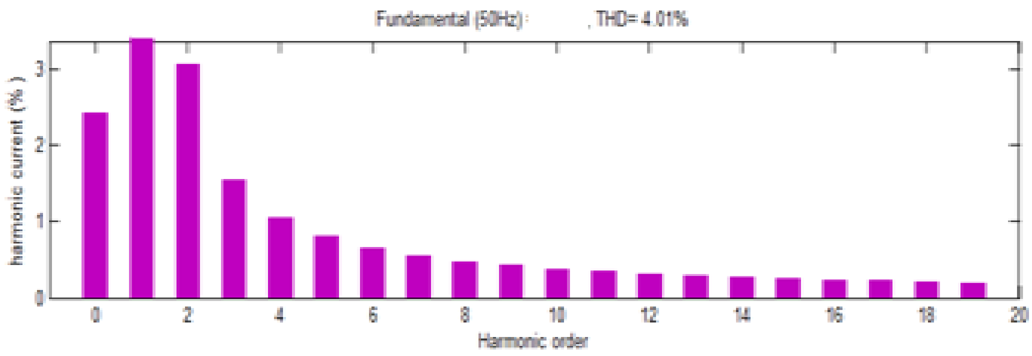


Figure 6. THD Performance of PMSG

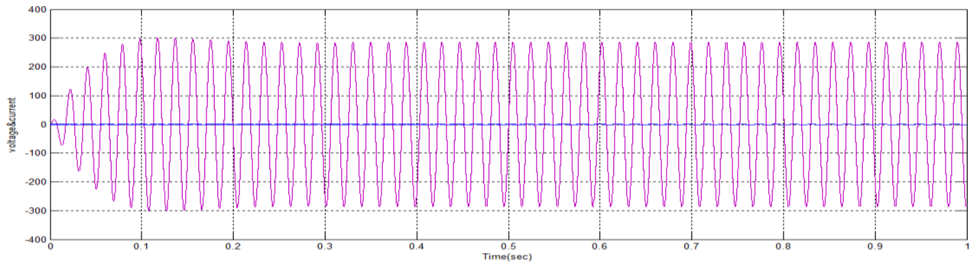


Figure 7. PFC using SEPIC Converter

## 4. CONCLUSION

This paper presented a new hydro energy based dc-dc PFC sepic based buck converter for marine lighting applications. The major advantage of the proposed power converter is high power factor and low THD with higher efficiency. SEPIC converter produces continuous smooth ripple free current because of two inductors in series in line in its circuit. Sepic converter produces lower switching losses because of lower voltage stress on power switch employed compared to other buck-boost converter topologies. Tidal wave energy is converted into mechanical energy with the help of a hydro turbine which drives a permanent magnet synchronous generator to produce three phase ac output voltage. It produces a low ac voltage which is converted into DC using passive diode rectifier and fed to sepic converter for voltage regulation as well as to improve quality of power supply such as high power factor, low THD. The sepic based power converter for marine lighting application is simulated in MATLAB/Simulink platform and the results verify the performance of the proposed converter.

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