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# An AC-DC Single Stage Full Bridge Hybrid Converter with Improved Output Characteristics

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***Abstract***— **This paper explains about a new auxiliary circuit for an ac-dc single-stage power factor corrected (SSPFC) full-bridge type converter. The new auxiliary circuit is simple, handles low power, and is active only when the converter is operating under light load conditions. The operation of a SSPFC converter is briefly reviewed and the main principle behind the auxiliary circuit is explained. The new auxiliary circuit is introduced, and its feasibility in a multilevel SSPFC is confirmed with experimental results. This project proposes a unique standalone hybrid power generation system, applying advanced power control techniques, fed by four power sources: wind power, solar power, storage battery, and diesel engine generator, and which is not connected to a commercial power system. This configuration allows the two sources to supply the load separately or simultaneously depending on the availability of the energy sources. The inherent nature of this converter, additional input filters are not necessary to filter out high frequency harmonics. Harmonic content is detrimental for the generator lifespan, heating issues, and efficiency.**

***Index Terms:*** **Pulse Width Modulation (PWM), MOSFET, Optocoupler, microcontroller, matlab.**

## INTRODUCTION

Single-stage power-factor-corrected (SSPFC) ac-dc converters are cheaper and simpler than two-stage converters. This is because the ac-dc front-end and dc-dc backend converters that form the two stages of a two-stage converter are combined and just one controller is used - to regulate the output voltage. Low-power SSPFC converters (< 200 W)are widely used in industry, but not higher power SSPFC full-bridge converters due to problems associated with their operation over an extended load range. The intermediate dc bus voltage (the voltage at the input of the dc-dc section of a SSPFC converter fed by its ac-dc section) is not controlled and can change with input line voltage and output loads, which affects its operation negatively. This can be limited if the load range is constrained, as is done for low power converters, but this cannot be done for higher power converters. The result may thus be a distorted input line current, high dc bus voltage levels and a large amount of ripple in the output inductor current. A new auxiliary circuit was proposed to reduce the amount of output inductor current that can exist when a single-stage power factor corrected (SSPFC) full-bridge converter is operating under heavy load conditions. The new auxiliary circuit is simple and is active only when the converter is operating under light load conditions. In this paper, the operation of a higher power SSPFC full-bridge converter was briefly reviewed, the main principle behind the auxiliary circuit was explained and its feasibility was confirmed with results obtained from an experimental prototype of a multilevel SSPFC that was proposed previously.

The intermediate dc bus voltage (the voltage at the input of the dc-dc section of a SSPFC converter fed by its ac-dc section) is not controlled and can change with input line voltage and output loads, which affects its operation negatively. This can be limited if the load range is constrained, and is done for low power converters, but this cannot be done for higher power converters. The result may thus be a distorted input line current, high dc bus voltage levels and a large amount of ripple in the output inductor current. A new SSPFC converter that does not have these issues was proposed in [10]. This converter does not expose its primary circuit components to the high voltage levels that a two-level SSPFC can because it is a multilevel converter. Issues associated with dc bus voltage variation such as excessive dc bus voltages are reduced and converter operation is improved. Although the output inductor current ripple is less than what is found in other higher power

SSPFCs, it can be reduced to make it like that of a two-stage PFC converter. A new auxiliary circuit that does that is proposed in this paper is simple and is active only when the converter is operating under light load conditions.The operation of the converter proposed in [10] is briefly reviewed, the principle of the new auxiliary circuit is explained with its operation, and its feasibility in a multilevel SSPFC is confirmed with experimental results. The converter shown in Fig.1 integrates ac-dc boost PFC into a three-level dc-dc converter. Equivalent circuit diagrams that show its modes of operation for a half cycle are shown in with the diode rectifier bridge output replaced by a rectified sinusoidal source. When switches S1 and S2 are ON energy from dc bus capacitor C1 is transferred to the output load. When switch S1 is turned OFF (Fig. 2(b)), the converter current freewheels in the converter primary and secondary and energy stored in Lin during the previous mode is completely transferred into the dc bus capacitor. This mode ends when the current in Lin reaches zero. The converter remains in a freewheeling mode until S2 is turned OFF and the primary current charges capacitor C2 through the body diodes of S3 and S4. This mode ends when switches S3 and S4 are switched ON. For the remainder of the switching cycle, the converter goes through the modes, but with S3 and S4 ON instead of S1 and S2. The PFC is performed by using auxiliary windings taken from the main transformer that act like a switch. Whenever a combination of S1 and S2 or S3 and S4 is ON, a voltage is induced in the windings that cancels out the dc bus voltage and allows current to flow through one of the auxiliary diodes. This is analogous to the input current rising in a conventional ac-dc boost PFC converter. Whenever the converter is in a freewheeling mode of operation, the voltage across the main transformer winding and thus the auxiliary windings is zero and there is no cancellation of the dc bus voltage. This is analogous to the input current falling in an ac-dc boost PFC converter.

## BLOCK DIAGRAM

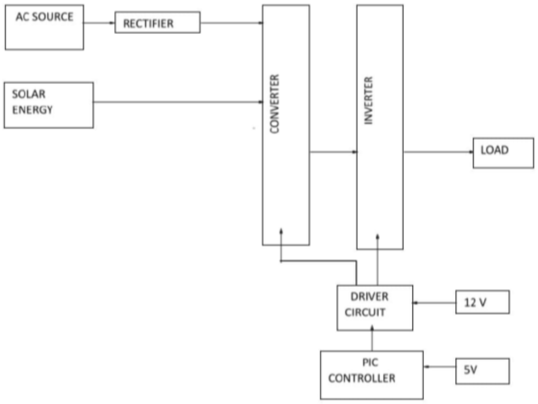
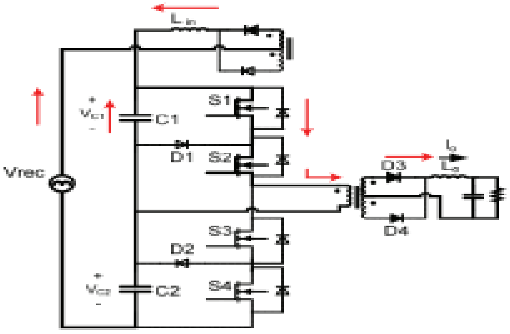


Fig:1 Block Diagram

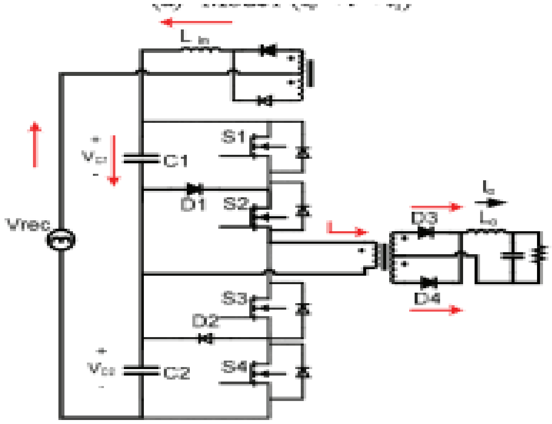
## MODES OF OPERATIONS

### MODE 1:



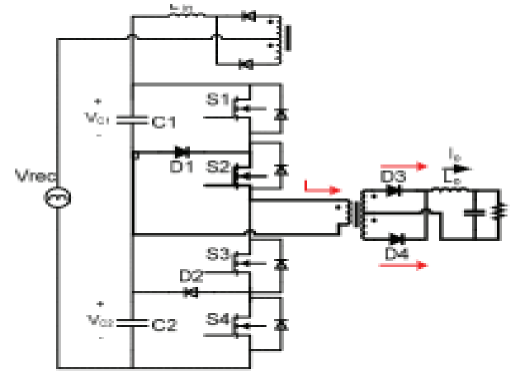
(a) Mode1 ($t_0 < t < t_1$)

### MODE 2:



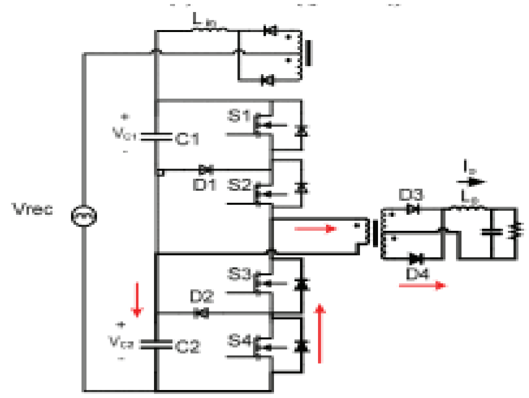
(b) Mode2 ($t_1 < t < t_2$)

### MODE 3:



(c) Mode3 ($t_2 < t < t_3$)

MODES 4:



(d) Mode4 ($t_3 < t < t_4$)

MERITS:

This system has the following features:

1 dispersed installation of different power sources that are interconnected in parallel.

2 elimination of dump load by using a unique dump power control aimed at prevention of battery overcharging.

3 no need for dedicated high-speed line for battery current/voltage status data Transmission.

4 easy capacity expansion through parallel connection of additional power sources to cope with future load increases.

ADVANTAGES:

1 Additional input filters are not necessary to filter out high frequency harmonics.

2 Low operating cost

3 High power quality

4 Easy to charge

APPLICATIONS

1 Distributed Generation Applications,

2 Constant Speed and Variable Speed wind Energy Conversion Systems,

3 Photovoltaic Energy System.

1.Simulation Results

The proposed input-output converter was preliminary verified in simulation using Mat lab/Simulink. Simulation was planned such that it used the same parameters as the final implemented hardware. The simulation result of rectifier output as shown in Fig.8 and Fig.9.

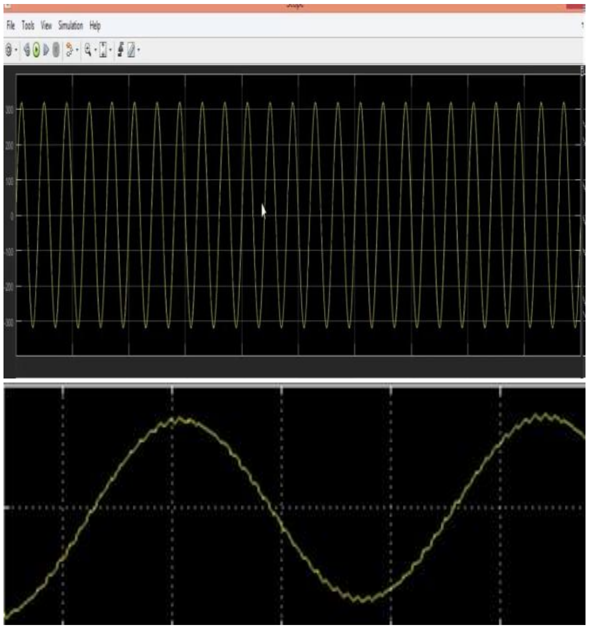


Fig 9.Output waveform

2.Hardware Results

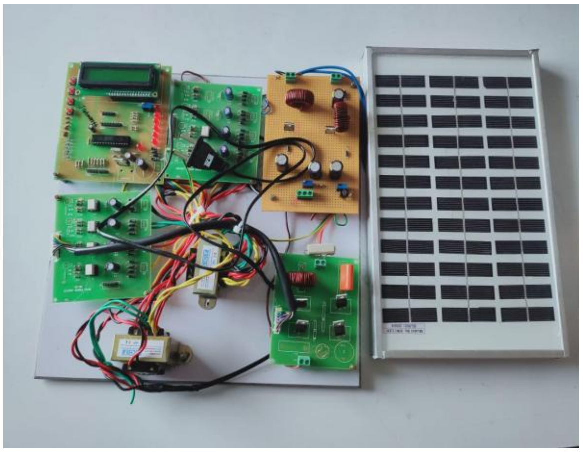


Fig. Hardware Prototype

## CONCLUSION

Performance characteristics like input power factor at supply side and total harmonic distortion for various rated power conditions and better transients parameters can be achieved using hybrid single stage full-bridge power factor correction converter for telecom applications Results of proposed hybrid converter system will be compared with anyone conventional topology results to obtain better performance.

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