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Article

Performance Enhancement of Advanced Solid State Power Converter for Industrial Applications

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Abstract: This paper deals with the design of high efficient ac-dc converter with high power factor for industrial applications. The conventional AC-DC converter has a diode rectifier followed by a feed-forward or a fly-back converter with or without a boost cell. A generally changing dc transport voltage implies that the converter should have fitting hold-up time when the dc transport voltage is low or high, which, thusly, implies that the dc transport capacitors should be chosen for a few transport voltages rather than only one. In the these converter if the voltage across the capacitor rectifier is stable and steady irrespective of input and load fluctuation then voltage regulation can be easily achieved hence a new topology is being proposed by modifying the conventional converter to minimize fluctuations.

The switching on time a MOSFET will decide the voltage level of the DC bus capacitor and depending on the DC bus capacitor voltage either both transformers can be made to transfer energy to load (dual fly-back mode) are only transformer two alone can be made transfer energy to load. The PID controller while sample the actual voltage and compare with set voltage to generate an error signal which is used to modify the ON time of PWM pulse in order to maintain the output at desired value.

Keywords: AC-DC converter; PID controller; Boost converter

1. INTRODUCTION

Force hardware specialists have proposed numerous procedures to attempt to keep the transport voltage to a most extreme degree of under 450V to stay away from enormous switch voltage stresses and capacitor size. None of these procedures, nonetheless, altogether restricts the variety in the dc transport voltage that can happen when the converter needs to work under general information line conditions[1-2]. The exceptional element of this converter is that its dc transport voltage is undeniably less subject to its working conditions than is the situation for most recently proposed single-stage converters [3]. The huge decrease in dc transport voltage variety takes into account a decrease in dc transport capacitor size as the need to fulfill hold-up time prerequisites for both low and high dc transport voltage is discarded. In the paper, the activity of the converter is examined and its methods of activity are clarified and investigated.

There are two systems that help make the dc transport voltage in the proposed converter less factor than that of recently proposed single-stage ac–dc converters. One is the replacement of the info inductor with a fly back transformer, which acts to clip the dc transport voltage. The second is that the info area did not depend on the lift converter, however is rather founded on a buck–help converter working with D ≤ 0.5 like a buck converter. Force hardware specialists have proposed numerous procedures to attempt to keep the transport voltage to a most extreme degree of under 450V to stay away from enormous switch voltage stresses and capacitor size [4-6]. None of these procedures, nonetheless, altogether restricts the variety in the dc transport voltage that can happen when the converter needs to work under general information line conditions.

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2. PROPOSED SYSTEM

The yield voltage of the inverter is changed by differing the PWM exchanging recurrence of the gating beats given to the force semiconductors (MOSFETs) of the inverter. The PWM exchanging recurrence can be changed to a limit of 10KHz. High exchanging recurrence is accomplished which improves the exhibition by diminishing all out music contortion and exchanging misfortune. Simple control conspire has the benefit of quick unique reaction, however endures the weaknesses of complex hardware, restricted capacities, significant expense, low handling velocity and trouble in circuit alteration[10].

The fast improvement in elite ease microcontrollers has supported exploration on computerized PWM control procedure. This control plot has the benefits of basic hardware, programming control, and adaptability in variation to different applications. This technology offers flexibility and it provides better noise tolerance [11-12].

2.1 Block Diagram:

The block diagram of the proposed Advanced Solid State Power Converter for Industrial Applications is shown in Fig.1.

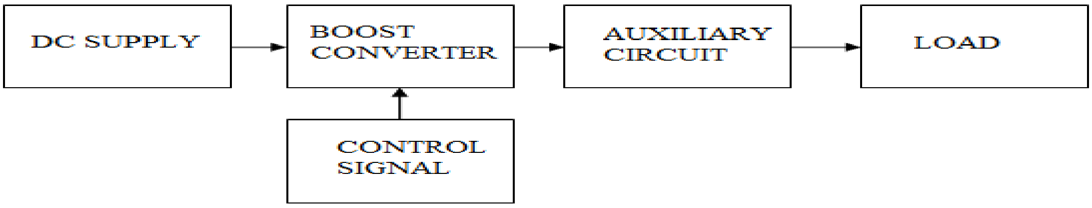

Figure 1. Advanced Solid State Power Converter for Industrial Applications

2.2. Modes of operation

Upper switch S_2 in the proposed converter replaces the rectifier diode in the customary lift converter. Lower switch S_1 and upper switch S_2 are worked with topsy-turvy correlative changing to manage the yield voltage. A helper circuit that comprises of a capacitor C_1, an inductor L_2, two diodes D_1 and D_2, and a capacitor C_2 is associated on top of the output capacitor C_3 to frame the yield voltage of the converter [13]. The assistant circuit builds the yield voltage, yet in addition helps ZVS turn-on of dynamic switches S_1 and S_2 in CCM.

Mode 1:

This mode starts when i_{L2} diminishes to nothing and D_2 is turned on as demonstrated in Fig. 2. During this mode, the lower switch S_1 keeps up ON state. Both information inductor current i_{L1} and helper inductor current i_{L2} courses through lower switch S_1. The slant of these flows are given by

$$\frac{di_{L_1}}{dt} = \frac{V_i}{L_1}$$

$$\frac{di_{L_2}}{dt} = \frac{(V_{C_1} - V_{C_3})}{L_2}.$$

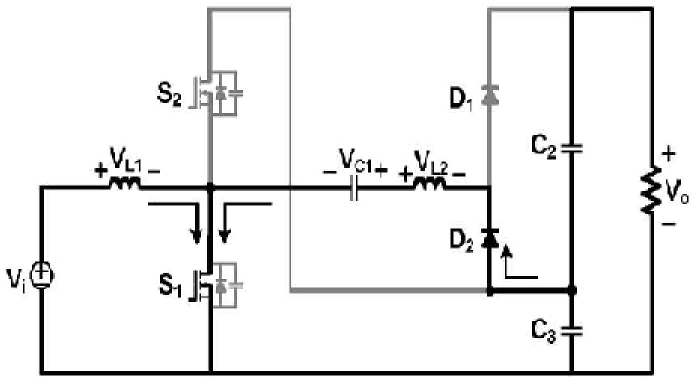

Figure 2. Mode1

Mode II:

This mode starts when S_1 is OFF and S_2 is turned ON. The gating signal for S_2 is applied during this mode, and S_2 is turned on under ZVS conditions (Fig.3). Both i_{L1} and i_{L2} are diminishing with the incline dictated by the accompanying conditions

$$\frac{di_{L_1}}{dt} = \frac{(V_i - V_{C_3})}{L_1}$$

$$\frac{di_{L_2}}{dt} = \frac{V_{C_1}}{L_2}.$$

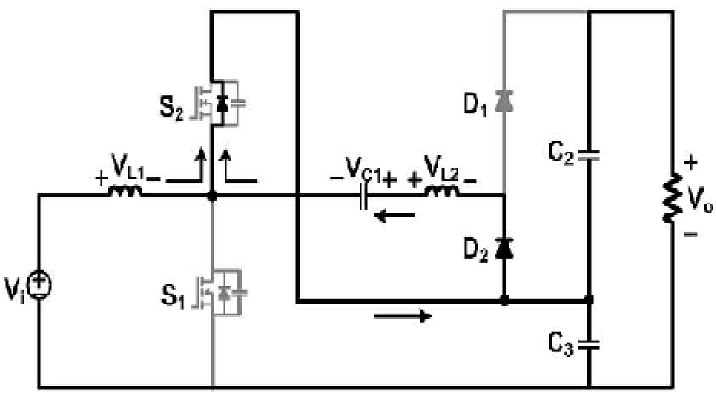

Figure 3. Mode 2

Mode III:

For mode 3 operation (Fig 4), *iL*1 keeps reducing with the slope determined from Mode 2, and *iL*2 increases with slope can be found by the following equation

$$\frac{di_{L_2}}{dt} = \frac{(V_{C_1} - V_{C_2})}{L_2}.$$

At the end of this mode, switch current *iS*2 reverses its direction of flow and conducts the main channel of S_2

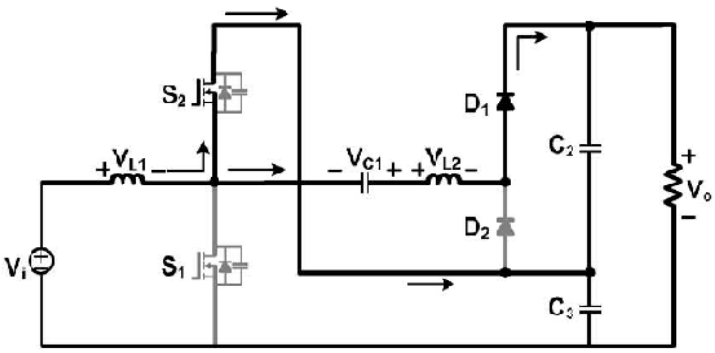

Figure 4. Mode 3

Mode IV:

For mode 4 operation (Fig 5), *iL*1& iL2 continue to flowing with the same slope determined in mode 3.

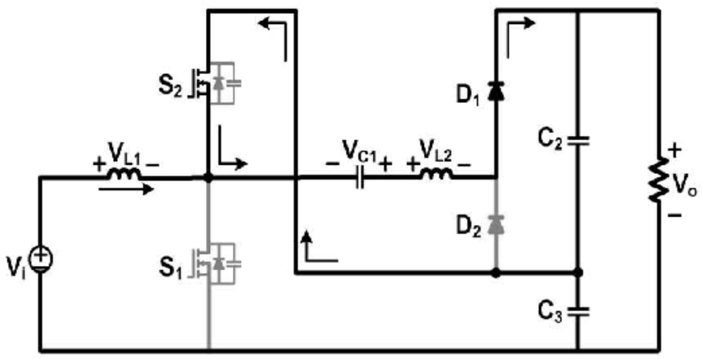

Figure 5. Mode 4

Mode V:

For mode 5 operation (Fig 6) when S_2 is off and S_1 is turned on. The gating signal for S_1 is given and S_1 is turned on under ZVS conditions. Inductor currents *iL*1& *iL*2 start to increase and decrease, respectively, with the slope determined.

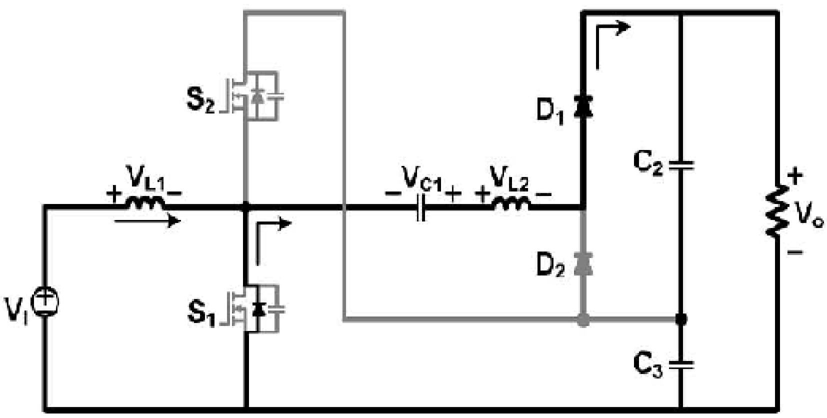

Figure 6. Mode 5

3. SIMULATION RESULTS OF PROPOSED CONVERTER

The performance of the proposed converter is simulated with help MATLAB/Simulink. Fig 7 shown simulation model of proposed advanced converter for industrial applications.

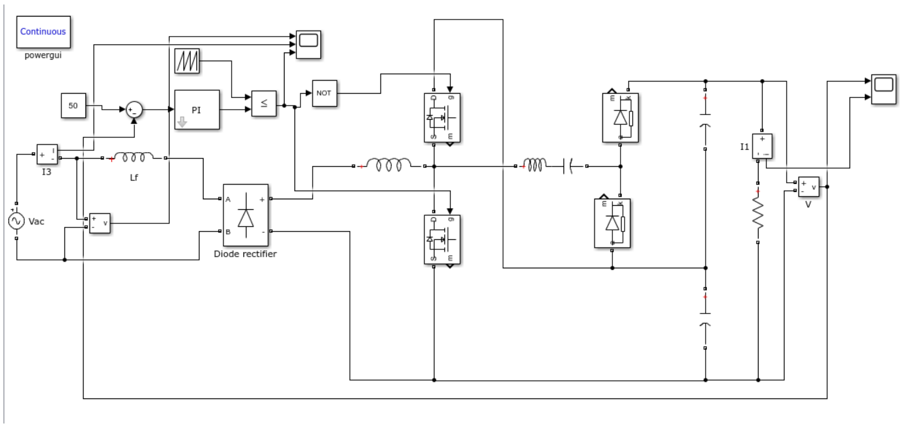

Figure 7. Simulation model for proposed advanced converter

Fig 8 shown the simulation result of proposed converter. It can be clearly understand the performance of proposed converter for power factor correction.

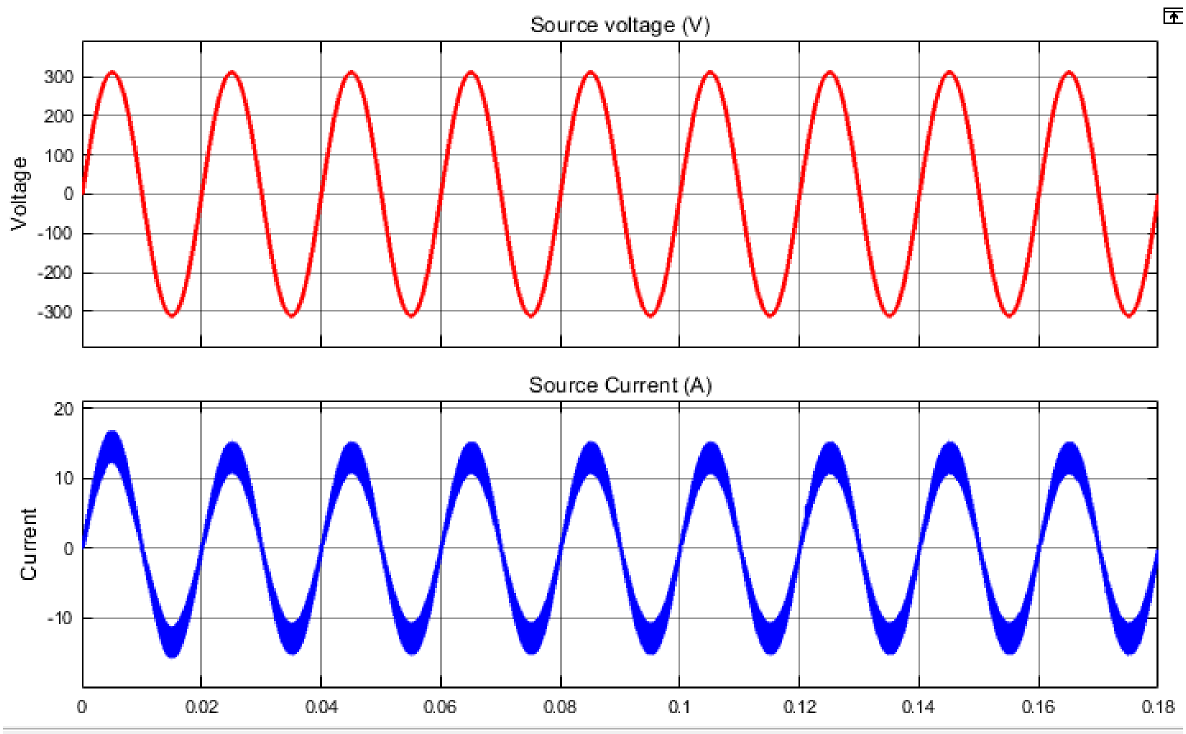

Figure 8. Simulation result for proposed advanced converter

4. CONCLUSIONS

In this paper, single-stage high-power factor converter is proposed and its result has been verified and simulated with the help of MATLAB Simulink. The extraordinary element of this converter is that its dc transport voltage variety is essentially not exactly that of other Single-stage converters, which permits more modest measured segments to be utilized. This is the consequence of the buck–help type input area and clasping of VC by the auxiliary twisting of T_1 to n_1Vo.The activity of the converter was clarified, and key trademark conditions were determined and used to plan the converter. The achievability of the converter—its capacity to work with an almost fixed dc transport voltage paying little heed to line and load conditions and its capacity to work with a great info power factor was affirmed with results acquired from an exploratory model.

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