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Power Factor Enhancement in Modified BL Converter with PI Controller Fed EV Battery Charger

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Abstract : Power factor enhancement is a technique used to improve the power factor of an electrical system, which is a measure of how efficiently the system is using the electrical power. A low power factor can lead to increased power consumption, reduced efficiency, and increased energy costs. This paper presents the implementation of a battery charger for EV with power factor improvement. In the proposed configuration, the conventional diode converter at the source end of existing electric vehicle (EV) battery charger is eliminated with modified Landsman power factor correction (PFC) converter. The PFC converter is cascaded to a flyback isolated converter, which yields the EV battery control to charge it, first in constant current mode then switching to constant voltage mode.

***Index Terms* – PI, EV, Converter, Photovoltaic, Grid, DC-DC.**

I. INTRODUCTION

The charging protocol relies upon the estimate and sort of the battery being charged. Some battery types have high tolerance for overcharging (i.e., kept charging after the battery has been completely energized) and can be revived by association with a constant voltage source or a constant current source, contingent upon battery type. Basic chargers of this sort must be physically disengaged toward the finish of the charge cycle, and some battery types totally require, or may utilize a clock, to cut off charging current at some fixed time, roughly when charging is finished. Other battery types can't withstand over-charging, being harmed (diminished limit, decreased lifetime), over warming or in any event, detonating. The charger may have temperature or voltage detecting circuits and a microchip controller to securely change the charging current and voltage, decide the cut off toward the finish of charge.

A stream charger gives a moderately limited quantity of current, sufficiently just to check self-release of a battery that is inactive for quite a while. Some battery types can't tolerate stream charging of any sort; endeavors to do so may bring about harm. Lithium particle battery cells utilize a science framework which doesn't allow uncertain stream charging.

Slow battery chargers may take a few hours to finish a charge. High-rate chargers may restore most limit a lot faster, yet high rate chargers can be more than some battery types can tolerate. Such batteries require dynamic monitoring of the battery to shield it from overcharging. Electric vehicles in a perfect world need high-rate chargers. For community, establishment of such chargers and the appropriation support for them is an issue in the proposed reception of electric autos.

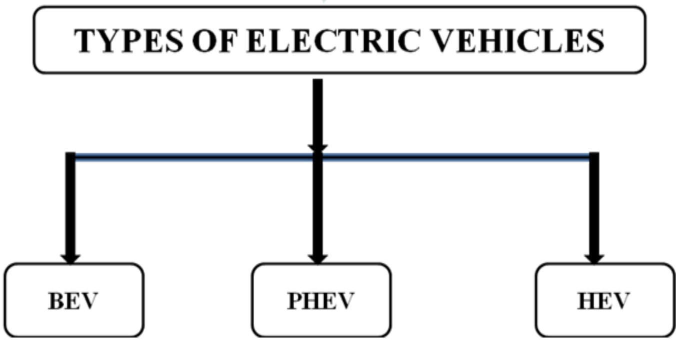

Figure 1: Types of electric vehicles

A decent battery charger gives the base to batteries that are sturdy and perform well. In a value delicate market, chargers frequently get low need and get the "after-thought" status. Battery and charger must go together like a steed and carriage. Judicious arranging gives the power source top need by setting it toward the start of the undertaking as opposed to after the equipment is finished, just like a typical practice. Architects are regularly unconscious of the intricacy including the power source, particularly while charging under unfavorable conditions.

There are three fundamental kinds of electric vehicles (EVs), classed by the degree that electricity is utilized as their vitality source.

Chargers give a DC charging voltage from an air conditioner source whether from a typical attachment outlet or all the more as of late from a reason manufactured DC charging station. Most significant are the techniques for controlling the charge and shielding the battery from over-voltage, over-current and over-temperature. These charger capacities are coordinated with and extraordinary to the battery.

II. PROPOSED MODEL & METHODOLOGY

Figure 2 is showing proposed design model battery charger for electric vehicle application. The entire block name is mentioned in the present model.

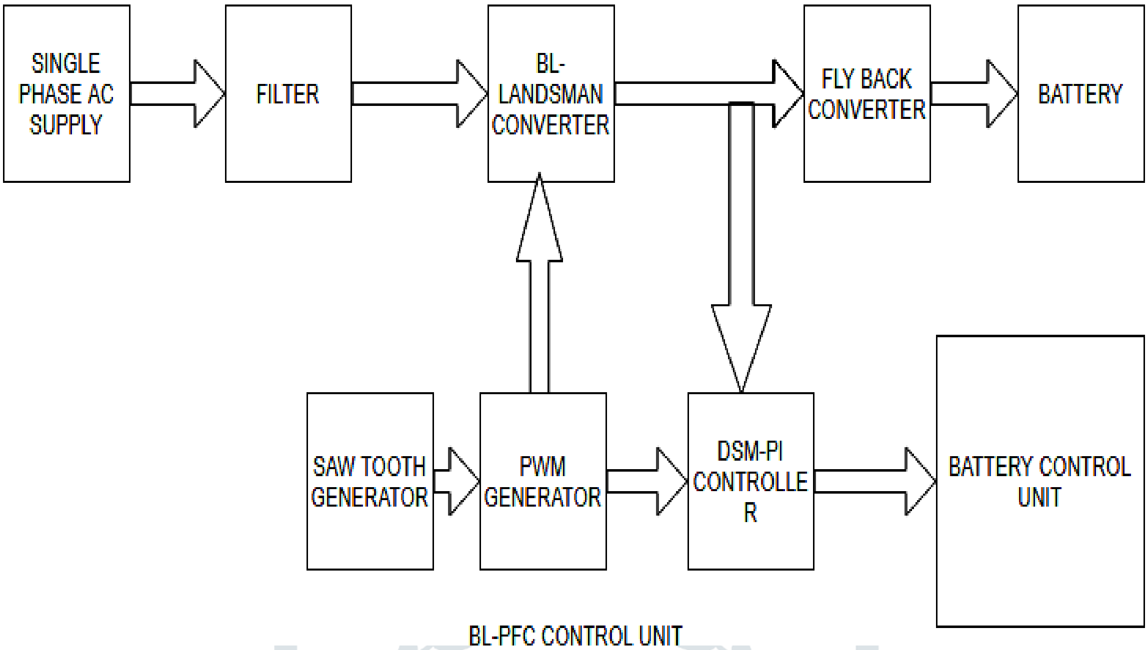

Figure 2: Block diagram of proposed model

The operating principle during positive half cycle, is explained as follows.

Mode P-I (t0-t1): During positive half cycle of mains voltage, the converter operation begins with mode P-I. The switch *SP*, connected in upper line, is in ON condition and the inductor *Lop* starts charging. During this instant, intermediate DC link capacitor, *Co* discharges through the isolated converter connected at the load side. However, the high frequency diode, *D1* has no conducting path during this period, due to the stored charge in the inductor and hence, contains a reverse bias voltage across it.

Mode P-II (t1-t2): The high frequency diode, *D1* operates in mode P-II, when the gate pulse to the switch is prevented. The inductor, *Lop* finds a path, to discharge through it. The DC link capacitor, *Co* starts charging and the flyback converter at the output, is supplied for each switching cycle.

Mode P-III (t2-t3): In mode P-III operation, the stored charge in inductor *Lop* is depleted completely at the end of switching cycle. The inductor current becomes discontinuous for the rest of the switching cycle. During this time, the output power is delivered by the intermediate DC link capacitor, discharging through the path.

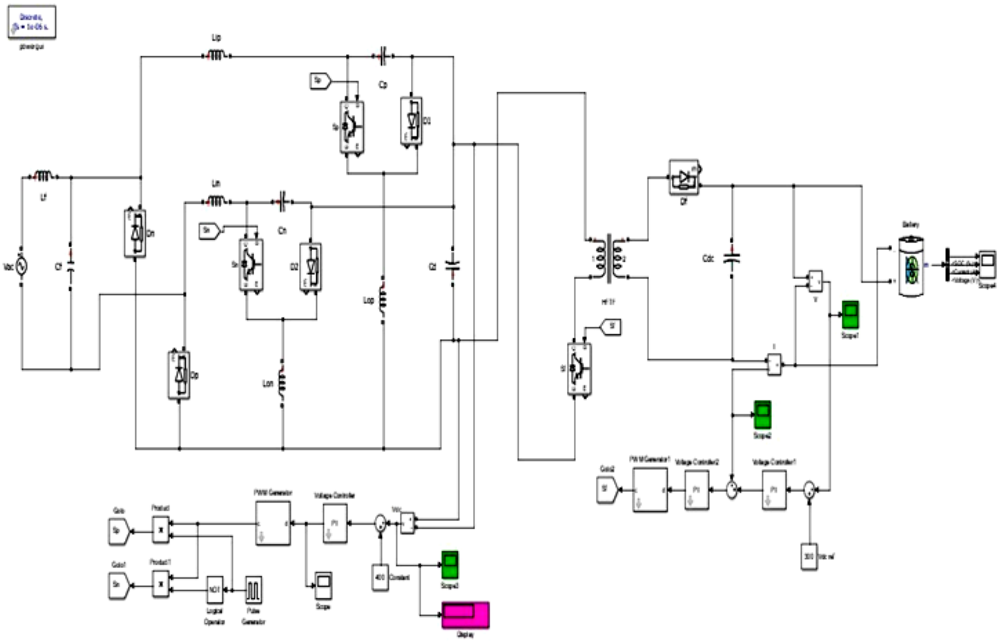

Figure 3: Modeling of proposed topology with PI controller

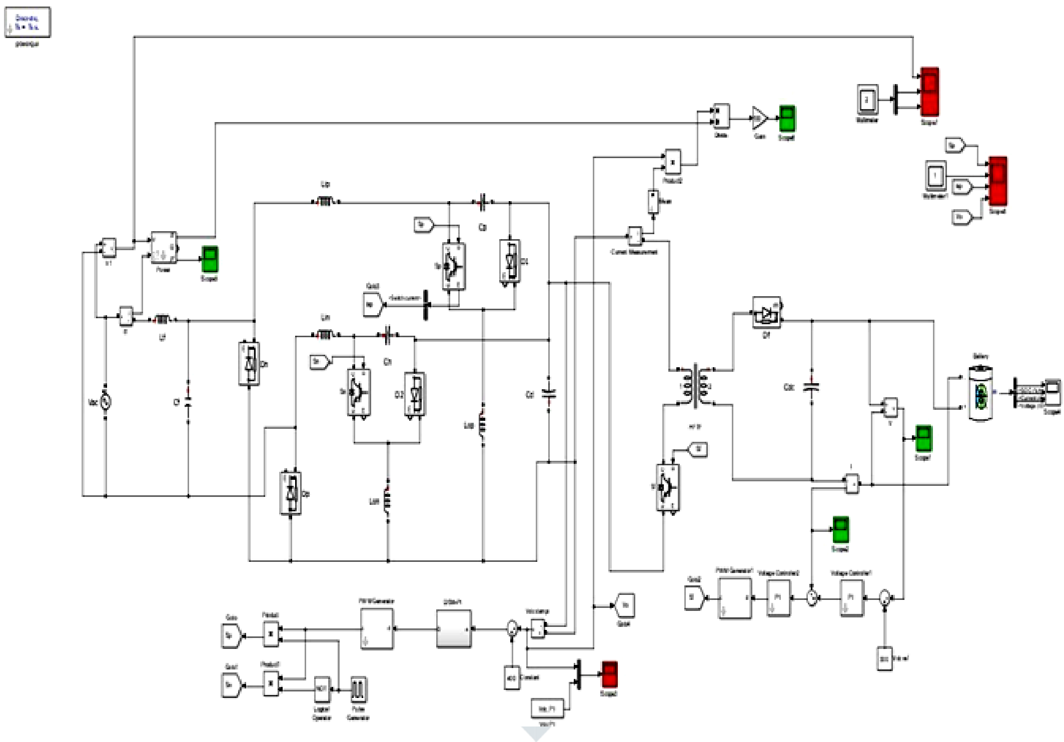

Figure 4: Modeling of proposed topology with DSM-PI controller

The proposed modified converter follows the same switching sequence for the lower switch Sn, inductor, Lon and diode, D2 in negative half cycle of mains voltage, the switching sequence for the components operating in different modes during complete input voltage cycle and switching cycle of proposed converter.

Module

- AC grid
- BL- Modified Landsman Converter
- Flyback Converter
- PWM
- BL-PFC Control Unit
- Fuzzy Logic controller

III. SIMULATION AND RESULTS

Case I :

Power Factor Improvement in Bridgeless Landsman Converter Fed EV Battery Charger with PI Logic Controller

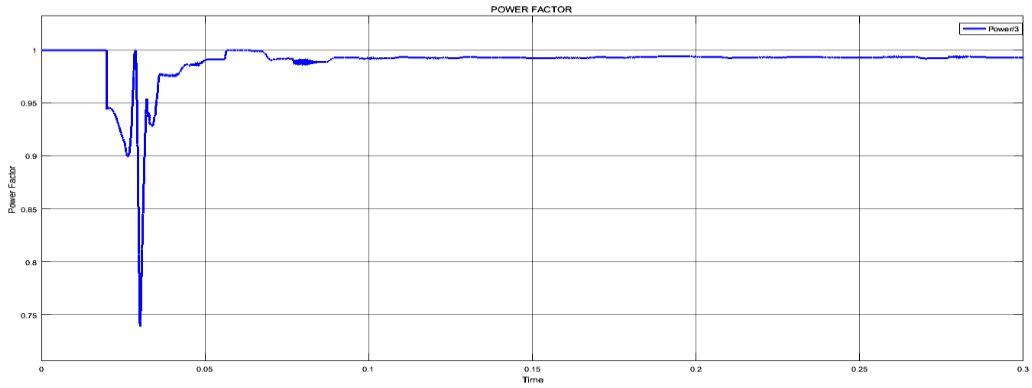

Figure 5: Power factor of source with PI controller

Case II :

Power Factor Improvement in Bridgeless Landsman Converter Fed EV Battery Charger with DSM-PI Controller

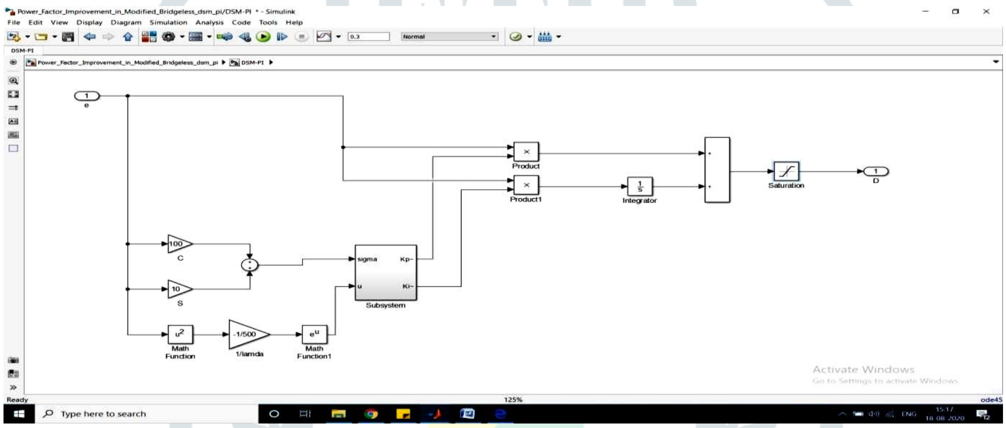

Figure 6: DSM-PI controller

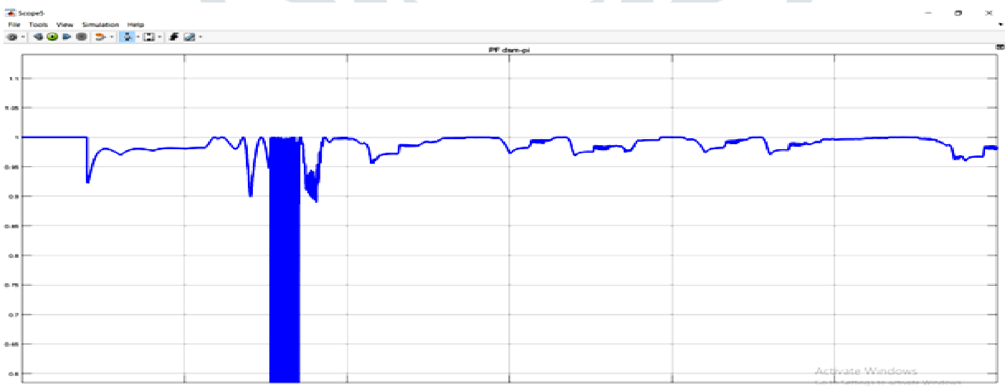

Figure 7: Power factor of source with DSM-PI controller

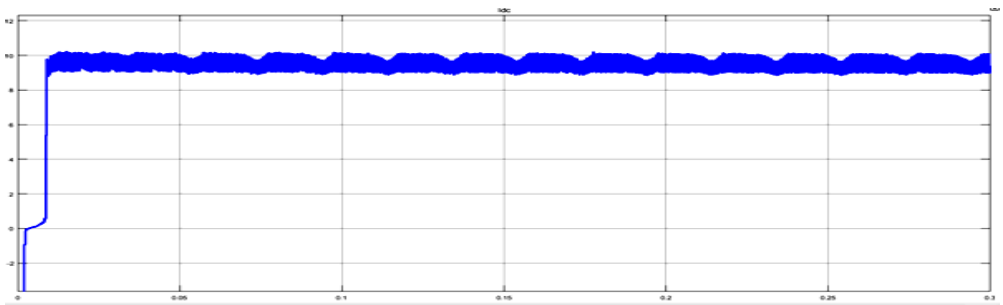

Figure 8: DC-DC Isolated converter current (Idc)

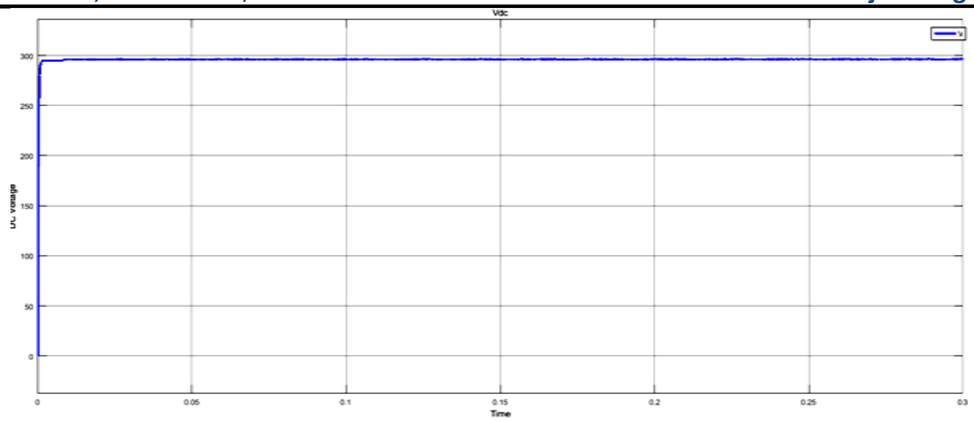

Figure 9: DC-DC isolated converter output voltage (Vdc)

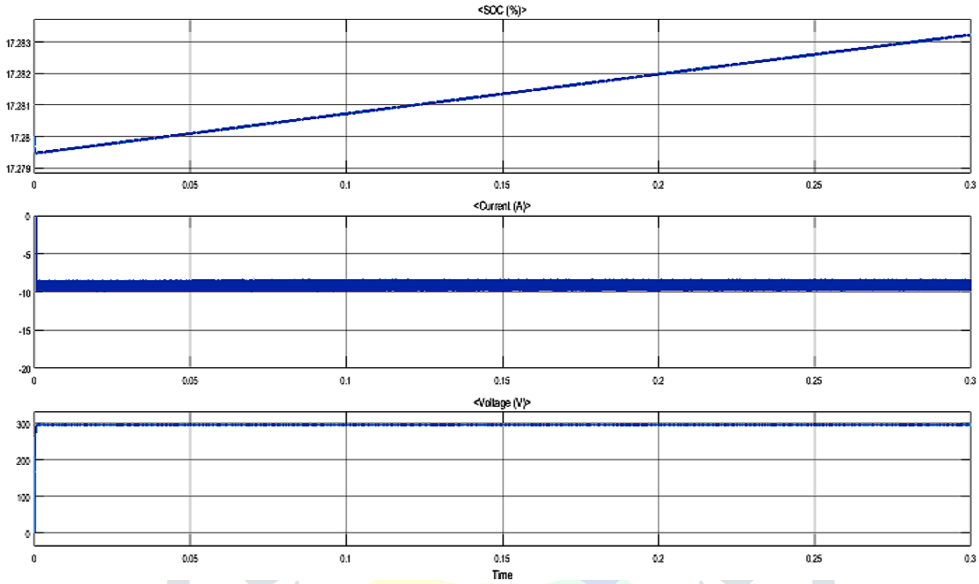

Figure 10: Battery characteristics

The simulation results shows that the proposed model gives better perform than existing work.

IV. CONCLUSION

The power factor correction has been effectively implemented using the Bridge less Landsman Converter followed by a fly back converter. The simulation model is a developed by matlab software. As per the graphs generated with respect to time the power factor of the source is more stable at the initial stage with DSM-PI controller as compared to PI controller. It is show that the performance of proposed charger is found satisfactory for improved power quality based charging of EV battery. The proposed BL converter fed charger aims at cost effective, reliable and suitable option to replace the conventional lossy and inefficient EV battery charger.

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