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Review on High-Efficiency, High-Lifetime and Low- Cost battery electrical vehicle with unity power factor charger

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Abstract : *The Transportation plays important role for the developing country, for that there should be energy sources present. Generally nonrenewable energy sources decide the economies of any nation day by day these sources are reduced and demand increases so that The battery electrical vehicle is the hot topic for today's development In this paper we have suggested the various techniques and methods to operate the battery electrical vehicle at high efficiency in this the output provided to the motor should be free from harmonics that can be controlled using power electronics circuitry. In ordinary converters it was observe that 50% of power loss during the conversion so we replaced that power electronics elements with high efficient power electronics devices also we have suggested the various materials which reduces the cost of battery electrical vehicle also we have focused on the battery life so that the life time of the battery electrical vehicle increases it can be seen in previous chargers there would be operated at lagging power factor because of exchange of the reactive power from converter circuit supply side here we use the cuk converter to operate the converter of the battery electric vehicle at unity power factor with the proper isolation also fast charging can be done*

Keywords:*Electric vehicle, Dc-Dc Converter, Lithium batteries*

I. Introduction

The electricity source of vehicles is changing rapidly and significantly in recent years with the improve in renewable energy technologies in the case electric vehicles (EVs). A smart answer has emerged in which the lost energy in a vehicle's shock absorber is converted to ansubstitute energy for the cars themselves, and this is called an energy regenerative shock absorber. Whereas present regenerative shock absorbers mainly effort on the systems of energy harvesting, there is no such regenerative shock absorber for use in extended range EVs. In this paper, we present a novel high-efficiency energy regenerative shock absorber using super capacitors that is applied to extend the battery endurance of an EV.

Many single stage AC-DC topologies for power factor improvement have been described by Singh et al in. The boost converter is the most widely used topology for PFC applications but to make the unity power factor operation available for wide range of input voltage, buck-boost converter present more attractive solution. Design and analysis of different buck-boost converters for variation in dc bus voltage and input voltages. Some non-inverting buck-boost converters which are suitable for PFC application. Moreover, soft switching and bridgeless based buck-boost topologies has also been developed earlier which offer low switch stress and low conduction loss in the circuit and make PFC operation more effective. However, numerous topologies based on the principle of buck boost converters with high frequency isolation transformer like Cuk, SEPIC, zeta and fly back converters have been selected for this application earlier so that wide range of supply variation can be withstand by these converters A unidirectional isolated Cuk and SEPIC converters have also been designed in the literature in DCM (Discontinuous Conduction Mode). Pal et al, have used the abovementioned isolated converter in DCM mode for LED

Lighting application with an efficient feedback control. Thus an isolated Cuk converter offers a great solution for EV offline unidirectional battery chargers. In this work, an isolated Cuk converter with improved power quality at the AC mains is proposed for EV battery charging applications. The proposed charger draws an input current from utility which exhibit in phase nature with the mains voltage and input current incorporates very low amount of THD

Li-ion batteries have replaced the conventional batteries like alkaline, Ni–Cd, and lead acid batteries in a wide range of applications, ranging from microelectronics to aerospace. The primereason for this sweep is up to two times higher voltage of Li-ion battery (~3.6 V) compared to aqueous batteries (~1.2–2 V) and up to six times higher gravimetric specific energy of Li-ion battery (~240 Wh/kg) compared to lead acid battery (~40 Wh/kg).After decades of intensive research on each component of Li-ion batteries, they can now be titled as one of the most widely used rechargeable systems. Li-ion batteries are also prospective candidates for use in electric vehicles. However, the very facts that give Li-ion batteries an edge over the alkaline and Ni–Cd batteries are also the bottlenecks of this technology. Wide voltage window demands the use of non-aqueous electrolytes. But the known no aqueous solvents are thermodynamically instable in this voltage window. The state of the art Li-ion battery is also called the "rocking chair" battery. It comprises of insertion materials as active materials . The Li-ions shuttle back and forth between the negative and positive electrodes during cycling. The electro chemistry of a typical Li-ion battery is shown in Fig. 1. By far, the most common active material used in the negative electrodes is graphite ($C_6 + xLi^+ + xe^- \_C_6Li_x$). However, there are innumerous other kinds of carbons which have also been used . As positive electrode mostly transition metal oxides and phosphates have been employed, out of which $LiCoO_2$, $LiMn_2O_4$, and$LiFePO_4$ are the most common ones. During first charge of the Li-ion battery the electrolyte undergoes reduction at the negatively polarized graphite surface. This forms a passive layer comprising of inorganic and organic electrolyte decomposition products. In an ideal case this layer prevents further electrolyte degradation by blocking the electron transport through it while concomitantly allowing Li-ions to pass through during cycling. This essential passive layer has appropriately been named solid electrolyte interphase (SEI) . The onset potential of SEI formation is not a fixed value. Literature offers values such as 2V , 1.7V , or 1V , but 0.8Vis the most widely adopted practical value. SEI formation may also continue up to few cycles. However, this parameter cannot be normalized because it depends on a number of factors like nature and composition of electrolyte, nature of additives used in the electrolyte , and sweep rates , etc. It is desirable to have complete SEI formation before Li-ion intercalation begins (>0.3V). It is more difficult to achieve this for disordered carbons as the intercalation begins from 1.5V as compared to ordered carbon where it begins at 0.25V .SEI is a very complicated layer comprising of inorganic components which are normally salt degradation products and organic components which are partial or complete reduction products of the solvent of the electrolyte. The thickness of the SEI may vary from few Atom tens or hundreds of Å . It is difficult to distinctly measure the SEI thickness as some of the components are partially soluble in the electrolyte.

II. Design And Operation Of Proposed Charger With Pfc Cuk Converter

Proposed Isolated UPF Cuk ConverterThe general schematic of the proposed PFC Cuk converter based battery charger has been appeared in Fig.1, with DC interface kept steady at 65 V at the converter's DC end,. This figure demonstrates the charger schematic comprising a DBR, a PFC disconnected converter and the CC-CV control for battery accusing procedure of fell PI controller (double circle). The unregulated dc voltage from the yield of a diode connect rectifier is utilized as power hotspot for the proposed secluded PFC converter. The proposed UPF converter comprises of a high recurrence switch Sw, an information inductor Li, a yield inductor Lo, two middle of the road capacitors C1, C2 and a high recurrence disconnection transformer (HFT).

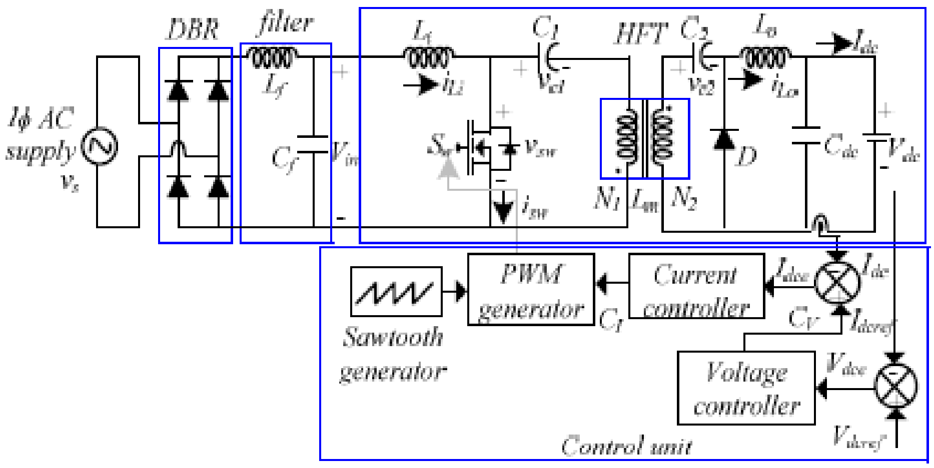

Fig.1 General Schematic of an EV Battery Charger with PFC CUK Converter

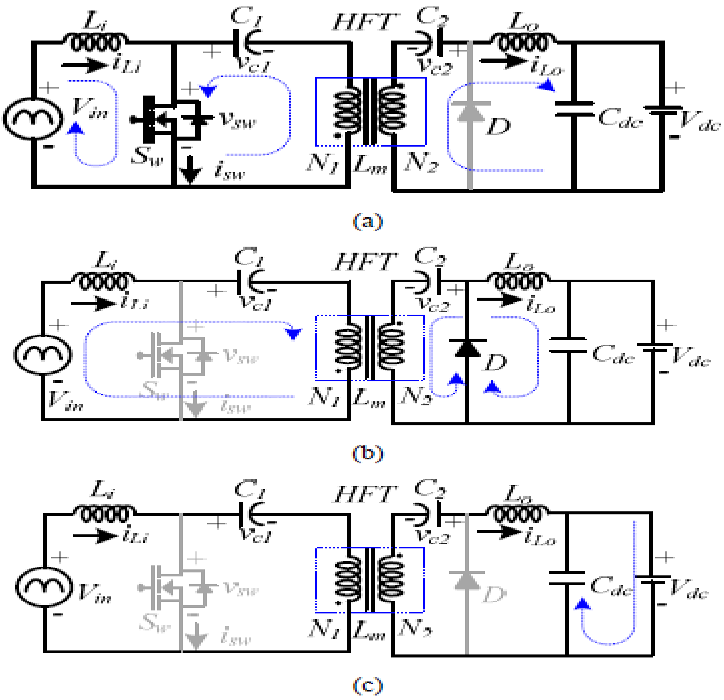

Fig.2 Operation of the proposed Cuk converter with isolation and power factor correction in (a) mode A (b) mode B (c) mode C

The vitality exchange from contribution to yield side happens by means of the middle of the road capacitor C1, C2. The information inductor Li charges through the high recurrence switch Sw when it is in ON condition and discharges its vitality through the capacitor C1.This, thus charges the polarizing inductor of the HFT. When, polarizing inductor charges, the capacitor C2 at the auxiliary side of the HFT begins releasing through the yield inductor and exchanges the expected vitality to the heap. At the point when turn Sw is killed, the diode at the optional side of the HFT ends up forward one-sided and yield inductor finds the releasing way through the dc connection and diode D at the yield, the battery is persistently getting charged from that point steady dc interface voltage kept up over the yield terminals of the proposed charger.

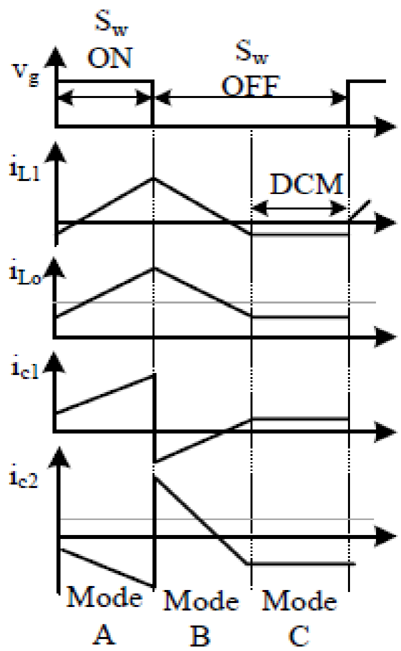

Fig.3 Operation of the proposed Cuk converter with isolation and power factor correction in Switching currentsthrough the different components in circuit

A double PI based shut circle control is utilized at the battery yield terminals to enhance the power quality at the information side of the charger. To control the charge streaming into the battery, the battery voltage, just as current, is detected and contrasted with the ideal reference esteems. The mistake signals are then gone through the PI controllers to produce the fundamental changing grouping to the high recurrence switch. The battery is charged in consistent current mode at first then after a specific limit the control changes to the steady voltage mode control. The swell current in the battery is diminished for the proposed UPF circuit. Distinctive working (Modes A-C) are being spoken to by Figs.2 (a)- (c). These figures are delineating unmistakably the persistent and DCM of activity for various segment utilized in the PFC converter dependent on the conduct of these segments, the current drawn from information is accomplished ideal sinusoidal fit as a fiddle enhancing the info PF to solidarity. In any case, different Operating stages for the proposed Converter are characterized as: Mode A (Fig.2a):

Mode A begins with the ON state of the semiconductor switch S1 amid which input inductor L1 begins charging through the way appeared in Fig. 2(a). The current in the inductor L1 increments with the mains voltage which chooses the slant of the inductor current for the specific moment. Be that as it may, the yield diode D has no current through it because of the extremity of the yield inductor voltage. Along these lines, the vitality to the heap side is exchanged through the at first charged capacitor C1, the high recurrence transformer, C2 and Lo. The current in the yield inductor Lo increments as it begins charging through the vitality given by C2. Different exchanging waveforms for the proposed converter has been appeared in Fig.3 . Mode B (Fig.2b):

This mode begins when door heartbeat to the switch S1 is ceased and diode D comes into conduction. The inductor L1 discharges its vitality through the middle capacitor C1 and high recurrence transformer. Amid this period, capacitors C1 and C2 begin charging through the inductor L1. The charging current to the battery is given by the yield inductor Lo which releases through the battery, as showed in Fig. 2 (b). Mode C (Fig.2c): Amid this mode, the semiconductor switches S1 and D1 are "off" and the dc connect capacitor controls the charging current through the battery. The polarizing inductance of the HFT is released totally toward the finish of this mode; be that as it may, switch S1 resumes its typical activity cycle for example ON condition. Thusly, the proposed planned circuit is splendidly good with the IEC 61000-3-2 control quality (PQ) standard and henceforth it is appropriate for current EV battery charging applications.

2.1. Components of SEI

The creation of the SEI is a profoundly discussed subject. It is very reliant on various components, which are nitty gritty in Section3. Proposed organization of SEI fluctuates starting with one research bunch then onto the next as working conditions in various labs can be unique. In this way it is difficult to standardize or sum up the synthesis or even substance of SEI. Table 1 records what different research bunches accept to be the significant segments of the SEI. Countless salts (hastens) starting from salt decreases might be available in the SEI. Subsequently, all the conceivable (revealed) inorganic segments are not recorded. We list the most conceivable and regular SEI segments alongside their references to the best of our insight.

2.2. Changes in SEI at elevated temperatures

The SEI structure and thickness does not remain steady all through cycling or capacity . There are various way sin which it can change. It might incompletely break up in a dissolvable of the electrolyte, e.g., dimethyl carbonates (DMC) . Its thickness may likewise differ amid cycling. SEI is accepted to be thicker at lower possibilities (contested condition of carbon) and more slender at higher possibilities (delithiated state) . Anyway the progressions showing up in the SEI are increasingly articulated at lifted temperatures . There are two prime responses that happen on hoisting battery temperature. First change of SEI happens. Here, the segments like lithium alkyl carbonates and semi carbonates convert to the steady segments like Li2CO3. Be that as it may, the temperature at which this happens is exceptionally reliant on the salt and dissolvable of the electrolyte, kind of carbon material, and its particular surface territory. For 1MLiPF6 in ethylene carbonate (EC) and diethyl carbonate (DEC) the beginning temperature was observed to be 105 ◦C.Whereas for LiBF4containingelectrolytes it was as low as 60 ◦C. The second procedure happening at high temperature is the response of dynamic material with the SEI, or SEI with the electrolyte, or dynamic material with the electrolyte. This starts at 120– 140 ◦C . At this temperature, the changed SEI enables Li from carbon to come into contact with the electrolyte and electrons to go through the SEI. Past this temperature, significantly increasingly exothermic responses like that of prosecuted carbon with fasteners (for example Polyvinyl-idenedi-fluoridehexafluoropropylene(PVDF-HFP) at 350 ◦C happen . All these exothermic procedures are adverse for the execution of a Li-particle battery and are basic from the wellbeing perspective. In this way they are cautiously analyzed by thermo investigative system, for example, differential examining calorimetric andquickened rate calorimetric.

2.3. Impact of SEI on battery execution

Each parameter and property of the SEI altogether influences battery execution. The piece, thickness, morphology, and Compactness are a couple to name. Irreversible charge "misfortune" (ICL) in the primary cycle happens because of dissolvable decrease and SEI arrangement and is thus a normal for SEI . Inconvenient procedures happening amid capacity (self-release) additionally rely upon the capacity of the SEI to lack of involvement dynamic material surface. Thus, timeframe of realistic usability of a battery additionally relies upon SEI . As referenced above SEI may likewise break up and additionally develop amid cycling. Accordingly, powerful and stable SEI is compulsory for good cycling life of the battery . It turns out to be considerably increasingly vital amid cycling at high rates and at deeperdepth of release. SEI parts are very temperature touchy. Consequently, execution of the battery at high/low temperature is reliant on the SEI . Anyway the most vital result of SEI is on the security of the battery.

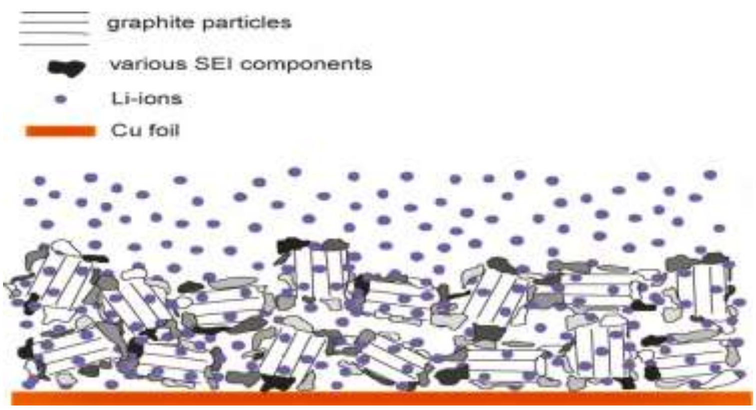

Fig. 4 Sketch of a litigated graphite composite electrode covered by inhomogeneous SEI.
The SEI components shown in darker shades of grey are mainly inorganic while those shown in lighter shades of grey are organic

2.4 Factors affecting SEI

Numerous indispensable variables add to properties of the SEI. There is no outright parameter encircling the SEI. It is the blend and accompanying impact of every one of these elements which manages the properties, quality, and proficiency of SEI. Subsequently, the subsequent impact of numerous components recorded in this segment is aggregate and reliant as opposed to free.

III. Improvement Of Regenerative Energy For An Ev

3.1 Improvement of Regenerative Energy for an EV

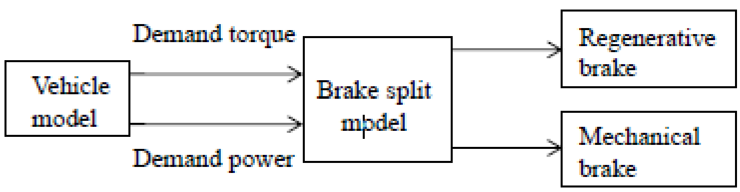

Fig. 5 Brake model

Brake display is appeared in Figure 5. The brake compel is separated into the mechanical brake and the regenerative brake by the brake split model. The mechanical brake constrain is characterized as an esteem subtracts the regenerative brake compel from the interest brake direction.

3.2 A proposed strategy to build the measure of the regenerative vitality

The regenerative brake of EVs, HEVs is restricted in view of the engine limit and the present furthest reaches of the battery as depicted above area. Thus the regenerative electric brake as well as the mechanical brake must be utilized. To expand the regenerative vitality, the engine limit and the battery limit are asked for to be substantial; anyway it is extremely troublesome as a result of the expense and the limit of the inverter limit. Along these lines, in this paper, the regenerative vitality is expanded by enhancing a breaking technique without changing the power train framework.

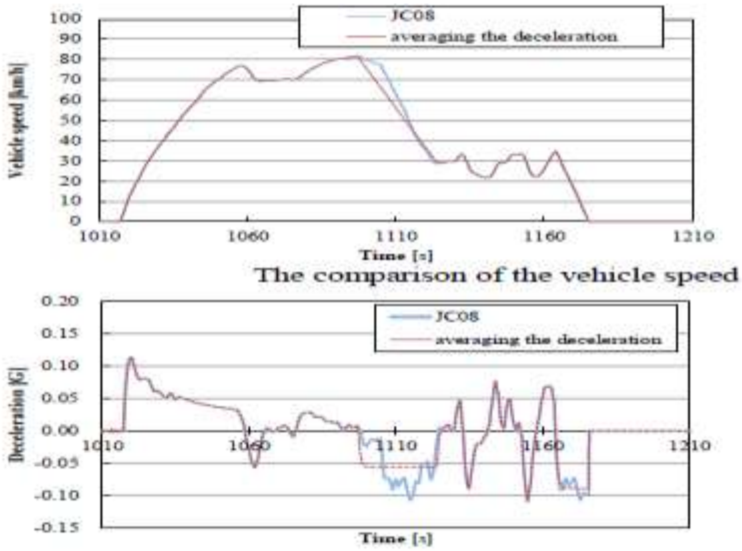

Fig. 6 The comparison of the deceleration

3.3 Averaging the deceleration technique

For instance JC08 mode which is utilized for the fuel utilization estimation in Japan is utilized as appeared in Figure 7. The proposed technique is averaging the deceleration when the vehicle is decelerated. Figure 8 demonstrates a correlation of the deceleration between the JC08 display and the proposed model. The deceleration of the proposed model is littler than the JC08 demonstrated by averaging the deceleration. Figure , 8 demonstrate the correlation aftereffects of the vehicle speed, the deceleration and the interest brake control, individually. Figure 07 demonstrates the deceleration of the proposed model is half of the most extreme estimation of the first model by averaging the deceleration. Thus the deceleration as well as the maximum interest control is decreased 66% esteem. Subsequently the regenerative vitality of the proposed model is bigger than the JC08 display notwithstanding when the regenerative brake is constrained by the info current limit of the battery. Averaging the deceleration strategy can be accomplished by utilizing a driving help device, for instance, the deceleration flag is appeared on a showcase with the route which gives the exhortation to the driver on the ideal vehicle task , or controlling a brake pedal by applying a stopping mechanism like a functioning quickening agent pedal, which demonstrates the proportion of increasing speed of the driver.

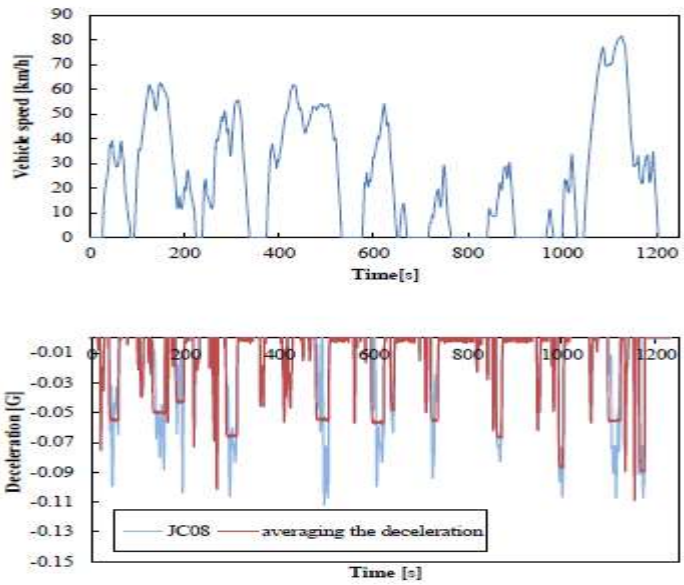

Fig. 7 (a)JC08 MODE and (b)Deceleration.

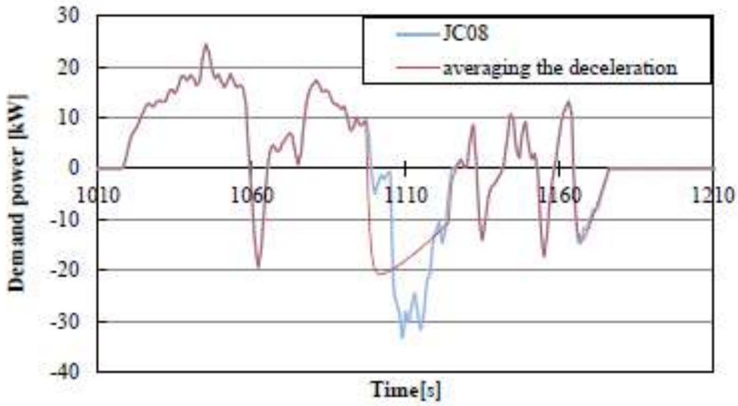

Fig. 8 The comparison of the demand brake power

IV. Conclution

A decent SEI on negative terminal is an essential for good execution of a Li-particle battery. Examining, breaking down, and understanding the SEI have underlined the noteworthiness of the numerous viewpoints identified with it. It is clear that there are numerous related and connected elements affecting the SEI and numerous associated and corresponded results of SEI on battery execution. the motivation behind why the regenerative vitality is constrained is right off the bat appeared, and a make strides technique to ingest the regenerative vitality is proposed. The proposed strategy is acknowledged by the driving task, the regenerative vitality is tremendously expanded, for instance it is powerful to adjust to people in general transport in light of the fact that a transport path enables the ideal deceleration to retain the regenerative vitality

A disconnected Cuk converter based battery charger for EV with astoundingly enhanced PQ records alongside very much directed battery charging voltage and current has been planned and reproduced. The converter execution has been discovered acceptable and well inside standard for evaluated just as various differing input rms estimation of supply voltages. The impressively enhanced THD in the current at the source end makes the proposed framework an appealing answer for proficient charging of EVs requiring little to no effort.

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