

Improved Charger for Electric Vehicle

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ABSTRACT: The numbers of electric automobiles are quickly increasing. Recharging facilities for electric vehicles are also becoming more frequent. This article examines the present state of rechargeable batteries, charge power levels, including charging techniques for electric cars, as well as their application. There are two types of off-board or on charging systems with or without dual power flow. The use of unidirectional charging reduces the amount of hardware required and simplifies connecting concerns. Battery - based energy injection back to the grid is made possible through bidirectional charging. Since of weight, space, or cost limits, most on-board chargers limit power. To circumvent these issues, they may be incorporated with the electric drive. This paper produces a different phase 230volt off boards charger utilizing CC, CV, or CC-CV charging techniques, as well as simulation results comparing the aforementioned approaches using a 3.2volt, 10AH battery pack in MATLAB.

KEYWORDS: Battery, Electric, MATLAB, Vehicle.

I. INTRODUCTION

A. Types of Charging Level in EV

- Level 1 (convenience), The charging voltage for electric vehicles is 120 volts. It normally takes 16 to 20 hours to completely charge the battery using this method.
- Level 2 (primary), 240 volts is the standard for Level 2 charging for electric cars. This form of charging necessitates the use of additional hardware.
- Level.3(fast) At public charging stations, level 3 charge for electric cars is available. DC fast charging transforms AC power into DC current for direct storing in electric car batteries and is referred to as DC fast charging.

The power levels are commonly addressed at 480 volts. Fast chargers for Li-Ion batteries (LIBs) are now needed for a variety of applications, including EVs, smartphones, computers, and tablets. Fast charging requires high converters in charging stations (EVCSs) to inject maximum current in constant current mode. At the conclusion of the current controlled charging procedure, this results in a large voltage drop just on internal resistance or polarization characteristics. Furthermore, since a high charging current might shorten the battery's

life, the charging process should be accurately managed. LIBs are used by a lot of electric vehicles. As a result, the charging mechanism for LIBs must be investigated. In this work, many charge mechanisms are presented, including as [1]–[3].

- Charging with a constant current (CC),
- Method of fixed voltage charge (CV), (CC-CV).

Power circuits, such as Dc-Ac inverters and DC - DC conversions, are an important part of any modern electric vehicle. A DC-AC inverter is used to power large electric motors or utility demands like air conditioning, whereas a DC - DC converter is used to power small, low voltage loads [4]–[6]. However, as shown in Figure 1, the demand for high-power bidirectional DC-DC converters in future electric cars has led to the creation of a slew of novel Dc - Dc converter topologies.

B. Block Diagram of EV Battery Charger

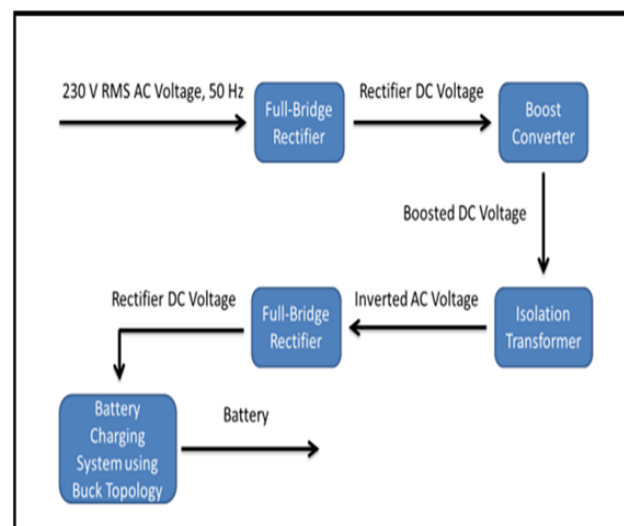


Figure 1: Illustrate the EV Charger Block Diagram.

Block.1 complete bridge rectifier is seen in the EV charger block diagram. When a single-phase ac power is converted to dc, it may quickly overheat and destroy the battery, shortening its life.

C. Constant Voltages Charging Methods (C Method):

The charging is maintained just at maximum level which should be applied to an in the constant power charging method, but also changes in the present while full charging

is approached. This strategy is efficient only for lower voltages where average temp is not a problem, or else time of able to charge is the main co this method [7]–[9].

a. *Constant Currents Constant Voltages:*

1. *Charging Methods CC CV Charging Methods:*

This technique of continuous common strategy to battery charging uses a complete bridge converter to provide a supply and then uses constant current till the battery is fully charged a preset filter circuit to smoothen the output. The dc continues to drop until the battery receives a full charge. Although this is the usual technique for charging batteries, it has its limitations.

2. *Block-2 boost converter*

In second stage, dc to dc converters is utilized to increase the voltage level at desired level of charging.

Block -3 isolation transformer:

It is necessary to shield the charge controller from of the control circuit, but it transforms the greater dc voltage to the applicable ac inverted voltage accessible at the transformer secondary.

3. *Block - 4 full bridge rectifier*

Now, with the help of filter circuits, a rectifier is employed to convert the inverted ac voltages from the transformer secondary to dc voltage.

4. *Block-5 buck converter*

Buck converters are used to reduce the voltage from of the FBRC by using MOSFET switches, diodes, and inductors, and the buck converter's output is applied to the battery.

D. *Methods of Charging Lithium-Ion Battery(LIB)*

a. *Constant Current Charging Methods:(Cc-Method)*

This charging process offers a consistent current while the battery voltage climbs to its full charge value. Because battery polarization is a problem, even if the constant current provided is within the rated current, the battery may be charged with a continuous current [10]–[13]. This CC-CV technique has been tweaked to incorporate numerous constant current phases, which improves the battery charging rate even further. Figures 2 and 3 indicate the battery specifications utilized in MATLAB testing and experiment purposes:

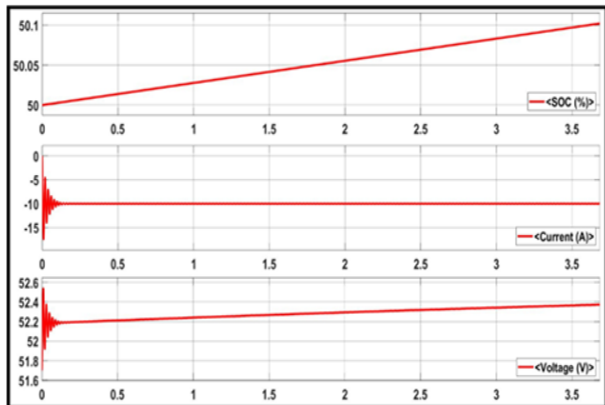


Figure 2: CC-Charging Circuit of LIB Cell (3.2V,10AMP-Hour) In MATLAB

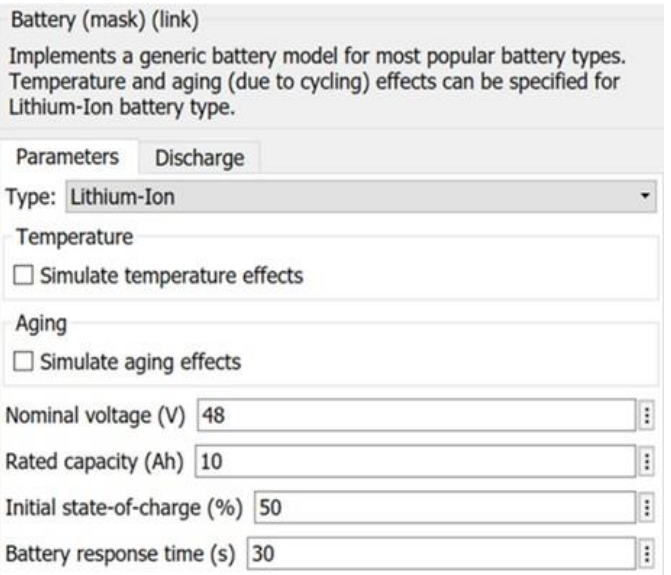
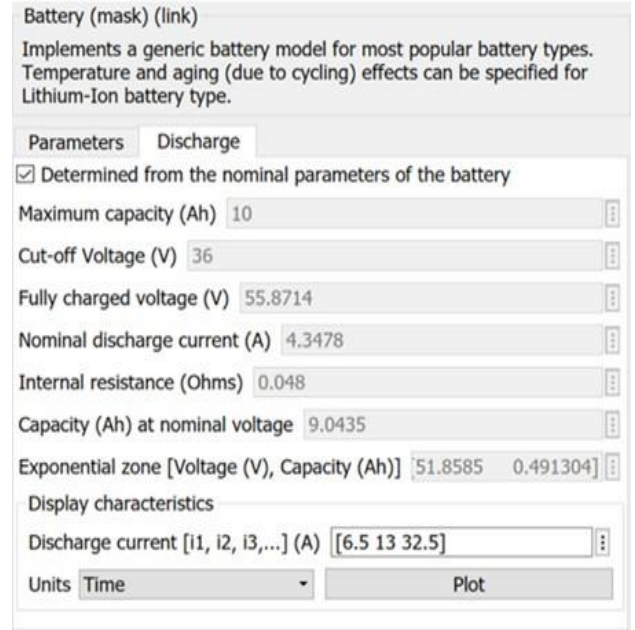


Figure 3: Illustrate the Implements a generic battery model for popular battery.

E. *Constant Current Charging Method*

In this method, a lithium-ion battery is charged with a continuous current of 10 amps, and the charge level of the battery is measured from 50 to 50% (0.1charge), as given in table 1.

Table 1: Constant Voltage Charging of LIB Results in MATLAB:

Current	10 amperes
Voltage	52.45VOLT
SOC (50%)	50.1%
TIME	3.5 SECONDS

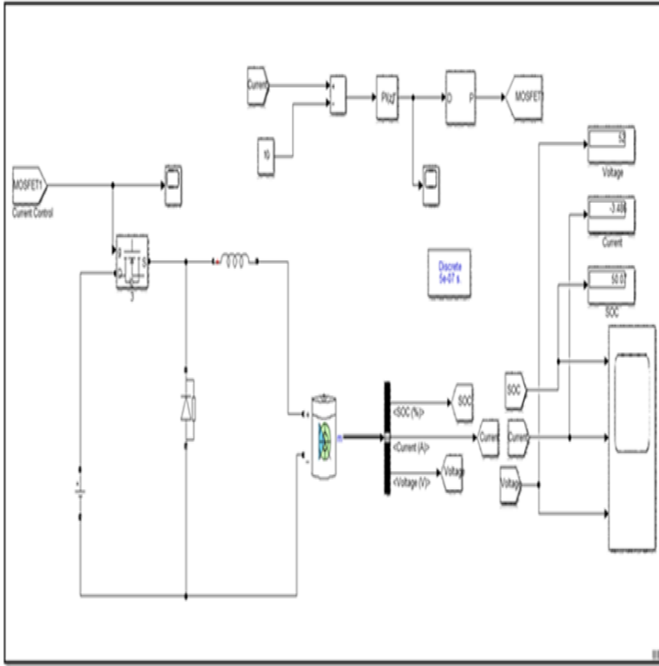


Figure 4: Output Waveforms of SOC, Voltage, Current IN CC Mode.

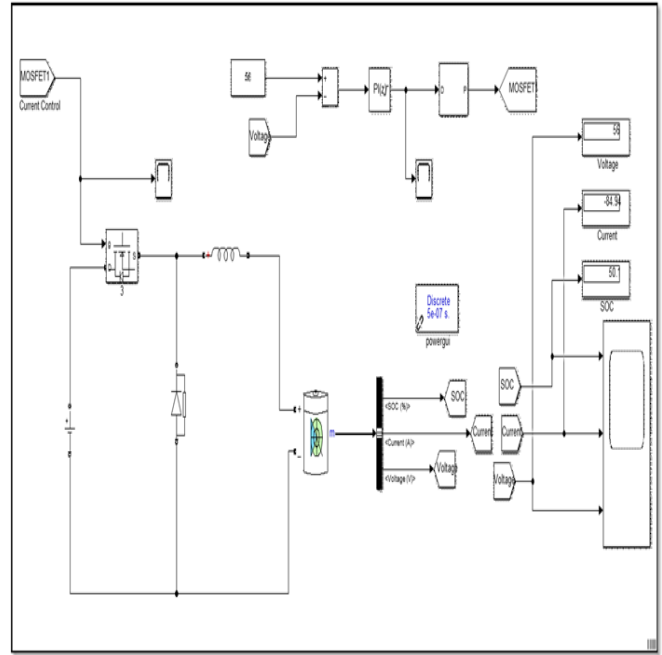


Figure 6: CV Charging circuit in MATLAB with 56 volt constant

Results of state of charge, voltage, current for 0.4% charge increases is shown in below figure 7.

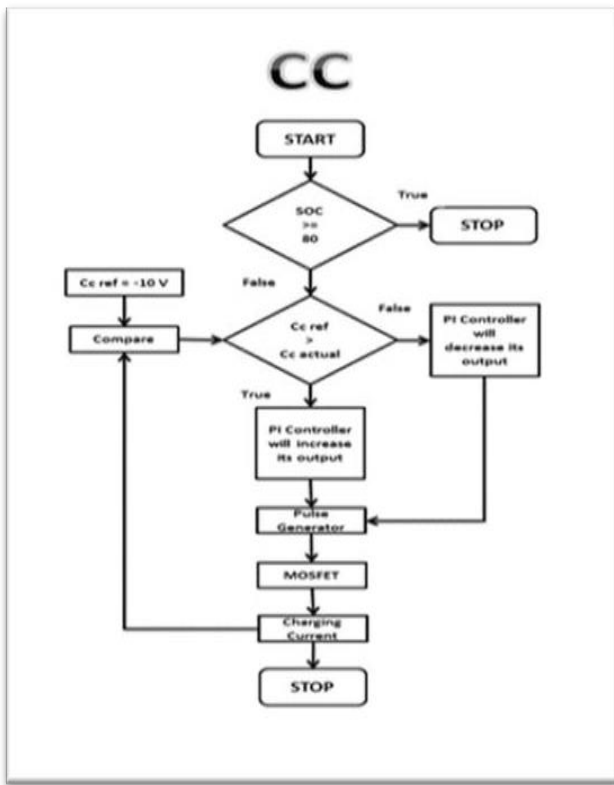


Figure 5: Illustrate the Flow Chart of CC Charging Method

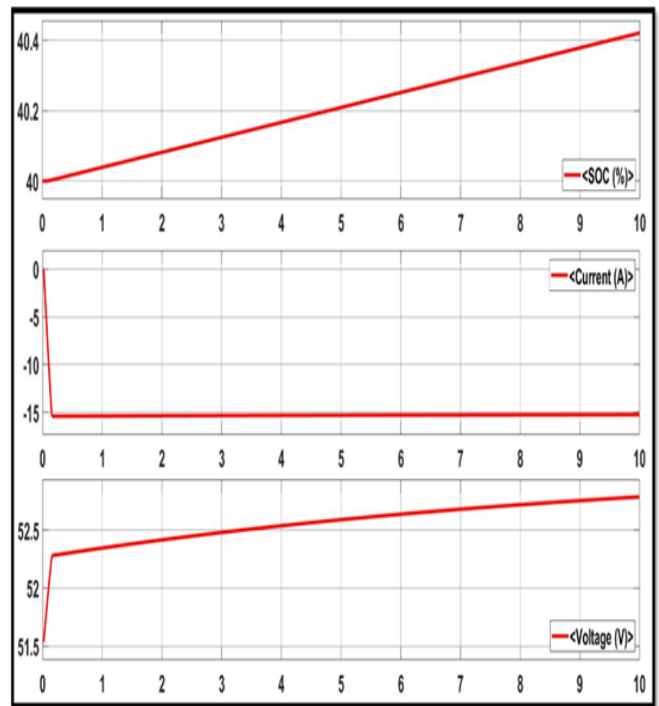


Figure 7: Output Results in MATLAB in CV Charging Method

Constant Voltage Charging Method: MATLAB (56 Volt) Constant voltage is provided to LIB for EV charger in this technique of charging, and the condition of charges, current, as well as voltage are monitored as the soc grows. Waveforms of Soc, Voltage, or Current flow Create a CV charging circuit with an operating voltage of 56 volts in Cc Mode using MATLAB, as illustrated in Figures 5 and 6.

Table 2 shows that SOC grows by 40 to 40.4 percent, voltage stays constant at 56 volts, and current is reduced to 15 amp in 10 seconds using the CV Charging technique. So, since CV charging takes longer than CC charging for battery chargers in EV vehicles, I suggested a rapid charging technique of CC-CV for EV batteries, as illustrated in Figure 8.

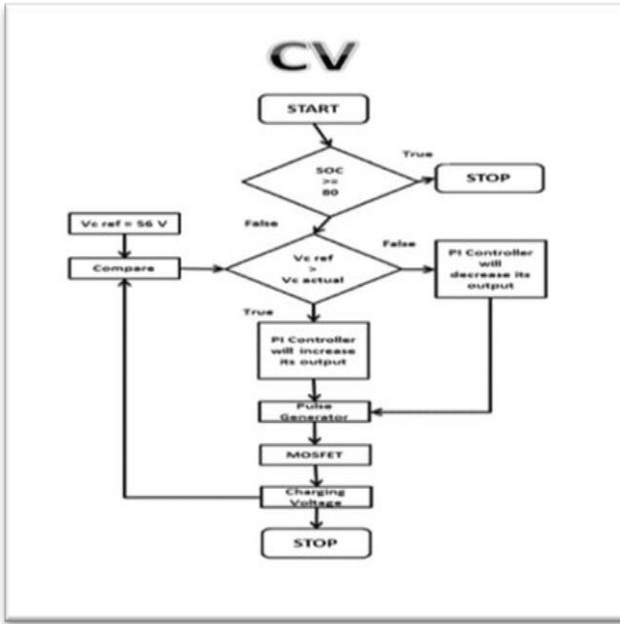


Figure 8: Illustrate the Flow Chart of CV Charging Method

When comparing the LIB's CC as well as CV charging methods, the CV technique takes longer to charge than the CC method, while the CC method also takes longer to charge the battery, taking 6 to 7 hours to reach full capacity. To overcome this issue with the EV battery's CC or CV charging methods, another charging technique is employed, which minimizes the battery charging time when compared to both CC or CV Charging methods, as illustrated in Figures 9 or 10. For this, I used MATLAB to simulate the CC-CV METHOD of charging, which is a mixture of the two approaches.

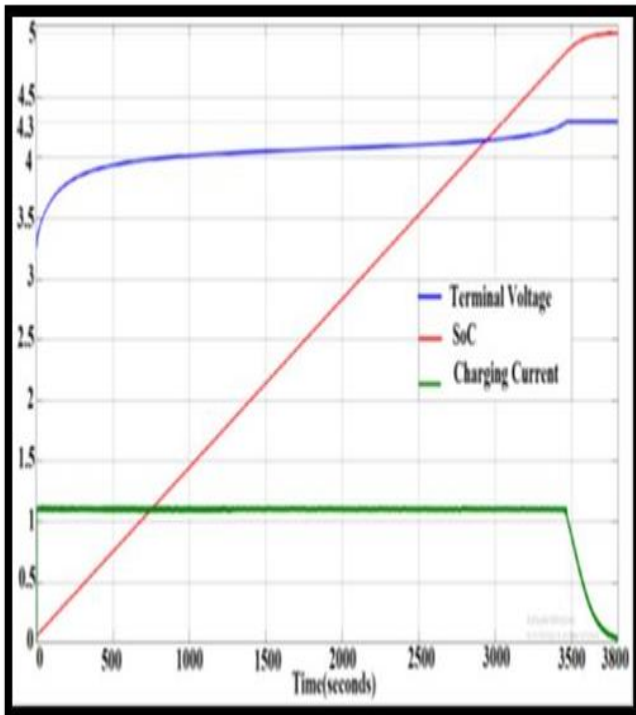


Figure 9: CC-CV Charging behavior of SOC, Voltage, Current

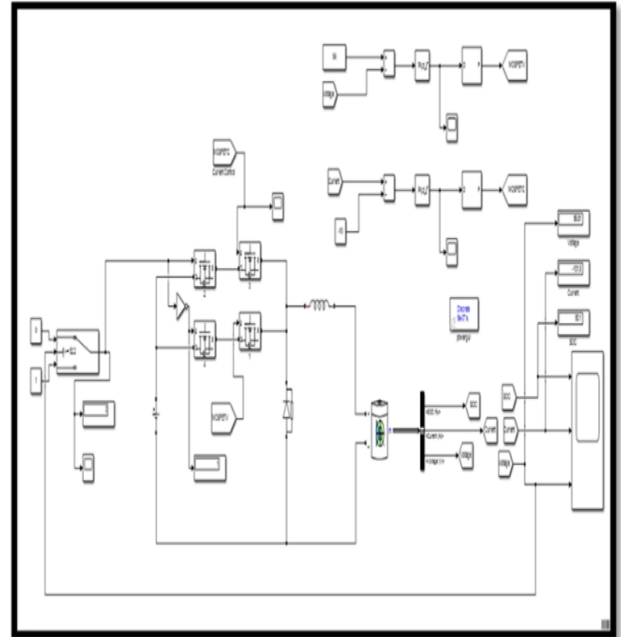


Figure 10: CC-CV Charging of LIB in MATLAB. Constants Currents Constant Voltage Charging Methods.

As shown in the illustration above. 6. While using the CC-CV technique of charging, first provide a constant current towards the battery, then apply a constant voltage whenever the voltage reaches a dominating value. Battery SOC rises from 50 to 50.1 percent in 0.61 seconds in the example above. In MATLAB, Table.2 shows the results of constant power charging of LIB. A comparative analysis of charging is carried out in MATLAB, as illustrated in Figure 11.

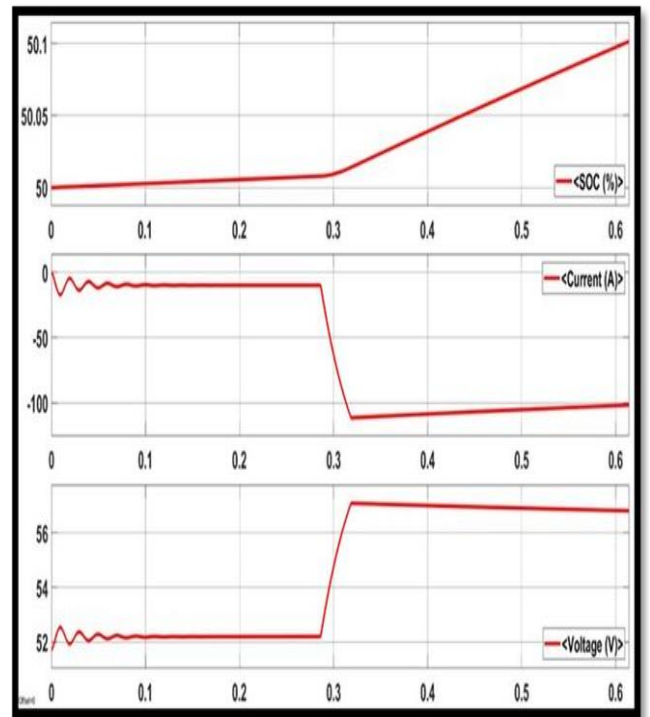


Figure 11: Comparative analysis of charging in MATLAB:

Table 2: Simulation results of CC-CV charging in MATLAB

PARAMETERS	CC	CV	CC-CV
STATE OF CHA	50-50.1	50-50.	50-50.1
CURRENT	10	18	10(CC)-100(CV)
VOLTAGE	52.23 V	56V	52-57V
TIME	3.1 SEC	3.6 SEC	0.61SEC

II. DISCUSSION

Our world has seen substantial changes as a result of technological advancements during the previous century. Increasing pollution or climate change have the most detrimental consequences. Because conventional cars rely on fossil fuels, they have a significant impact on the environment or climate change. Charging infrastructures consisting of low-cost Level 1 chargers for home usage or Level 3 rapid chargers for public use are required to build an EV market. A quick charger is necessary to develop the EV market, but its power should not be too high for ease of installation. Because daily driving range is restricted and chargers are not used frequently, it may not be required to install as many rapid chargers. A public charger should be capable of safely and effectively supplying energy to various types of electric vehicles.

III. CONCLUSION

MATLAB was used to explore a LIB charging control mechanism in CV, CC, and CC-CV combined mode in this work. With a 3.2-volt, 10-amp-hour battery. The suggested quick charging control approach makes use of a multi-stage current depending on the internal impedance of the battery. This method of charging is based on a controller that incorporates both battery pack or charger models. In this author talks about Improved Charger for Electric Vehicle. Continued testing and experimentation with different charging ways of LIB, large power Li-ion batteries stack for the future charging strategy is ongoing.

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