Bidirectional buck boost converter with PI control for Electric Vehicle Application

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***Abstract*—This paper represents a PI control Bidirectional buck boost converter for electric vehicle application. Electric vehicle is known for the cleanliness and environment friendly. So, a source for electric vehicle source with highly efficient converter that can be used for less price as we know the fuel prices are very high so a less price source has been research in many papers. In this paper a converter is proposed that will supply the electric vehicle.**

***Keywords*—Electric Vehicle, bidirectional converter, buck boost operation, PI control**

I. INTRODUCTION

As electric vehicle technology is growing in the market the research work on the EVs is also increasing, in EVs a main part comprises with the energy storage system used in the vehicle a simple energy system is mentioned in [1] and for further efficiency a hybrid energy storage system has been mentioned in [2]. A bidirectional converter is mentioned in [3] which helps in charging the electric vehicle and works in discharging also. In this paper a bidirectional converter is proposed with buck boost operation that will be controlled with the help[of PI controllers. Hybrid electric vehicles is mentioned in [4] with the topologies mainly consists of isolated and non-isolated bidirectional and unidirectional converter for the application for electric Vehicles is commercializing and the cost effective EVs should be built to give access to all people and to make it more efficient by making storage capacity more ability to store more electrical energy and it can supply the vehicle for long time with good power output and efficiency. Increased usage of electric vehicles will help to reduce greenhouse gas emissions while also increasing petroleum prices. Electric transportation necessitates the establishment of a diverse variety of energising systems in a user-friendly environment to facilitate choosing has been proposed in this paper with more modification can be made in future. A converter can work in both directions that is it can flow power in both directions of the circuit with the help of a bidirectional converter. A bidirectional can be of many types but mainly it is divided into isolated and non-isolated. A bidirectional buck-boost converter can work in boost mode and buck mode. In general, bidirectional has a source side a load side. The components in between can be varied. In a mode, we can feed power to the load, and in another mode, the load can also feed the power back to the source. The main applications of bidirectional converters are mainly related to an electric vehicle. As in the present time electric vehicle is used for their cleanliness and low impact on the environment. In these converters, there is generally, one side which is the high-voltage side, and the other is the low-voltage side. As in these converters, many passive components and switches have been used, so there are many losses generated from turning ON and OFF the power switches consisting of in the converter as its very fast transition of voltage and currents occur on the power switches, soft switching is used to reduce switching losses and to improve power density. Mainly there are two types of basic soft-switching zero voltage mode and zero current mode.

II. IMPLEMENTATION

F The implementation of the bidirectional converter for buck boost application with a PI control is implemented in MATLAB 2018a.

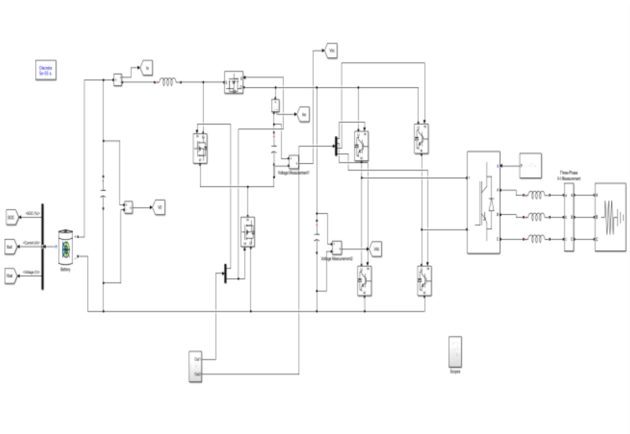

Fig 1. Proposed model of the Bidirectional converter

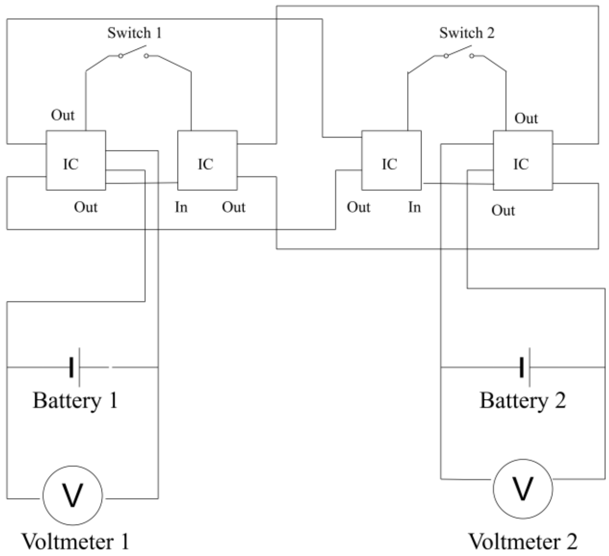

Fig 1(a) Circuit diagram for the bidirectional converter

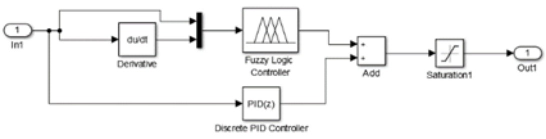

Fig. 2: FISPI controller

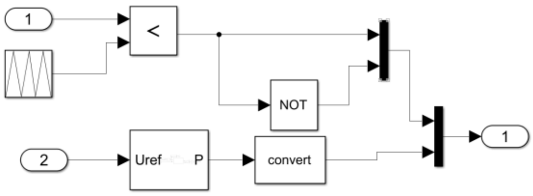

Fig 3. The selector control for the mode selection

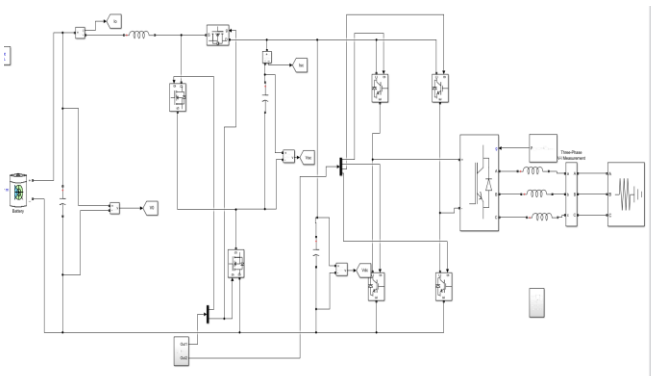

Fig 4. Model for the boost mode operation

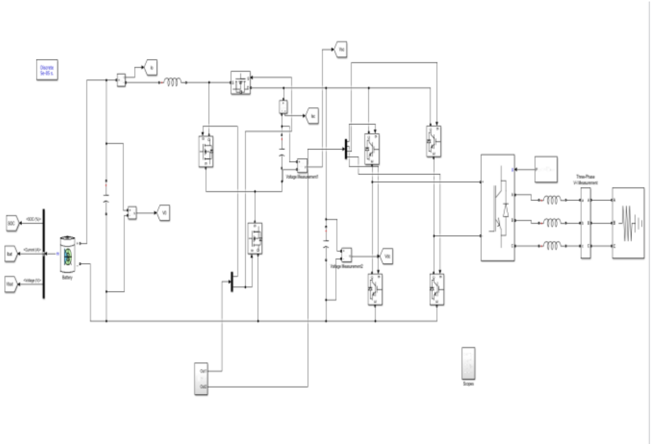

Fig 5. Model for the buck mode operation

```
function [va,xy] = fcn(d1,d4,d3,d2,pg,pb,psc,pscmax)

if (pg>pb)
    if(psc<(0.81*pscmax))
pg=psc+pb;
        ds=1-d2;
        dw=d4;
    else
    pg=psc+pb;
     ds = d1;
    dw=d4;
    end
else
    pg=pb;
   ds = d1;
    dw=d4;
end

va=ds;
xy=dw;
```

Fig 5(a). Subsystem code for choosing the mode for converter i.e., charging and discharging

III. RESULTS

This section shows the results from the implemented model.

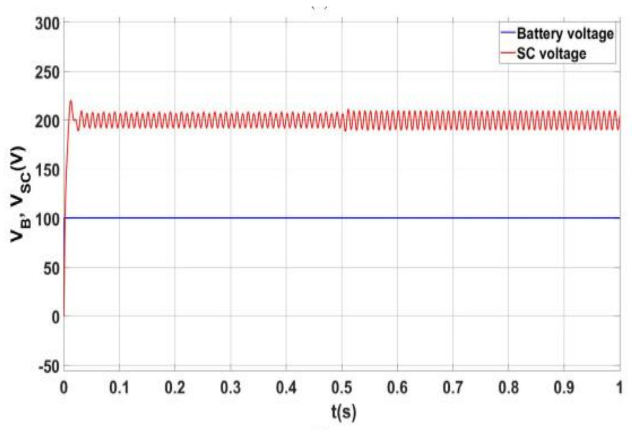

Fig 6. Output for Boost mode

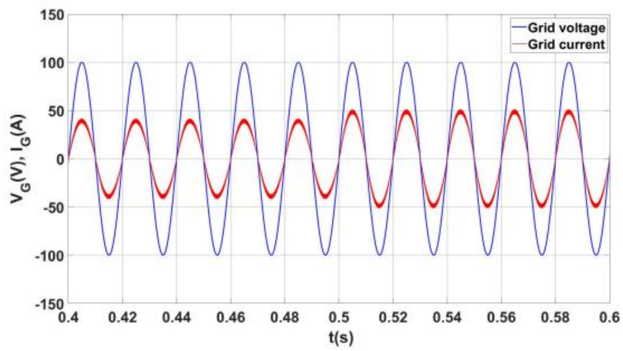

Fig 7. Output Voltage and current

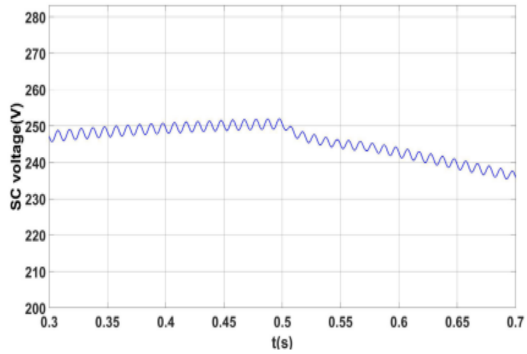

Fig 8. Output for buck mode

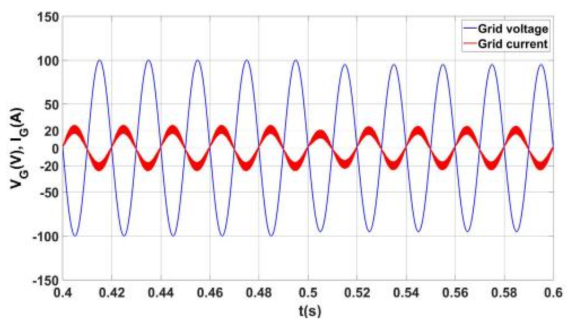

Fig 9. Output voltage and current

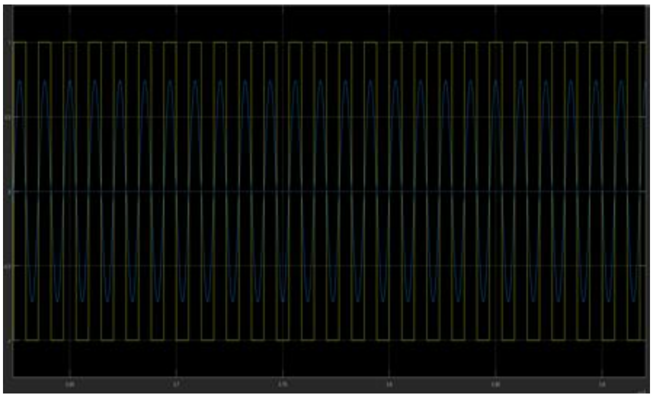

Fig 10. Waveform given in input

IV. CONCLUSION

In this paper a novel approach is described with the help of the PI control system to regulate output voltage and supply power to electric vehicle. . In MATLAB software we have simulated the converter that can be used for applications related to the vehicle to grid and grid to vehicle application in the electric vehicle and renewable energy sector. .

For further efficiency we can implement soft switching which can be explored in future research. Battery potential difference is fluctuating as we need a reference voltage from the battery for soft switching, but we cannot get a reference voltage from the battery as the potential difference is fluctuating and in this circuit, we are not using any external source. If we get stable reference voltage then with the help of an op-amp at the point when the voltage is getting full at the battery then from that we can get the reference, as we are not using any external source. The source is only two batteries. When a battery is getting charged from a battery(acting as a source). The voltage of the primary battery getting low that's why the output we cannot maintain. So, soft switching cannot be done in this circuit. In the future, we can get information regarding the reference and how to get a stable reference for the soft-switching mode.

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