Implementation of Dab Based Multiport Converter For Interfacing Hybrid Energy Storage System In EV

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Abstract- *Electric vehicles are seen as the most viable solution, one of the major hurdles for electric vehicles is the limited range and lifetime of batteries. During starting and acceleration of the vehicles, high current is drawn from the battery which greatly reduces their lifetime. The solution to this problem is to not use the battery during starting and acceleration, and instead use an alternative energy storage device that can supply large current without oversizing. A multi-port converter (MPC) based on Dual Active Bridge topology is proposed in this project, which aims at electric vehicle applications for interfacing battery and supercapacitor to the drive train. In hybrid power sources or in electric vehicles, the promising concepts for these are multiport converters. They are much beneficial as conversion can be done in a single stage while even interfaced with multiple input power sources. Due to the flexibility of a multiport converter, it gives several advantages. It can be used for many applications as electric vehicles, renewable energy sources for Uninterruptible Power Supply without storage, or it can be used for storage, or it can be used for storage of energy using hybrid sources.*

I. INTRODUCTION

Conventional transportation based on fossil fuels is a major source of environmental pollution. In this context, electric vehicles are seen as the most viable solution. Electric Vehicles are the representatives in charge of transportation, and this innovation is presently developing quickly. While the carbon impression of an Electric Vehicle (EV) is effectively wrangled about it is seen as a promising distinct option for controlling fuel costs. EVs have an exceptional power profile that has both force usage and recovery at various moments of their operation. DC-DC converters are equipment, which is used to interface the power supply to the load. There are two ways for the integration of the power side with the load and storage side.

1. Common DC-DC bus
2. Multiport DC-DC bus

The common DC bus method is the conventional method. In the which, every source of energy relates to its own DC-DC converter while in the multiport DC-DC bus method, there is a single controller for the multiple inputs and output ports.

PROBLEM IDENTIFICATION

The major hurdles for electric vehicles are the limited range and lifetime of batteries. During starting and acceleration of the vehicle, a high current is drawn from the battery, which greatly reduces their lifetime. Apart from the reduced lifetime, the utilizable energy capacity of the battery depends on the current drawn and is reduced if the battery is discharged at a high current, which ultimately translates to a reduced kilometer range of EV. To cater to the high current required during starting and acceleration, the battery must be designed according to the power requirement. Designing a battery pack for high current leads to a large volume of the battery pack which is uneconomical and take a large space inside the EV. This is eventually reflected in the cost of EV, which is currently facing a tough challenge due to competition with ICE vehicles in terms of cost. Further, charging a large battery pack takes a long time using the residential EV chargers, further adding to the reluctance towards the acceptance of EVs. The solution to this problem is to not use the battery during starting and acceleration, and instead use an alternative energy storage device that can supply a large current, without oversizing.

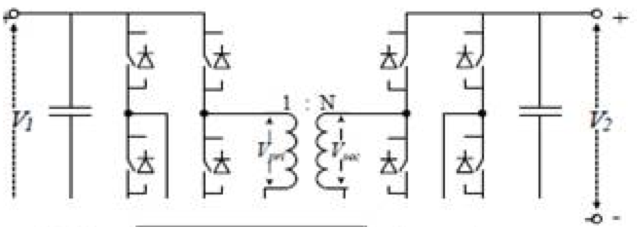
PROPOSED SYSTEM

In the proposed system, Supercapacitors are high energy content capacitors, which are can boardable of supplying high currents for short intervals of time. However, unlike batteries, they cannot store a large amount of energy and cannot provide the required range to EV, so they cannot be used as the only energy storage device onboard an EV. A combination of supercapacitor and battery is generally known as a Hybrid Energy Storage System (HESS). A multi-port converter (MPC) based on Dual Active Bridge topology is proposed, which aims at electric vehicle applications for interfacing battery and supercapacitors. The DC output of the HESS is interfaced with the drive motor using an inverter.

In the multi-port DC-DC power converter, there will be fewer power components, which implies the expense of the power converter will be lower than that of the conventional converter. Additionally, the transformation steps are minimized, bringing about higher productivity. Due to the vicinity of the transformer in some circuits, electric confinement is accessible, which is essential for safety. With the turn proportion of the transformer in certain topologies, it will be more effective to coordinate diverse renewable vitality wellsprings of distinctive voltage levels.

FIG 1 DUAL ACTIVE BRIDGE CONVERTER

According to Fig 1, DAB converters can be modeled as two high-frequency AC voltage sources, interconnected through a transformer. However, DAB suffers from the drawback of a high switch count, which becomes even higher when multiple energy sources are to be interfaced. Moreover, in voltage-fed DAB, the source current ripple is high, which is not desirable for battery applications. For battery applications, current-fed DAB should be the converter of choice because of the low ripple input current.



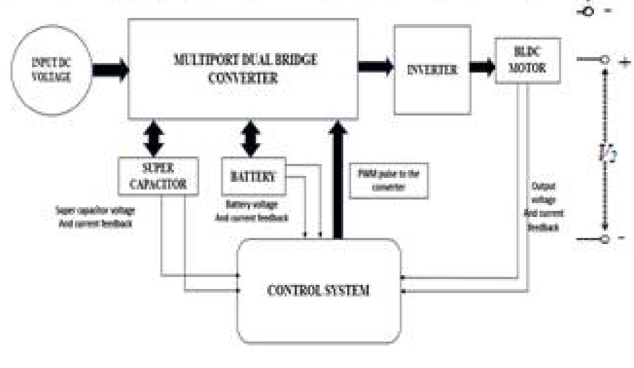


Fig 2 Block Diagram

Fig. 2 shows the schematic of the proposed Multi port converter (MPC), which is based on a current fed DAB. There are four ports in the proposed converter, which are,

A. DC charging port for battery charging (Port1)
B. Battery port (Port 2)
C. Supercapacitor port (Port 3)
D. Load DC port (Port 4)

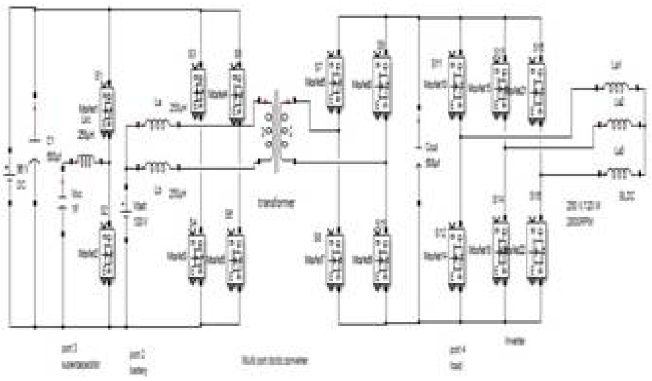


Fig 3 Circuit Design

Fig 3 shows the driving mode, power is drawn from the battery pack to drive the motor, and to charge the supercapacitor to its maximum voltage. The battery converter (S3-S6) is operated to control the battery current. The reference for battery current is obtained by filtering out the high-frequency component of the load current. The supercapacitor converter (switches S1-S2) is operated in voltage control mode to regulate VC1, to maintain the power balance. Load voltage is controlled by the DAB stage. In this mode, the EV is under regenerative braking, and the kinetic energy of the moving vehicle is fed back to the HESS. The battery current is charged gradually from its initial value to the final value which corresponds to the power regenerated. The supercapacitor is controlled to absorb the power difference by operating in voltage control mode. The DAB converter is operated in a negative power transfer region to send the regenerated power to HESS, thereby preventing overvoltage at the DC link. In this mode, the battery pack is charged by taking power from the DC charging port. Switches S1 and S2 are kept off. The battery is charged at a regulated current, by operating the switches S3-S6 like an interleaved buck converter. The interleaved structure reduces battery current ripple, further enhancing battery life. Using the proposed MPC, a separate charger is not required, and the MPC performs the task of the onboard DC charger as well. The secondary side HF inverter and the drive inverter are off in this mode.

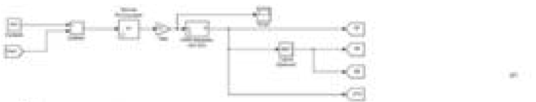
DESIGN OF MULTIPORT CONVERTER:

PARAMETER	VALUE
Input DC voltage	96 v
Super capacitor	1 F
Vsc , max	52v
Lsc, La, Lb	250 µH
Battery	120 v ,1Ah
Fsw	50 kHz
Cout	500 µF
Duty ratio(d)	0.5
Bldc motor	250v,120w 2800rpm

SIMULATION RESULT:

To support the theoretical equation for the proposed converter, simulation results are provided in MATLAB. The proposed design is developed by using MATLAB/ SIMULINK as shown in Fig 4.

FIG 5 INPUT WAVE



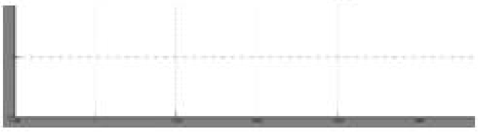


FIG 4 SUBSYSTEM

FIG 6 DUTY CYCLE

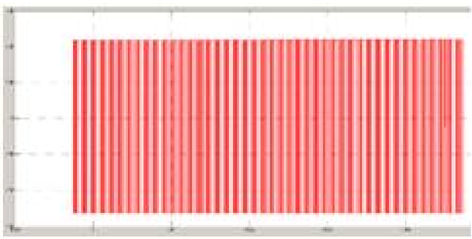


FIG 7 TRANSFORMER OUTPUT

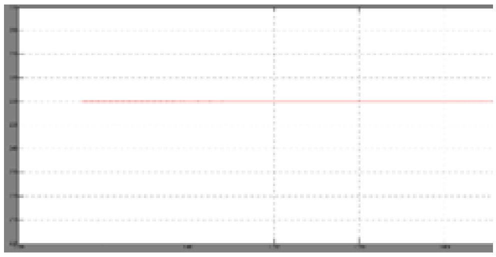


FIG 8 CONVERTOR OUTPUT

II. CONCLUSION

The proposed converter provides isolation, boosting the capability of battery and supercapacitor voltage, battery current control, and eliminates the need for the onboard DC charger. Simulation results proved that the proposed converter can shield the battery from sudden power surges while supplying the load the required amount of power and thus helps in preventing the battery life deterioration upto converter output was simulated in this phase.

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