

# Design and Modulation of Multilevel Converter Use For Electrical Vehicle

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**Abstract**—This paper presents the MATLAB Simulation model of the multilevel converter for EV. On increasing demand of EV, efficiency and performance plays a very vital role. In this paper, a novel multi port multi cell (mpmc) topology is proposed, which combine the futures of two independent two port converter system, which are commonly used in EV. The MATLAB simulation is performed to evaluate and analyze its performance and investigate the mitigation of multilevel converter Fuel Cell efficiency and Voltage Response of converter. Simulation model of hybrid energy source is presented and used to investigate the design optimization of EV on board of energy source in terms of energy efficiency.

**Keywords**—MATLAB, multilevel converter.

## I. INTRODUCTION

The first demonstration EV were made in the 1830s, and commercial EV were available by the end of the 19th century. The EV has now entered in third century as a commercially available product and as such it has been very successful, outlasting many other technical ideas that have come and gone increasing rapidly population and energy consumption in the world increasing oil and natural gas prices and the depletion of fossil fuels are justifiable reasons for using electrical vehicle (EVs) instead of fossil-fuel vehicles. the interest in developed EVs with clean and renewable energy sources as a replacement for fossil-fuel vehicles has therefore steadily increased . the EVs are proposed as a potential and attractive solution for transportation application to provide environmentally friendly operation with the usage of clean and renewable energy sources. The continuously increasing emissions of carbon dioxide , combined with the finite fuel resources, intensified the search for alternative energy sources in the past decades. A reduction of fossil fuel combustion is a inevitable to obtain a sustainable energy balance [1]. The amount of environmental pollution caused by road transport substantially contributes to the global carbon emissions and the development of electric vehicles (EVs) increased in importance.

Its depend on the available infrastructure, the charging via high-power charging stations is usually preferred, due to its substantially reduced charging time compared to the one achievable with the additional single- phase charger. Consequently, from an economical point of view, the rare use of this auxiliary charging unit and the limited available space Fig. 1: Simplified block diagram of the electric distribution network in modern electric vehicles (EVs) with the two isolated DC/DC converter systems under consideration (blue-shaded). in EVs demand is extremely low costs and high power density of this system. Besides the two battery chargers an additional galvanically isolated DC/DC converter system is required, which feeds power from the high voltage (HV) DC-bus to the low voltage (LV) DC- bus (cf. Fig. 1). This Low voltage bus supplies all the auxiliary electronics, as for example the board computer and automotive lights. Even though a small LV battery buffers this voltage bus, the main part of the required power needs to be delivered by the HV battery by means of the aforementioned DC/DC converter [4]. As shown in Fig. 1, the entire electric distribution network comprises of a large number of different converter systems [5]–[7], which are used to provide the required charging methods, the different voltage levels as well as the inevitable galvanic isolation between these voltage buses. This results in a complex, large and inefficient total power distribution system. In addition of , certain parts of the system are only operated either during charging or in the drive mode, providing the possibility of integrating individual converter systems into a single converter unit, which then is operating in both, charging or in the driving mode.

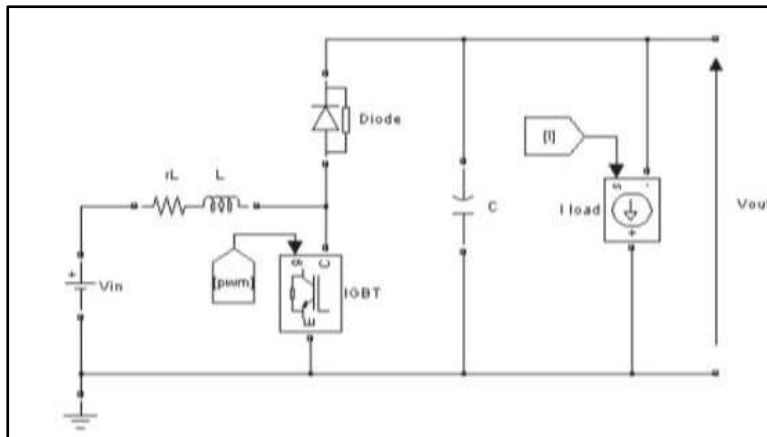


### 2.1 Boost DC/DC converter

A boost DC/DC converter with output DC voltage is greater than its input DC voltage. It is a class of switching-mode power. The smoothing inductor is used to limit the current ripple. The filter capacitor can filter out the output voltage ripples. The ripple current of inductor is calculated by neglecting the output voltage ripple. The value inductance is given by the following equation.

$$L = \frac{V_{out}}{4 \times F \times \Delta I_{L_{max}}} = 400 \mu H$$

The capacitor must be able to keep the current supply At peak power. The output voltage ripple is a result of alternative current in the capacitor.



**Fig.3. Output voltage ripple.**

Where:

$$C = \frac{I_{L_{max}}}{4 \times F \times \Delta V_{out\_max}} = 781 \mu F$$

Vout: the output voltage,

$\Delta I_{L_{max}}$  : the inductor current ripple, F : the switching frequency

### 2.2 Full-Bridge Full-Controlled

The Full bridge active rectifier is composed by 2 legs of IGBTs. This rectifier can produce three distinct voltage levels, i.e., the voltage vxy can assume the values of -vdc, 0 and +vdc. During the positive half-cycle of the power grid voltage, when the IGBTs S1 and S3 are off and the IGBTs S2 and S4 are on, the voltage vxy is 0 (changing the state of all the IGBTs the voltage vxy is also 0), and when the IGBTs S2 and S3 are off and the IGBTs S1 and S4 are on, the voltage vxy is +vdc. During the negative half-cycle of the power grid voltage, when the IGBTs S1 and S3 are off and the IGBTs S2 and S4 are on, the voltage vxy is 0 (changing the state of all the IGBTs the voltage vxy is also 0), and when the IGBTs S2 and S3 are on and the IGBTs S1 and S4 are off, the voltage vxy is -vdc. The maximum voltage is applied to each IGBT is Vdc. The Advantage of this active rectifier comparing with the previous is the possibility to operate in bidirectional mode, i.e., the EV charger can be used to transfer energy from the batteries to the power grid. This is an important characteristic considering the future scenarios of smart grids.

## II. BATTERY ELECTRIC VEHICLE (BEV)

EVs with only batteries to provide power to the drive train are known as BEVs. EVs have to rely solely on the energy stored in their battery packs; therefore the range of such vehicles depends directly on the battery capacity. Typically they can cover 110 km–260 km on one charge [5], whereas the top-tier models can go a lot further, from 300 km to 500 km [5]. These ranges depend on driving condition and skill, vehicle configurations, road conditions, climate, battery type and age. Once depleted, charging the battery pack takes a lot of time compared to refueling a conventional ICE vehicle. It can take as long as 36 hours completely replenish the batteries [6,7], there are far less time consuming ones as well, but none is comparable to the little time required to refill a fuel tank. Charging time depends on the charger circuit, its infrastructure and operating power level. Advantages of BEVs are simple construction operation and convenience. These does not produce any greenhouse gas (GHG), does not create any noise and therefore beneficial to the environment. Electric propulsion provides instant and high rques, even at low speeds. These advantages, coupled with limitation of range, makes them the perfect vehicle to use in urban areas; as depicted in Figure 2, urban driving requires running at slow or medium speeds, and these ranges demand a lot of torque. Nissan Leaf and Teslas are some high- selling BEVs current days, along with some Chinese vehicles. Figure 3 shows basic configuration for BEVs: the wheels are driven by electric motor(s) which is run by batteries through a converter circuit. Federal Urban Driving Schedule torque-speed requirements. Most of the driving is done in the 2200 to 4800 rpm range with significant amount of torque. Lower RPM require torque as high as 125 Nm; urban vehicles have to operate in this region regularly as they face frequent start-stops. Data from [4]/

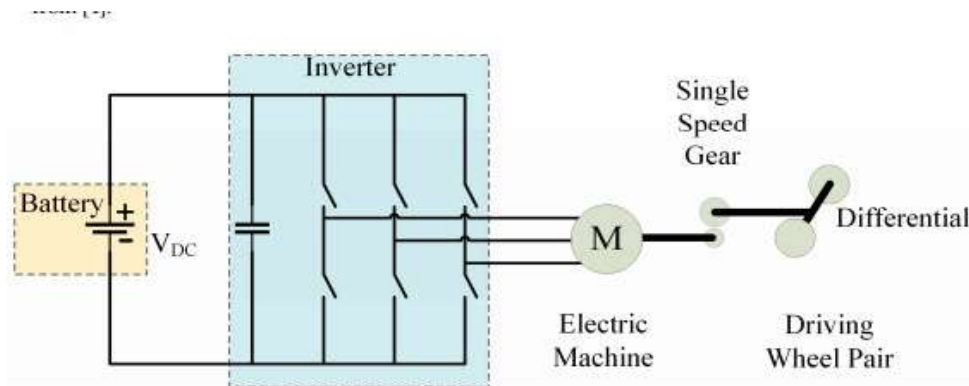


Fig.4

## III. ADVANTAGES

Environment Friendly ,No Green house gas , EV has a big Market, India is developing EV and is in the world market, Petrol and diesel usage is not needed, Huge Scope for Advancements, Safe to Drive.

## IV. FUTURE SCOPE

National Electrical Mobility Mission Plan 2020.EV 2030 (india's Race To Clean Mobility) Future of Indian auto industry.

## V. APPLICATIONS

Public & Private Transportation, Ultra Capacitor can be used for energy density controller, Battery can be used in Auxillary Equipments, Fuel Cell is the alternate energy source.

## VI. CONCLUSION

Battery stresses, ultracapacitor efficiency and hybrid use for regenerative braking and Fuel cell use and future in EV Setup EVs can have different configurations as shown in [4]. Figure 11a shows a front-engine front wheel drive vehicle with just the ICE replaced by an electric motor. There is a differential as well that allows the wheels to rotate at different speeds. It has a fixed

gearbox in place of the gearbox which removes the chance of getting the desired torque-speed characteristics. The configuration of Figure 11c has the motor, gear and differential as a single unit that drives both the wheels. The Nissan Lefe, as well as the Chevro Spark, uses an electric motor mounted at the front to drive the front axle. Mechanical interaction can be often further reduced by placing the motors inside the wheels to produce an 'in-wheel drive'. A planetary gear system is employed here because advantages like high speed reduction ratio and inline arrangement of input and output shafts. Mechanical gear system is totally removed in the last industry is being known and studied. Efficient performance of energy providing components are studied.

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