

# Implementation of Robust Charging Method for Electric Vehicles Using Dual – Inverter Opto Isolate Drives

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**ABSTRACT:** A dual-inverter with an open-end winding motor configuration is an attractive method to supply a higher voltage to a motor for electric vehicle (EV) applications. A topology utilizing two isolated dc sources is considered to reap the advantages of reliability and high voltage. Although this design may require two battery chargers, in this study, the use of only one charger to a main battery was considered. The central issue is to charge the secondary battery from the main battery via the motor, whether it is at a standstill or running. The inverter voltage margin remaining after motor torque production determines the charging capacity. The unity-power-factor operation is shown to be useful to maximize the charging power. We implemented the proposed system using micro-controller (MC89C51) to control the pulse for Inverter drive (IR2110) for proper charging the Electric Vehicles. The experimental simulation results are presented.

**KEYWORDS:** Electric vehicle, Dual-Inverter, Battery.

## I. INTRODUCTION

The propulsion motors for electric vehicles (EVs) are characterized by high power densities and wide operating ranges. The two issues are not separate because the high-speed capability is necessary to increase the power density. However, high-speed operation requires a high dc link voltage, as the back electromotive force (EMF) grows linearly with the speed. However, a high voltage is not favourable for a battery because the cell balancing pays a penalty for battery efficiency. To accommodate a high voltage, some vehicles, such as the Toyota Prius, are utilizing a boost converter in the inverter dc link. The Z-source inverter provides another means to increase the inverter output voltage without using a separate boosting stage. The Z-source inverter, however, requires two bulky capacitors and inductors, and the boosting ratios are limited by the output voltage and shoot-through zero state. A dual-inverter with an open-end winding motor configuration is one method to supply a higher voltage to the machine.

Typically, two inverters are connected to both terminals of an open-end winding motor. Though it requires six additional switches, the increased voltage output leads to high efficiency in a high-speed region. In, a motor control scheme for a dual-inverter with a floating capacitor bridge has been developed. However, this scheme provides only a reactive voltage component from the secondary inverter to the motor. Suggested unity power factor control, voltage quadrature control, and an optimum inverter utilization control for a dual-inverter with two isolated dc sources. Proposed a series hybrid power trains based on an open-winding machine drive. An open-end winding permanent magnet (PM) generator was coupled to an internal combustion engine, and the generated power was split into two isolated dc buses through individual rectifiers

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## II. EXISISTING SYSTEM

EV propulsion motors are required to run at a high speed because most EVs use fixed reduction gears. At the same time, the zero-speed torque should be sufficiently high to start the vehicle on a slope. A high-torque machine and having a high back EMF constant, requires a large dc link voltage as the speed increases.

However, the battery voltage cannot be easily increased owing to the efficiency issue in the series cell connection. To make a high-voltage battery pack, battery cells are usually connected in parallel and in series. Overcharging, as well as over discharging causes lithium-ion batteries an irreversible damage. In a serially connected battery stack, the discharging, as well as the charging, process has to be stopped immediately as soon as one of the terminal cell voltages fall below the discharge voltage limit or exceeds the charging voltage limit.

As the Voltage level increases, the complexity of a battery management system (BMS) increases correspondingly, and the battery system efficiency decreases because the voltage balancing normally fits each cell voltage to a minimum level by burning away the excess voltages of the other cell.

## III. PROPOSED SYSTEM

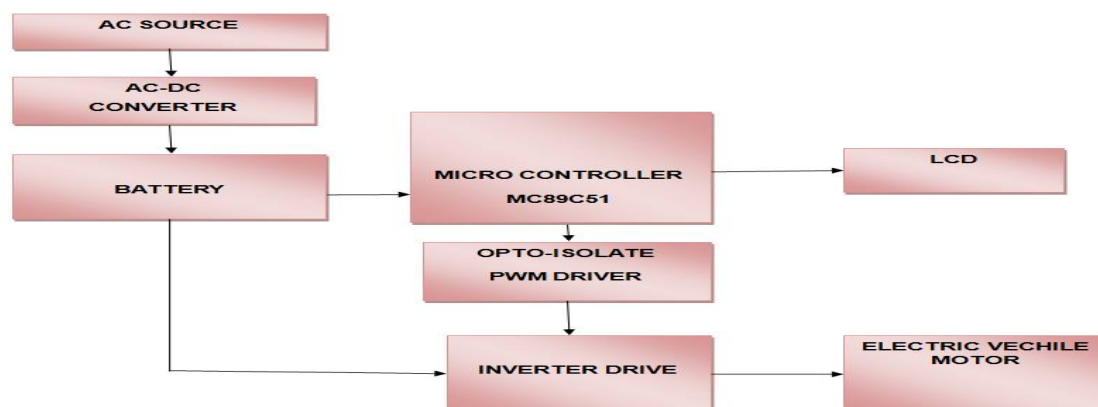
A secondary battery was considered inside the circuit. It acts as a storage device for both charging & discharging as energy requires .There was a speed sensor which provides a feedback to controller. It regulates the microcontroller to provide a proper PWM pulse. The pulses regulate the inverter bridge to meet the requirement.

At a standstill, only the d-axis current is utilized for charging. While letting the q-axis current be regulated to zero. Because no torque is produced with the d-axis current, the rotor remains fixed at a point. Note that, on the other hand, the positive d-axis current may saturate the motor core, leading to a decrease in inductance. However, a small decrease in inductance is not a problem in the charging mode.

In the field-weakening region, the motor terminal voltage is limited by the maximum available voltage from the inverter. However, even in the field-weakening region, some voltage margin, though not sufficient, can be attained by increasing the d-axis current in the negative direction.

## IV. PROPOSED ARCHITECTURE

**MICRO CONTROLLER:** The AT89C51 is a low-power, high-performance CMOS 8-bit microcomputer with 8K bytes of Flash programmable and erasable read only memory. The device is manufactured using Atmel’s high-density non-volatile memory technology and is compatible with the industry-standard 80C51 and 80C52 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer. It provides a highly-flexible and cost-effective solution to many embedded control applications.



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Figure -1 shows the simplified block diagram of proposed system. The AC-DC Converter converts the source AC voltage into DC which acts as a source for Battery. The micro-controller provides a controlled pulse with pre-programmed instruction for the operation of Opto-Isolate PWM driver. The Opto-Isolate PWM driver drives the inverter drive with the help of primary source from battery. Then the Electric vehicle motor is driven by inverter drive. The inverter voltage margin remaining after motor torque production determines the charging capacity

**SECONDARY BATTERIES:** Secondary batteries must be charged before use; they are usually assembled with active materials in the discharged state. Rechargeable batteries or secondary cells can be recharged by applying electric current, which reverses the chemical reactions that occur during its use[2].. Devices to supply the appropriate current are called chargers or rechargers.

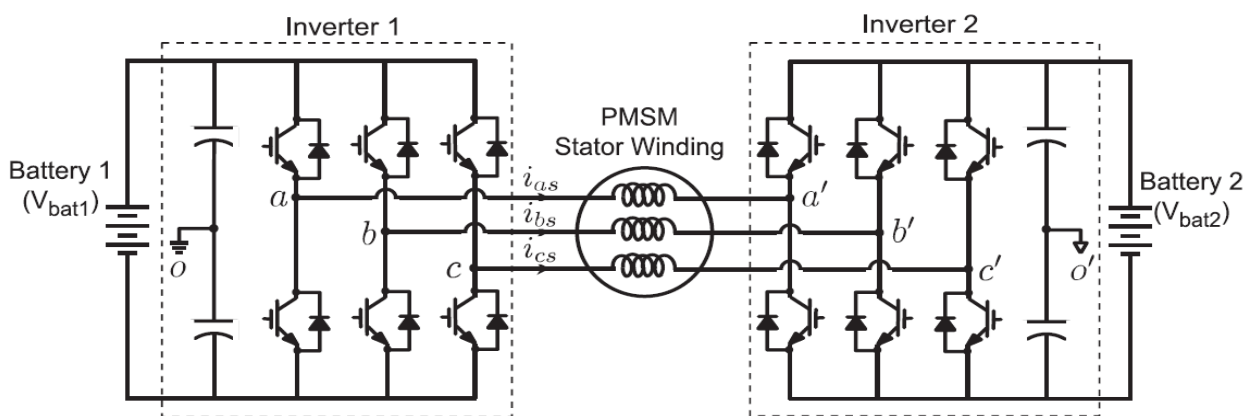
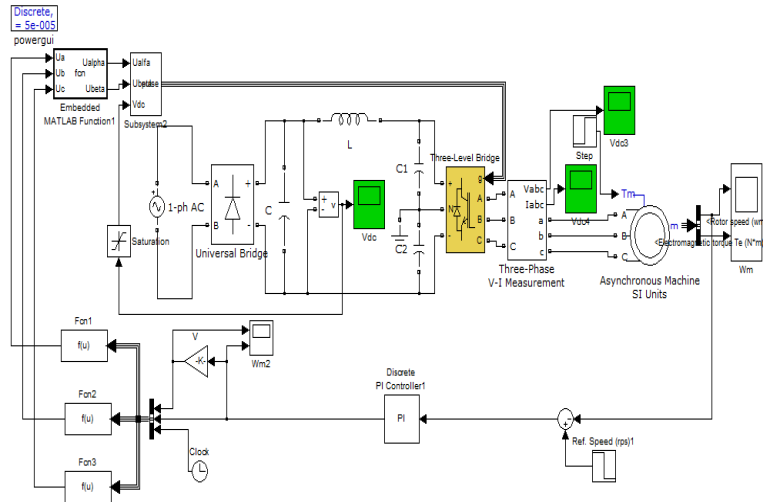


Figure 2: Configuration of Dual inverter system with Isolated Dual voltage source, this configuration shows two battery systems with two inverter drives for PMSM stator winding. There six switches are pulse fired as required in operation according to the load. There are four capacitors which supports the battery for stable operation during either charging or discharging mode.

**POWER SUPPLY:** A step-down transformer (230/15) V is used to give input supply to the power circuit. The 15V AC input is rectified into 15V pulsating DC with the help of full bridge rectifier circuit. The ripples in the pulsating DC are removed and pure DC is obtained by using a capacitor filter. The positive terminal of the capacitor is connected to the input pin of the 7812 regulator for voltage regulation. An output voltage of 12V obtained from the output pin of 7812 is fed as the supply to the pulse amplifier. An output voltage of 5V obtained from the output pin of 7805 is fed as the supply to the micro controller [5]. The same output pin of the 7805, a LED is connected in series with the resistor to indicate that the power is ON.

**MATLAB:** Simulink model (figure -3) used to show the implementation results of our proposed system as shown below



### V. SIMULATION RESULTS

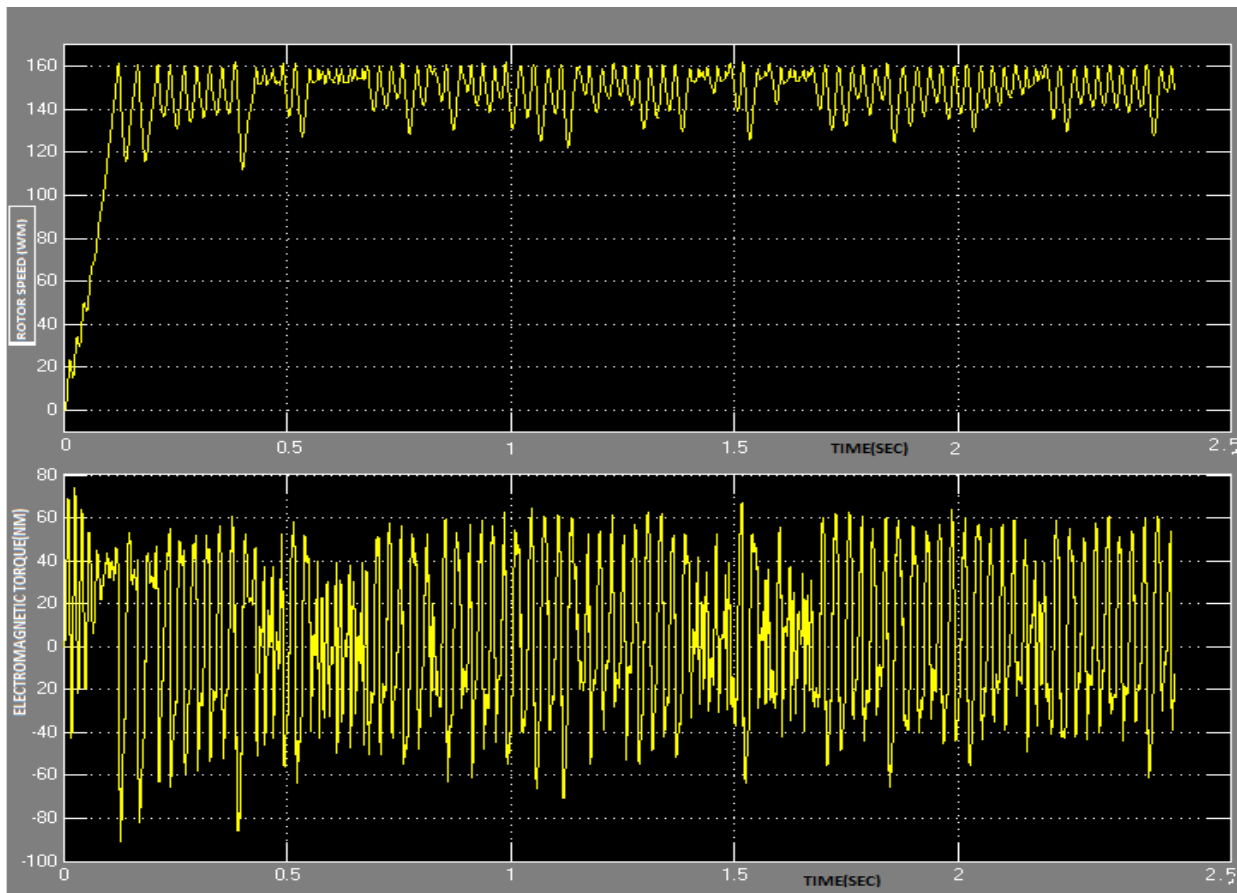


Figure 4: shows Simulation result of output waveform of rotor speed & Electromagnetic torque of Electric vehicle with respect to time. The output result clearly shows the rotor speed of an electric vehicle almost constant according to the battery's proper charging.

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## VI. CONCLUSION

A battery charging method was proposed for a dual-inverter Opto-isolate drive system with an open-end winding IPMSM. Throughout the paper, a secondary battery charging method was considered. The charging scheme covered the whole speed range of the motor at a standstill, in the low-speed region, and in the field weakening region. At a standstill, only the d-axis current was used for charging in order to not produce a torque. In the field weakening region, the operating point was moved along the constant-torque line to a tangential intersection with a voltage limit curve to gain a potential to charge the battery. Furthermore, it was shown that the unity power factor operation of Inverter 1 yielded the maximum power to Battery 2.

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