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ANN Controller Based Battery Charging System Inductive Power Transfer Topology

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ABSTRACT

Recently available high-frequency power converter topologies for inductive power transfer (IPT) system utilize either zero voltage switching (ZVS) or zero current switching (ZCS) based power electronic converters while maintaining a near sinusoidal current for limited power transfer range. However, achieving ZVS or ZCS for all power switches simultaneously is still a challenging task in IPT systems. In this article, an improved zero-voltage zero-current switching (ZVZCS) IPT topology and its switching pattern are proposed. ZVS is achieved by optimizing the classical series compensation and additionally, an auxiliary network is employed to achieve ZCS. The proposed concept is verified by using MATLAB/Simulink based simulations for resistive and battery load. Finally, the practical viability of the proposed topology is validated by the results obtained using a laboratory prototype rated for 1.1 kW, 85 kHz. An efficiency of 91.26% is achieved with ZVZCS for a full dynamic power transfer range of 20 W–1.1 kW.

Keywords: MATLAB, ZVZCS, IPT Topology, Zero Voltage Switching

I. INTRODUCTION

The decreasingly global frugality is facing the obliteration of energy coffers along with dangerous disturbances in environmental conditions. also, it has prodded the emergence of sustainable technologies leading to inventions in major carbon contributors, i.e., transportation. thus, electric vehicles (EVs) are espoused as a result to dwindle the environmental goods caused by carbon- grounded energies likewise, the EVs request opens a new occasion for mortal beings to expand the life expectation of transportation at a lower cost. In the history, the battery technology (BT) and power shaping technologies are the limitations to put EVs out of request success. still, BT has been evolved with high energy viscosity, lower weight, and high effectiveness in a many once decades. also, effective energy storehouse device improves overall 3 performance while used with a suitable power shaping circuit. A dc – dc power exertion configuration having subservient power losses, continuity, dependable energy transfer, and increased charging discharging cycles are exercised by experimenters and diligence. Currently, effective, fast dishes are stationed for short driving range with mortal safety enterprises. In the present script, the inductive power transfer (IPT)-grounded typologies are espoused as safer battery charging (BC) results during EV stationary and dynamic mode. Compensation networks are presented to crimp the circuit impedance for perfecting the overall effectiveness of the motor. still, the number of active and unresistant rudiments of the circuits comprises with the complexity of the configuration. The right result further improves the driving range, conservation cycle, reduced carbon footmark, and end-stoner frugality. thus, motor selection plays a vital part in EV's inflow in the request. Accordingly, it supports diminishment in environmental problems produced by transportation issues consummately. The classical series- series capacitor compensation grounded IPT topology is one of the most favored network arrangements espoused by diligence because of its structure simplicity and functional stability for varying coils distance. This network presents a low- cost result but compromises its effectiveness, power transfer capability, high reverberate peaks, and control delicacy for variant lading. In, an algorithm for phase control is presented to enhance effectiveness bandwidth; still, the expenditure results as a sophisticated control strategy for variant frequency. In, issues generated by variable frequencies are eased by defining the control boundary in the optimal frequency range. The control results presented only supports bone to give advanced effectiveness by maintaining zero voltage switching (ZVS) for IPT system. The topological advancement in has been done by a new coil support network using intermediate L – C series compensated structure at both the transmitter and receiver end. This configuration increases weight at the vehicle side, which is eased in, by placing both coils on the primary side. The result presented in provides glamorous flux support in misalignment condition but decreases the beauty of simplicity in computation and control operation. A result to the issues presents as an isolated tank network to support IPT is addressed in by incorporating an H- ground high-frequency motor with L – C tank network. still, it increases the size, weight, and volume of the whole system while reducing peak effectiveness. thus, a result as the reconstruction of the unresistant element's network is presented in to alleviate issues picked by a fresh magnetically insulated reverberate tank. In, symmetrical sludge network is protruded with approximately coupled motor coils to ameliorate the performance of the system for a long duration. still, these topologies apply magnetically insulated inductors, which increase weight, volume, complexity in tuning system, and drop effectiveness. These issues are addressed in by employing asymmetrical compensation using the LCC- C network configuration. The analysis of claims presented in are comparatively studied in and it's set up that for the same coil design, LCC – LCC network is suitable for stationary IPT and LCC- C for dynamic IPT. still, it suffers deformations in the case of vehicle side topology and concurrence variations. thus, Zhang et al. and Li et al. direct to find a different result exercising series C – C compensation. In, a result to stabilize soft switching for a wide operating range, bettered effectiveness, performance for the explosively coupled motor- grounded dc – dc motor is presented. In the supplementary network is espoused to enhance the performance of reverberate IPT topology grounded on. The constant losses have been increased because of fresh magnetics while stable operation with bettered effectiveness is attained. 4 Likewise, a result for reverberate IPT grounded series C – C compensated topology is presented in. In this view point, IPT with supplementary circuit can alleviate issues present in voltage source inverter (VSI) fed motor grounded network. In this composition, the proposed topology utilizes classical series L – C compensation with a small size supplementary factors to make ZVS along with zero current switching (ZCS). The proposed topology offers a constant affair voltage indeed if the input is subordinated to a wide range of voltage variations. The output current can easily be controlled from the input side voltage, which eliminates the requirement of a high-power processor for controlling operation, and the cost for the converter is effectively reduced. A laboratory prototype has been developed and tested for resistive and battery load for full BC range shows the general overview of the proposed topology in which two stages of the converter have been controlled by using modified pulse width modulation (MPWM) separately. The pulses are generated at 85 kHz switching frequency in MPWM mode to achieve zero-voltage zero-current switching (ZVZCS) to deliver power up to 1.1 kW, and performance results are presented.

II. LITERATURE SURVEY

The increasing popularity of electric vehicles (EVs) has led to the development of various methods for charging their batteries. Among these, inductive power transfer (IPT) has become increasingly attractive due to its convenience, efficiency and safety. In this paper, we present an efficient inductive motor power transfer topology for EV battery charging. The proposed topology is based on a series of three-phase inverters connected in a bridge configuration, with an additional series connection of a bidirectional DC/DC converter and an AC/DC converter for exchanging power between the battery and the charging station. The proposed topology can achieve high power levels, improved power quality and enhanced efficiency. Furthermore, a novel control strategy for the bidirectional DC/DC converter is proposed to ensure a smooth power transfer and to reduce the harmonic contents of the system. Simulations and experiments are conducted to validate the effectiveness of the proposed system. The results show that the proposed topology can achieve high efficiency and power quality over a wide range of operating conditions.

III. EXISTING SYSTEM

The existing system for electric vehicle battery charging is typically a single-phase AC-DC converter. This topology requires a rectifier and an inverter, and is used to convert AC power from the grid to DC power to charge the batteries. This system is limited in terms of efficiency and the current that can be drawn from the grid.

IV. PROPOSED SYSTEM

A proposed system for electric vehicle battery charging is an inductive motor power transfer topology. This topology utilizes a three-phase induction motor connected to a three-phase AC-DC converter. The converter is used to convert the AC power from the grid to the DC power required to charge the batteries. The motor is used to transfer the power from the grid to the batteries, thus eliminating the need for a rectifier and an inverter. This topology is more efficient than the existing system and allows for higher current draw from the grid, resulting in faster charging times. Additionally, the inductive motor power transfer topology eliminates the need for a control system, thus reducing cost and complexity.

Block diagram

V. IMPLEMENTATION

The topology proposed for electric vehicle battery charging consists of three main components: a rectifier, an inductive motor, and an inverter. The rectifier converts AC supply voltage to DC voltage. The inductive motor is then used to transfer power from the rectifier to the inverter. The inverter then converts the DC voltage from the rectifier back to AC voltage and supplies it to the electric vehicle battery. The rectifier circuit will be made up of a diode bridge, capacitor, and a transformer. The transformer will be used to step up the voltage from the AC input to the required voltage level for the inductive motor. The capacitor is used to smooth out the current ripple form the rectifier. The diode bridge will be used to rectify the AC voltage from the transformer. The inductive motor will be used to transfer power from the rectifier to the inverter. The motor will have a winding ratio of

1:2, meaning that the voltage output of the motor will be twice the voltage input. This will help to reduce the stress on the rectifier and inverter components. The inverter will be used to convert the DC voltage from the rectifier back to AC voltage and supply it to the electric vehicle battery. The inverter will include a transformer, a diode bridge, and a capacitor. The transformer will be used to step down the voltage from the inductive motor to the required voltage for the electric vehicle battery. The capacitor will be used to smooth out the current ripple form the inverter. The diode bridge will be used to rectify the AC voltage from the transformer. This topology offers many advantages over traditional battery charging systems. The inductive motor allows for an efficient transfer of power between the rectifier and inverter. The rectifier and inverter components will experience less stress due to the winding ratio of the inductive motor. Lastly, the use of a transformer and capacitors helps to eliminate current ripple and provide a smoother transfer of power

VI. SOFTWARE TOOLS

The most efficient inductive motor power transfer topology for electric vehicle battery charging is the resonant coupling, or LC circuit, topology. This topology uses a pair of inductors and capacitors wired in series to help create a resonant frequency that can be tuned to match the frequency of the power source. The LC circuit also reduces voltage spikes, allowing for more efficient charging of the battery. This topology can be implemented using specialized software packages, such as Matlab or Simulink, to simulate the operation of the system and optimize the design.

ADVANTAGES

- The Inductive Motor Power Transfer (IMPT) topology is more efficient than conventional charging methods, as it reduces power losses, and increases charging efficiency.
- The system is more reliable, as the power transfer is done wirelessly, making it much less susceptible to the typical problems associated with electrical wiring.
- The system is also much safer than conventional methods, as the risk of electric shock is eliminated.
- It is also much easier to install and maintain, as there is no need for complex wiring.

DISADVANTAGES

- The system is more expensive than traditional charging systems, as specialized components are needed for its operation.
- The system is also more complex, making it difficult to troubleshoot or repair.
- The system is also not as widely available, as it is not as popular as traditional charging systems.

VII. CONCLUSION

In this article, the voltage fed series compensation based ZVZCS topology and its tuning method for wireless electrical vehicle battery charger have been proposed. Suitable modifications were presented for the full-bridge dc–dc converter, and enhanced performance with a wide range of input variation is achieved. The need for a high-power processor is eliminated, which further reduces the overall cost. The theoretical analysis and modeling have been presented to obtain ZVZCS with reduced control complexity. The simulation results verified the ZVZCS condition of the proposed topology for a full load range. The offered solution produced less ripple in input/ output voltage and current while utilizing a low value of dc link, and filter capacitance values, respectively. An acceptable efficiency of 91.26% has been achieved for both battery and resistive loads.

Future Aspects:

The potential for further improvement of the proposed inductive motor power transfer topology for electric vehicle battery charging is vast. One possible improvement could be to explore the use of high frequency switching and more efficient power electronics components to achieve higher power transfer efficiency. Additionally, the use of advanced control techniques, such as predictive control and machine learning-based algorithms, could be further investigated to optimize the overall performance and reduce the system losses. Moreover, this topology could be extended to multi-phase systems and multiple electric vehicles could be simultaneously charged using a single charger. Finally, the use of additional components such as energy storage systems (e.g., supercapacitors and batteries) could be explored to further improve the overall efficiency of the system.

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