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Dynamic Wireless Charging for Electrical Vehicle

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Abstract: *For the user convenient of user, the electrical vehicles are reliable for electrical vehicles. Dynamic wireless charging charges the vehicle when the vehicle is in the motion. Based on the application, wireless charging system for EV can be distinguished into two categories, static wireless charging and dynamic wireless charging, so we are using inductive power transfer for charging the battery. In this project we are optimizing battery size and also proving how the dynamic wireless charging is effective than the plugged charging of electrical vehicle.*

Keywords: Dynamic Wireless Charging Of Electrical Vehicle, Battery Charging, Electrical Vehicle (EV), Inductive Power Transfer

I. Introduction

Wireless Charging Systems (WCS) have been used in high-power transfer, including EVs [1].In comparison with plug-in charging, Wireless charging system can have more advantages in the form of simplicity, reliability and user friendliness[2].Since the introduction of wireless charging system for EVs, four method for the design of WEVC : inductive power transfer (IPT),Capacitive wireless power transfer(CWPT),magnetic gear wireless power transfer(MGPT) and resonant inductive power transfer(RIPT) [3].

Plugged in charging of electrical vehicle has some sort of difficulty to travel a long distance and slow charging characteristic hence to reduce the fault we introduce dynamic wireless power transfer of electrical vehicles. So, using dynamic wireless power transfer (DWPT) we increase the rang of electrical vehicle. The power transfer over the air from stationary transmitter to the receiver coil in a moving vehicle. The best part of dynamical wireless charging of electrical vehicle is we can transfer power dynamically and charge the battery and thus this solution reduce the environmental impact, cost and travel our vehicle long duration. So, our vehicle required smaller battery and its possible to reach an infinite distance. [4] Using dynamic wireless charging we extended their travel time without need for large battery or extremely costly infrastructure. In order to make wireless battery charging accessible to everyone and everywhere, a network of induction charging stations needs to be created, with the charging plates being embedded in the road surface. Induction charging while driving is the prime option. The only thing that is certain already today is that the network of fast-charging stations is continually expanding and that recharging electric cars will become increasingly easy as electric charging options evolve. [5]

II. Literature Review

SUN Yue, XIA Chenyang et.al [1] describes Wireless Charging of Electric Vehicles in Electricity and Transportation Networks Research internet in ieee Xplore in 2016 The optimization framework allows separate minimization of electricity generation cost within the electricity market and establishes UE traffic assignment among EVs in the transportation network. The finding is the operation of the wireless charging station in the electricity and transportation network.

N. Tesla, et.al [2] proposed Wireless Power Charging on Electric Vehicles Research gate in 2014.The wireless power charging for a small electric scooter was presented. The resonance coupling at 6.78 MHz was applied to avoid the EMC issue, electromagnetic emission limitation and the finding is the resonance coupling effect is proposed to reach the high performance of wireless energy transmission.

Aqueel Ahmad et.al [4] described Wireless Charging System for Electric Vehicle Research Gate in 2016.The waiting time can be minimized with real-time data processing and the finding is in this paper, a prototype to make buses communicate to the commuters in a Smart City ecosystem has been proposed and developed.

O.C. Onar, J.M. Miller, et.al [5] explained IoT Based Smart System for Avoidance of Fire Accidents on Running Buses. International Journal of Engineering & Technology in 2013. The presented by Stationary IPT charging system is simple in that EVs are charged wirelessly when vehicle are park at home or stopped at parking of office and the finding is The IPT concept is implemented for wireless charging system which is used to recharge an electric vehicle battery.

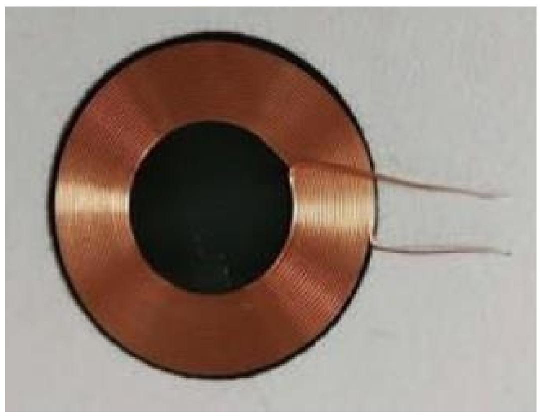
S. Sarabi and L. Kefsi, et.al[6] proposed the centralized power supply rail mode is usually coupled by one or more pick-up mechanisms and the same long rail coil. power supply method for electric vehicles with multi- guideway power supply mode is presented, the structure and principle of the system are described in detail, the design method and loss of the guideway are analysed.

C. Liu et al [7] explained "Field Circuit Coupling Analysis of Dynamic Wireless Charging for Electric Vehicle, " 2018 IEEE 2nd International Electrical and Energy Conference (CIEEC), Beijing, China, 2018.

III. Hardware Requirements

3.1 Transmitter and Receiver coil

- Magnetic Coil: antifreeze plate + coil
- Meet the QI international standard, be customized according to order Ultrathin, compact, high efficiency, low heat
- Length and gap of the outgoing line is customizability
- Size 24mm



Parameter Transmitter & Receiver Coils

- Number of turns : 18
- Inner diameter : 140 mm
- Conductor diameter: 4 mm
- Turn spacing : 3 mm
- Outer diameter 4
- Transmitter circuit parameter
- DC supply
- Compensation parameter (R, L, C)

3.2 H-bridge Inverter

- Feature
- On-Resistance
- Low Input Capacitance
- Fast Switching Speed
- High Reliability

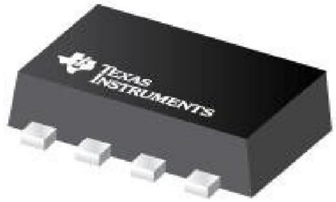


Figure: H Bridge Inverter

The circuit is designed in such a way that both switches must not turn-on at a single time & only one of the two switches will conduct. Each switch will operate for half period (T/2), providing half of the applied voltage the load (± Vdc/2). When both the switches are off, the reserved voltage across the load will be Vdc instead of Vdc/2. This is called a half-bridge inverter. [2]

Some of the conventions in the given circuit are such that

- Current through S1 is i1, while the current flowing through S2 is i2.
- Output voltage and current are Vo and io
- T is the time period and switches are considered unidirectional.

3.3 Receiver

1. Compensation parameter (R, L, C)
2. Bridge Rectifier
3. Single-Phase low-cost Bridge Rectifier
4. Maximum Input Voltage (VRMS): 560V
5. Maximum Peak Reverse Voltage (VRRM): 800V
6. Output DC Current: 1.5A (max)
7. Voltage Drop Per Bridge: 1V
8. Output Voltage: (√2×VRMS) – 2 Volt

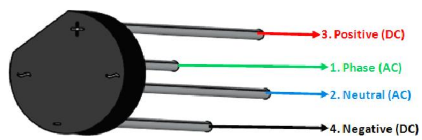


Figure: Bridge Rectifier

Bridge Rectifiers use four diodes that are arranged cleverly to convert the AC supply voltage to a DC supply voltage. The output signal of such a circuit is always of the same polarity regardless of the polarities of the input AC signal. depicts the circuit of a bridge rectifier with diodes interlocked in a bridge configuration. The AC signal is applied at the input terminals a and the output is observed across the load resistor .[9]

3.4 Boost Converter

- The tendency of an inductor to resist changes in current by either increasing or decreasing the energy stored in the inductor magnetic field.
- 1.6-MHz (X Option), 0.6-MHz (Y Option) Switching frequency.
- Low RDS(ON) DMOS FET

Figure: Boost Converter

Boost converter which increases the input DC voltage to a specified DC output voltage. A typical Boost converter is shown below. [8]

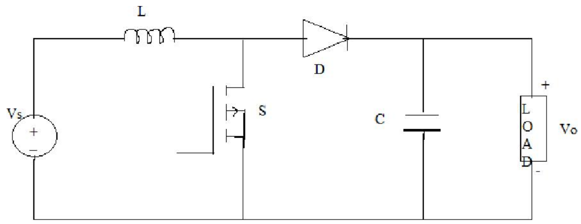


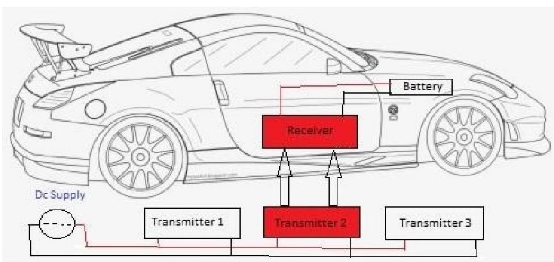
Figure: Circuit for Boost Converter

3.5 Battery

- Nominal Voltage 72V
- Nominal Capacity 100Ah
- Energy 7200Wh
- Series and Parallel Connection 24S1p
- Cycle Life >2000 cycles
- Efficiency ≥99%

Figure: Battery

IV. Block Diagram



If the coupling coefficient between receiver and transmitter is consistent while a vehicle is in motion, input impedance will be capable to optimize easily the same as stationary vehicle. Constant coupling coefficient leads to obtain nearly consistent power transfer. [1] This illustrates that new approach is based on effects of two excessive transmitter coils on vehicle and optimal placement of coils (X) in transmitter array, so efficient specified distance between two coils must be calculated by using distance of total coils to vehicle (d1, d2… dn). [9] Compare to tradition plugg-in charging for electrical vehicle method, there is no physical connection between the source and the load during the wireless power transmission (WPT) charging process, therefore the charging process is safer and more convenient, which makes WPT a promising energy supplement method [4–6]. The WPT technology applied to EVs is divided into static wireless power transmission and dynamic wireless power transmission.

Considering that the dynamic wireless charging service system is electrical vehicle in the charging area, the ideal charging power control method should be that the system adjusts its own parameters according to the electrical driving speed, so as per the driving state of the EV, So the power will get transmitted. Therefore, this paper considers adjusting the system parameters according to the lower limit of the charging power demand associated with different speeds in order to achieve the EV charging power control. when studying the EV dynamic wireless charging process control method of electric vehicles, it is necessary to consider the influence of the dynamic change of driving speed on the vehicle power demand.[10]

At the transmitter side transmitter coil buried in the ground and the receiver coil is inside the vehicle connected through the battery. When the transmitter coil is get perfectly aligned to the receiver then power is transferred. When the vehicle moves forward then pervious transmitter is ready to transfer power to the receiver, then vehicle can travel a long distance. [4]

V. Results And Discussions

The analysis of the energy transferred to the EV and the energy stored in the battery shows that these energies are closely related with the vehicle speed, assuming that up to 40 kW is transferred to the coil, and the power that is not consumed by the vehicle is used to charge the battery. In fact, if the EV considered in this study is moving to a speed of 92 km/h, the energy stored in the battery increases at 2.05%.

5.1 Result

Parameter	Value
Opereting Frequency	460 KHz
Output Power(Po)	1W
Input Voltage	5V
Output Voltage	2vpk-pk
Transmitter detection coil	257.5uH
x-coil(Lx)	127uH
Y-coil(Ly)	217.3uh
Distance between coil	200mm

In this way we have implement dynamic wireless charging of electrical vehicle with the output power 1W and input voltage 5V and to gives the output 2V peak to peak.

VI. Conclusion

In this paper, a wireless power supply method for electric vehicles with multi- guideway power supply mode is presented, the structure and principle of the system are described in detail, the design method and loss of the guideway are analyzed. The function and performance of the power supply mode are analyzed.

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