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A Matrix Converter Based Bidirectional Contactless Grid Interface

Shah Faisal[1], Shaikh Sameer[2,] Momin Shahbaz[3], Shaikh Sajid[4], Shahbaz Shaikh[5]
[1,2,3,4,5] *(Deptartment of Electrical Engineering, MMANTC, Mansoora, Malegaon, India)*

Abstract : *Inductive coupled, bidirectional grid interfaces are fast popularity as an smart solution for vehicle-to-grid (v2g) and grid-to-vehicle (g2v) systems. However, such systems conventionally use a large, electrolytic dc-link capacitor as well as a large input inductor, leading to expensive, less bulky, and reliable systems. A matrix converter is gaining popularity as an efficient and reliable technique. Moreover MCs are always rich in harmonics and thus affect both power quality and power factor on the grid side. Although grid contactless system for matrix converter are proposed as an alternative, the matrix converter is an A.C–A.C power converter topology, mainly based on semiconductor switches with minimal requirements for passive components. Performance of such converter has been analyzed when driving linear load current controllers. The matrix converter framework that permits bidirectional power stream and it changes over a voltage with a variable abundance and recurrence from a consistent voltage of greatness and recurrence. Along these lines the proposed framework utilizes a less complex exchanging procedure with a lower exchanging recurrence and decreases the absolute sounds.*

Keywords: *matrix converter, wireless power transfer, grid integration, inductive power transfer, interface.*

I. Introduction

The demand for electric vehicles (EVs) has raised significantly due to several reasons, such as improvement in EV technologies, high fuel costs associated with conventional vehicles and increased awareness on reducing greenhouse gas emissions. Moreover, with the emergence of vehicle-to-grid (V2G) and grid-to-vehicle (G2V) technologies, EVs have been proposed as energy storage devices for storage and retrieval of energy for dynamic demand management. Presently, hard-wired bi-directional grid interfaces are employed for grid integration of EVs. Although hard- wired interfaces between EVs and the utility grid are simple, they must be suitably isolated to avoid the risk of shock hazards. However, they still increase the risk of electrocution, particularly under wet environments and harsh weather conditions, such as snow and ice, making safe use of hard-wired interfaces practically difficult.

Since these particular grid interfaces are equipped with long cables, they can also be inconvenient and inflexible. In recent years, inductive power transfer (IPT) has emerged as a favored technique for supplying contactless power for a wide range of applications. In contrast to hardwired interfaces, contactless grid interfaces based on bi-directional inductive power transfer (BD-IPT) technology have shown substantial promise as an attractive solution for V2G and G2V applications due to their higher galvanic isolation, flexibility and efficiencies comparable to hard-wired systems[1]. Nevertheless, the operating frequencies of BDIPT systems are typically much higher than the utility grid frequency. Therefore, contactless grid integration of EVs for V2G or G2V applications involves a single or multi-stage frequency conversion, using one or more bi-directional power electronic converters.

Doing so, it converts the utility grid AC voltage to a DC voltage and maintains the converted DC voltage at a relatively constant value. The converter on the back end, known as the inductive power transfer (IPT) primary converter, then converts the constant DC voltage at the intermediate DC-link to an AC voltage at the resonant frequency, in order to drive the resonant network. Hence, this system necessitates a large electrolytic DC-link capacitor and an input inductor for minimizing voltage ripple at the intermediate DC link and reducing input current ripples, respectively. Inclusion of these two energy storage elements makes the system bulky and more expensive. In addition, numerous external factors such as, type of dielectric material used, operating and storage temperatures, contribute to determining the life time of the DC-link capacitor.

II. Related Work

2.1Existing System:

This paper suggests a lattice converter (MC) that straightforwardly makes voltages at high occurrence since the utility matrix to drive thunderous systems of the bidirectional contactless interface. A comprehensive model that predicts the steady-state voltages and currents as well as the power drawn by the system is proposed to gain an insight into the operation of the proposed MC topology. Utilizing the model, a modulation strategy is also proposed to attenuate the undesirable harmonics in the grid current.

2.2Proposed System:

A novel matrix converter based IPT interface that requires only a single-stage power conversion process to facilitate bi-directional and contactless power transfer between EVs and the grid. A mathematical model, which predicts the behavior of the, is presented to demonstrate that both power stream and bearing can be controlled through either proposed system relative phase angle or magnitude modulation of voltages produced by converters [2].

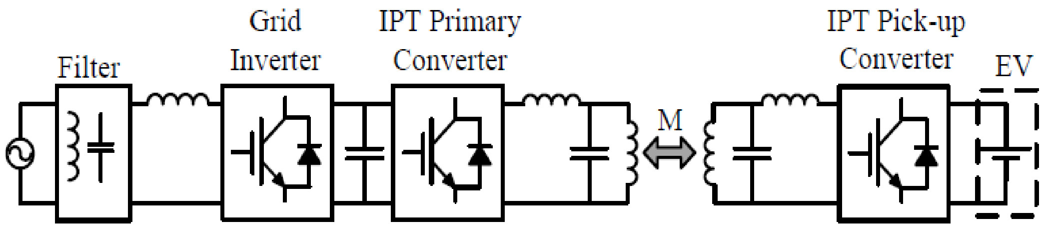

Fig.2.1 Grid inverter based system

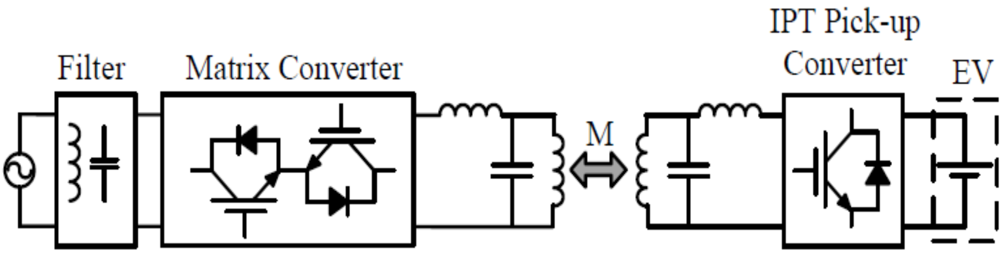

Fig. 2.2 Matrix converter based system

A schematic of the proposed grid integrated BD-IPT system. The primary side of the system consists of two converters that are connected in a back-to-back configuration. The front end converter, which is referred to as the grid converter, is directly interfaced with the utility grid. Due to current source nature of the tuned inductor-capacitor-capacitor-inductor (LCCL) resonant network, an input inductor is not required for controlling the grid current. Therefore, the large input inductor is eliminated. Regardless of the direction of the power flow, switching devices Sp1 and Sp4 remain ON during the entire positive half of the grid voltage, whereas, during the negative half cycle of the grid voltage Sp2 and Sp3 remain ON.

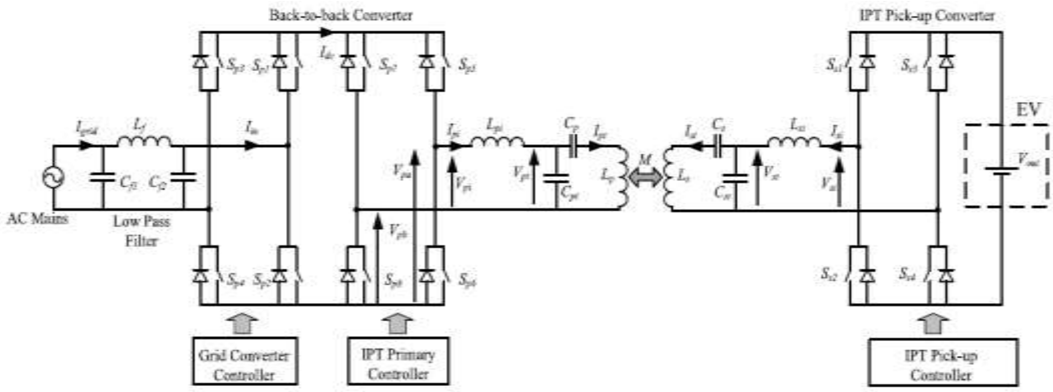

Fig.2.3 Proposed converter topology for grid integration of BD-IPT systems.

2.3 Proposed Grid-integrated Bidirectional IPT system

A schematic of the proposed grid integrated BD-IPT system is shown in Figure.2.2. The primary side of the system consists of 2 converters that are connected during a back-to-back configuration. The front end converter, which is referred to as the grid converter, is directly interfaced with the utility grid. Due to current source nature of the tuned inductor–capacitor–capacitor– inductor (LCCL) resonant network, an input inductor isn't needed for controlling the grid current. Therefore, the large input inductor is eliminated. Regardless of the direction of the power flow, switching devices Sp1 and Sp4 remain ON throughout the complete positive half of the grid voltage, whereas, during the negative half cycle of the grid voltage Sp2 and Sp3 remain ON. However, this needs precise detection of zero-voltage crossings of the utility grid voltage, however measuring voltages accurately near zero is practically a difficult task. To make the situation worse, incorrect detection of zero-voltage crossings can lead to a phase-to-neutral short circuit through the grid converter. When the grid voltage, Vgrid>_$V+$ and Vgrid<_$V-$, the grid converter is said to be in normal operation. Due to the switching of $Sp1-Sp4$ as shown in Fig. 1.3, a dc voltage with a ripple of Vin is formed in the dc-link, where Vin is the peak of the utility grid voltage. Thus, the grid converter functions as a rectifier at utility grid frequency when the power flows from the grid to the EV, while it operates as an inverter when the power flow is in reverse direction, i.e., from the EV to the grid[3].

Table: Comparison of Existing and Proposed System:

Existing System	Proposed System
Existing Concept: In the existing system, the integrated BD-IPT can be used. They are using a unidirectional converter to interface the grid with the electrical vehicles.	This project proposes a matrix converter based grid interconnected BD-IPT interface that ameliorates the after mentioned issues of previously reported bidirectional contactless grid interfaces .being an AC to AC converter the mc is capable of deriving a high frequency ac output voltage as output.
Existing Technique: Integrated BD-IPT system	Proposed Technique: Matrix converter based integrated IPT system
Drawbacks: 1)the system is so bulky 2) highly expensive	Advantages : 1)it avoids the system as bulky 2)less expensive 3)the LC filter reduces the harmonics in the input side

III. Matrix Converter Simulation Module Description

A matrix converter is well-defined as a converter with a single stage of conversion. It is bidirectional controlled switch to produce automatic conversion of power from AC to AC. It results in an optional to PWM voltage rectifier [4].

Matrix converters are describing by sinusoidal waveforms that indicate the input and output switching frequencies. The bidirectional switches cause it possible to have a controllable power factor input. In adding, the lack of DC links ensures it has a compacted design. The demerits of the matrix converters is that it has a lack bilateral switches that are totally controlled and cable to run at high frequencies. Its voltage ratio that is output to input voltage is limited [5][6].

3.1 Model Circuit Diagram

A simulation design system is implemented in MATLAB SIMULINK with the help of switches and voltage sources we get desired output voltage.

After the running a simulation, it can analyze the simulation results using MATLAB and Simulink. Simulink contain de bugging tools to help to understand the simulation behavior or nature.

We can inspect the simulation behavior by observing signals with the displays showing and scopes provided in Simulink. We can also observe the simulation data Inspector, where we can compare multiple signals from different simulation runs. Extension is the square in Simulink by which we can quantify and see the voltage, flow, and power in electrical area.

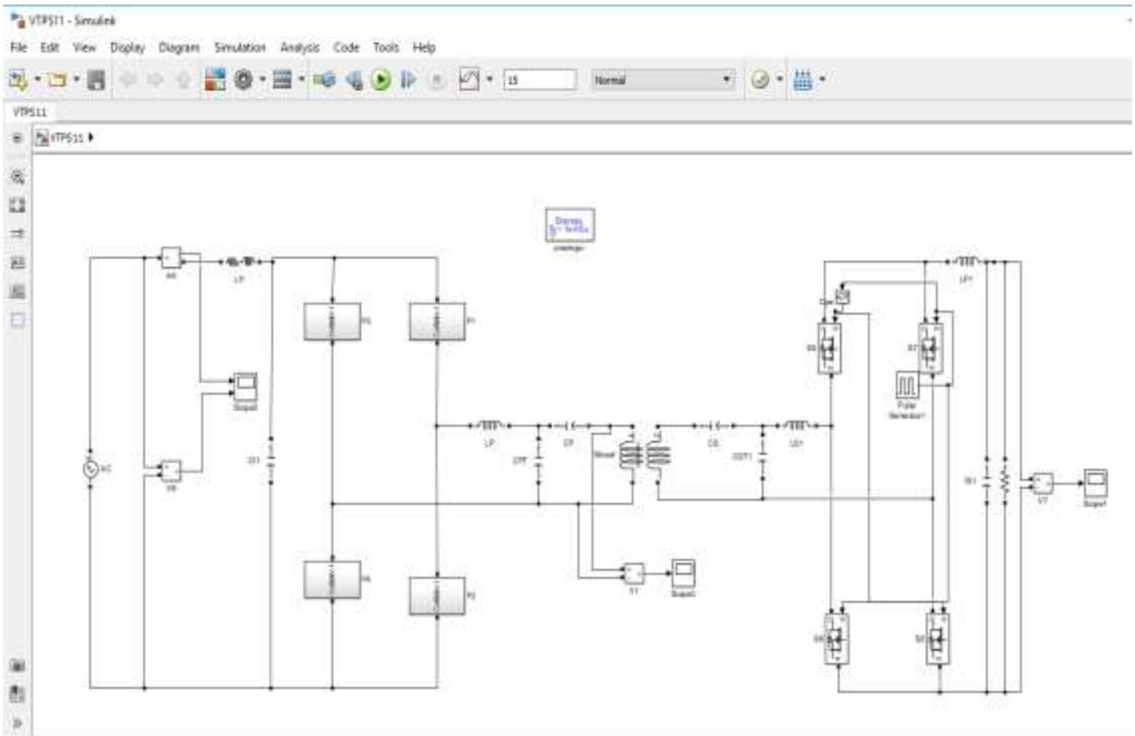

Fig. 3.1 MATLAB Simulation

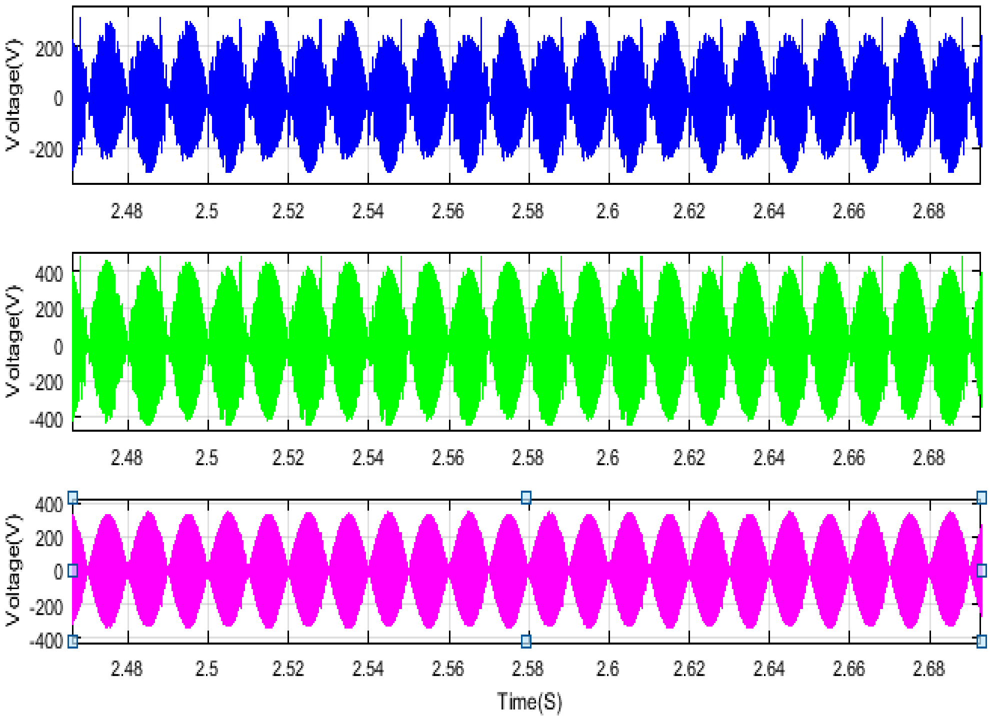

Fig. 3.2 Voltages Before and After Of Mutual Inductance

3.3 Output Voltage

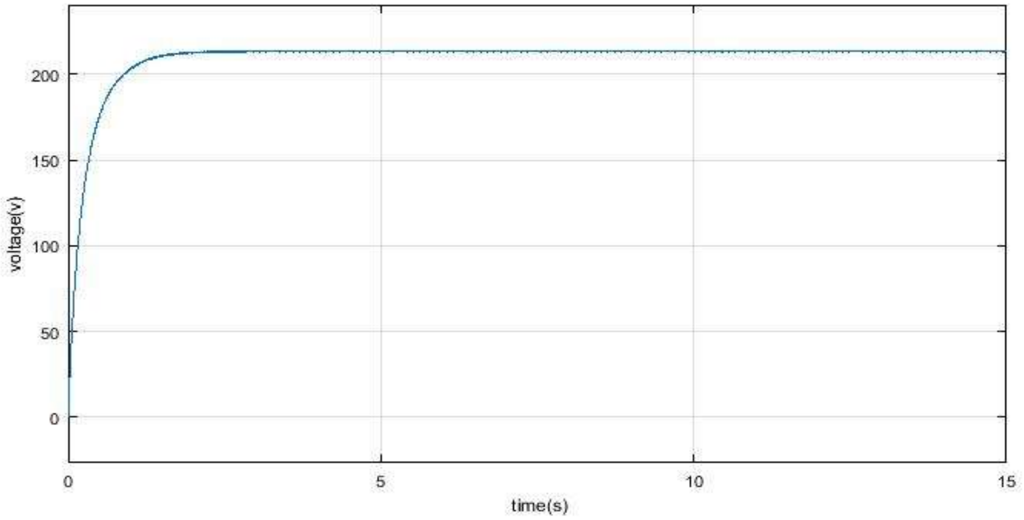

Fig. 3.3 Output voltage of Simulation

Application

- DC motor applications
- Un interruptible power supply
- Switch mode power supply
- Battery
- Bio medical implants
- Vehicle charging and discharging
- Consumer electronics

IV. Conclution And Future Work

The proposed system wirelessly transfers power through loose magnetic coupling, and with simulation results have been presented to show that the proposed technique is viable and requires a simple control strategy to effectively control both direction and amount of power flow. The proposed IPT power interface is reliable, efficient and low in cost without an additional power conversion stage, and expected to be attractive for applications, which require wireless power. All the hardware gadgets required dc supply to work. The UPS is application of hardware computers so on .if the source having harmonics means, it may damage the equipment's. In these system removing the losses by improving the power factor.

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