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Grid-Connected Symmetrical Cascaded Multilevel Converter for Power Quality Improvement

Bashir Parveena[1] , Singh Kuljinder[2]
[1]M. Tech Scholar, [2]Assistant Professor
Department of Electrical Engineering,
Desh Bhagat University, Punjab,
India

Abstract: **This paper presents the use of a cascaded multilevel converter for flexible power conditioning in smart grid applications. The main motive behind the proposed approach is the use of independent DC links with reduced voltages, which makes such a topology an ideal choice for medium and high power applications with high level reliability.**

IndexTerms – DC, EPP, CHMI, PCC.

I. INTRODUCTION

An electrical converter in its simplest terms is mentioned associate device that converts the DC voltage into the AC voltages. A construction electrical converter is more outlined as an influence device that is capable of providing desired alternating voltage level at the output mistreatment multiple lower level DC voltages as associate input principally a two-level electrical converter is employed so as to get the AC voltage from DC voltage additionally construction inverters are accustomed acquire high voltage powers from the medium voltages. Basically, there are the various needs. In sure cases, there's a demand of medium voltage to be generated whereas in alternative, high voltages are needed. In cases wherever a medium quantity of voltage is to be needed, if high voltages are created, it's going to harm the full machinery. So, construction inverters are getting used to get voltage in keeping with our own needs and want. There are sure topologies concerning however the construction inverters are connected to every alternative the foremost outstanding and standard being the cascaded construction inverters. A cascaded construction electrical converter uses a minimum of three voltage levels and uses bridges, diodes, and H-Bridge because the tremendous demand of medium-voltage-high-power is increasing, the cascaded construction inverters are tested to be the most effective possibility for an equivalent particularly within the smart-grid applications. Conventionally two level inverters are used for grid-integration of system. However, these inverters offer pulsating waveforms of current and voltage at their outputs and filters are required to urge harmonic curved waveforms potency of this method is low since energy contained within the higher order harmonics is wasted. Keeping in view higher prices and lower efficiencies of star systems, it is important to plan new inversion methodologies to create compact, low cost and economical star systems several construction inverters topologies are planned. Multilevel inverters were first introduced for top power and high voltage applications [13] however in recent years, they have found applications in low power systems particularly the thought of construction converters has been introduced since 1975. The term construction began with the three-level device later on many construction device topologies are developed. However, the elementary thought of a construction device to realize higher power is to use a series of power semiconductor switches with many lower voltage dc sources to perform the facility conversion by synthesizing a stairs voltage undulation.

II. PROBLEM DEFINITION

The problem is related the use of cascaded multilevel converter for flexible power conditioning in modern grid applications and there are different methodologies that may prove more flexible for providing a simpler way to compensate for disturbances selectively, and simplifying our understanding of the related electrical characteristics. CPT is an alternative framework for the development of electronic power processors (EPP), especially to the design of physical elements and to the definition of selective compensation strategies for multifunctional grid-tied inverters or shunt active filters. The existing systems , however gives the current quality deterioration due to harmonic pollution from switching devices has been penetrating the utility grid and causing great concerns for the utility companies, operators, or even regular consumers in the local grid. Among different topologies of multilevel converters, such as the neutral-point-clamped or diode-clamped and the flying capacitor, cascaded multilevel converter is one of the most popular. It is composed of multiple H-bridge power cells. In practice, the number of power cells in a cascaded H-bridge inverter is mainly determined by its operating voltage and manufacturing cost. Cascaded H-bridge Multilevel Inverter (CHMI) requires the least number of components for the same voltage level as compared to other types of multilevel inverters.

III. METHODOLOGY

The proposed approach will adopt a research methodology that combines the theory model with empirical evaluation and refinement of the proposed scheme on MATLAB simulation tool. Moreover, the visualization and debugging features of MATLAB are simple. DVC performance for

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main voltage and load variation is examined. Proposed solution is validated with simulation study and experimental laboratory tests. The CHMI is composed of a series of cascaded H-bridges, each fed by independent DC sources. Each H-bridge as a power cell is capable of three different voltage levels at the output. The series connection of the H-bridges generates output voltage waveforms that are synthesized by the combination of each output of the H-bridges at certain switching states. This topology offers many advantages such as the feature of modularity, control and protection requirements of each bridge cell. The cascaded multilevel shunt converter is indicated in following figure where it is also possible to see the network loads connected at the point of common coupling (PCC). The PCC loads are constituted by both balanced and unbalanced linear and nonlinear devices.

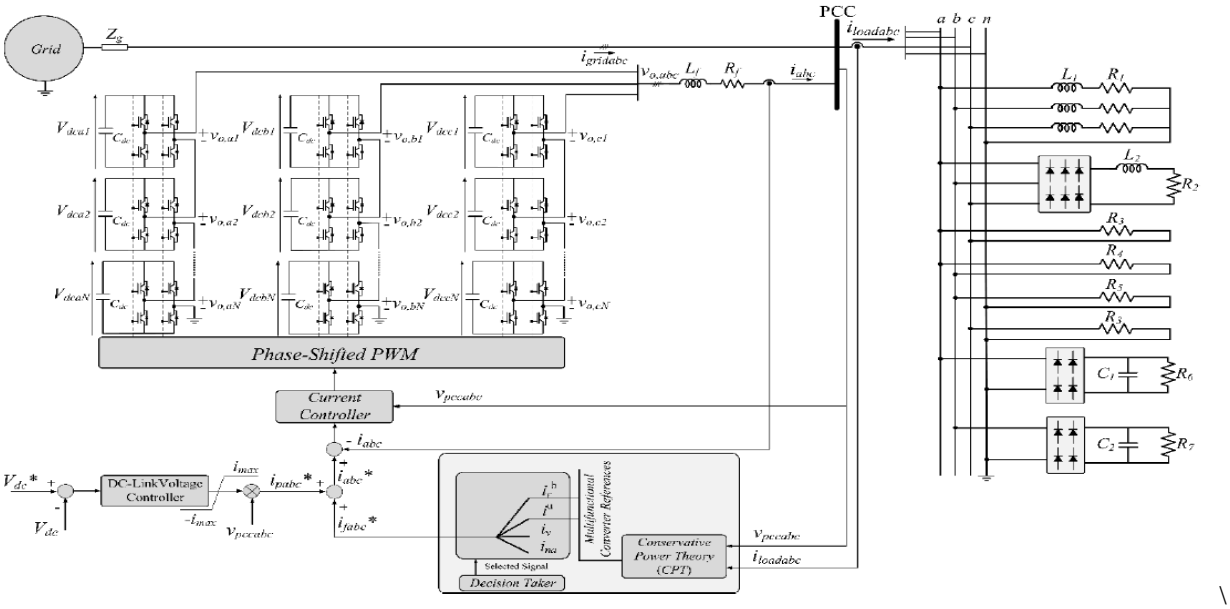


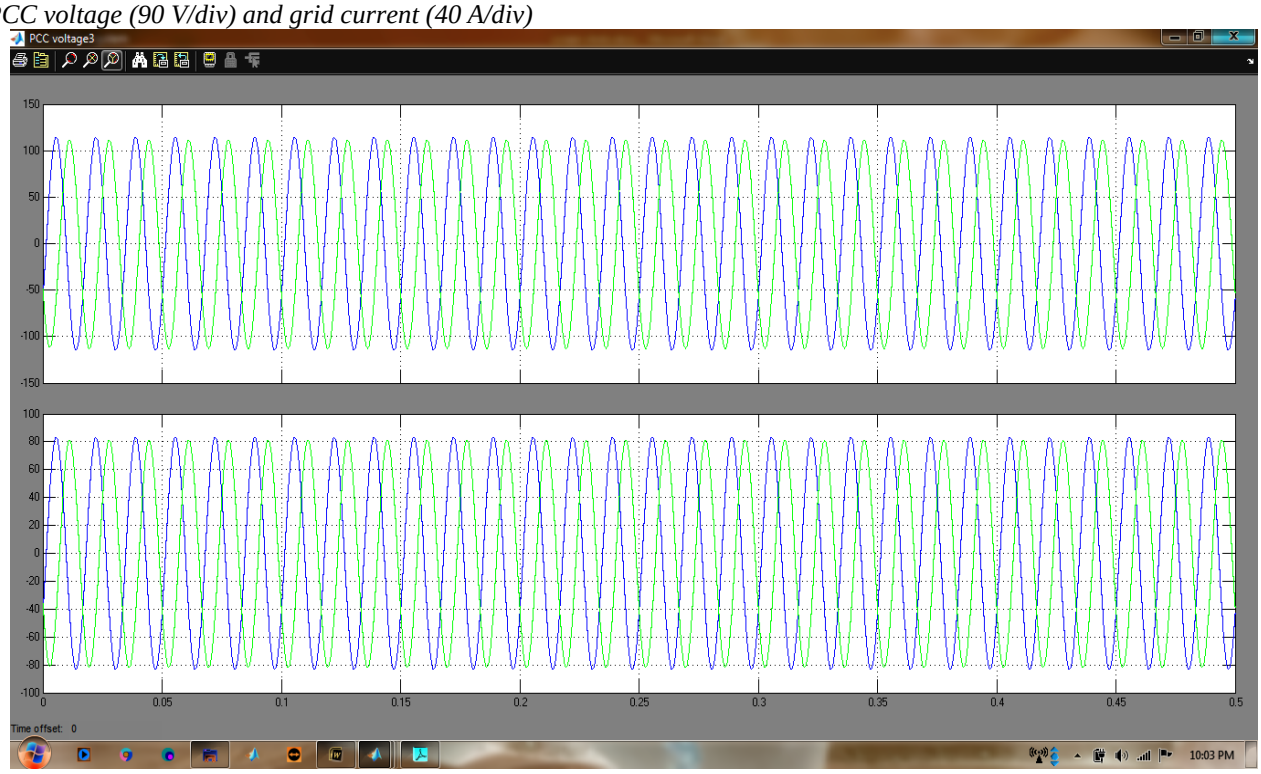
Figure: Block diagram of the power circuit, control scheme, and loads to the power grid.

IV. RESULTS

The results are very important for research and development work to prove the problem definition practically. In my research I am using MATLAB tool to simulate the results.

Compensation of i_{na} current under symmetrical and sinusoidal voltage sourc:

(a) PCC voltage (90 V/div) and grid current (40 A/div)



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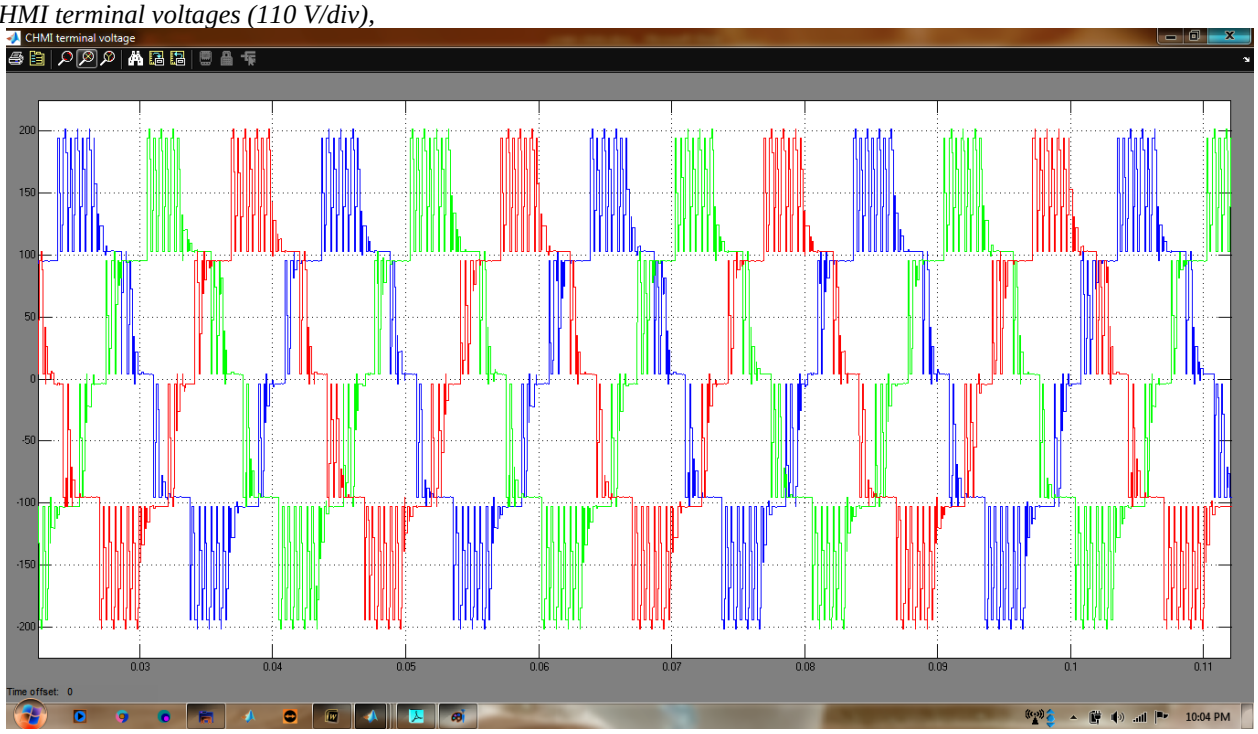
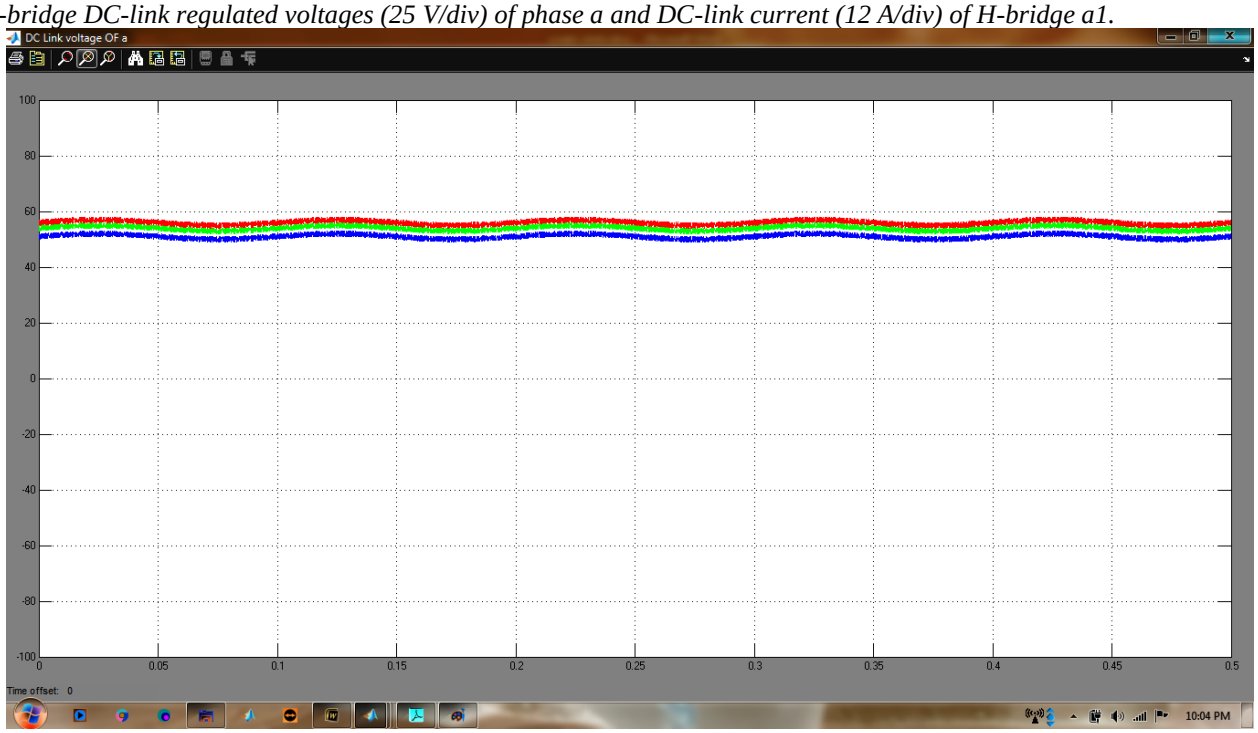
(b) CHMI terminal voltages (110 V/div),



(c) H-bridge DC-link regulated voltages (25 V/div) of phase a and DC-link current (12 A/div) of H-bridge a1.



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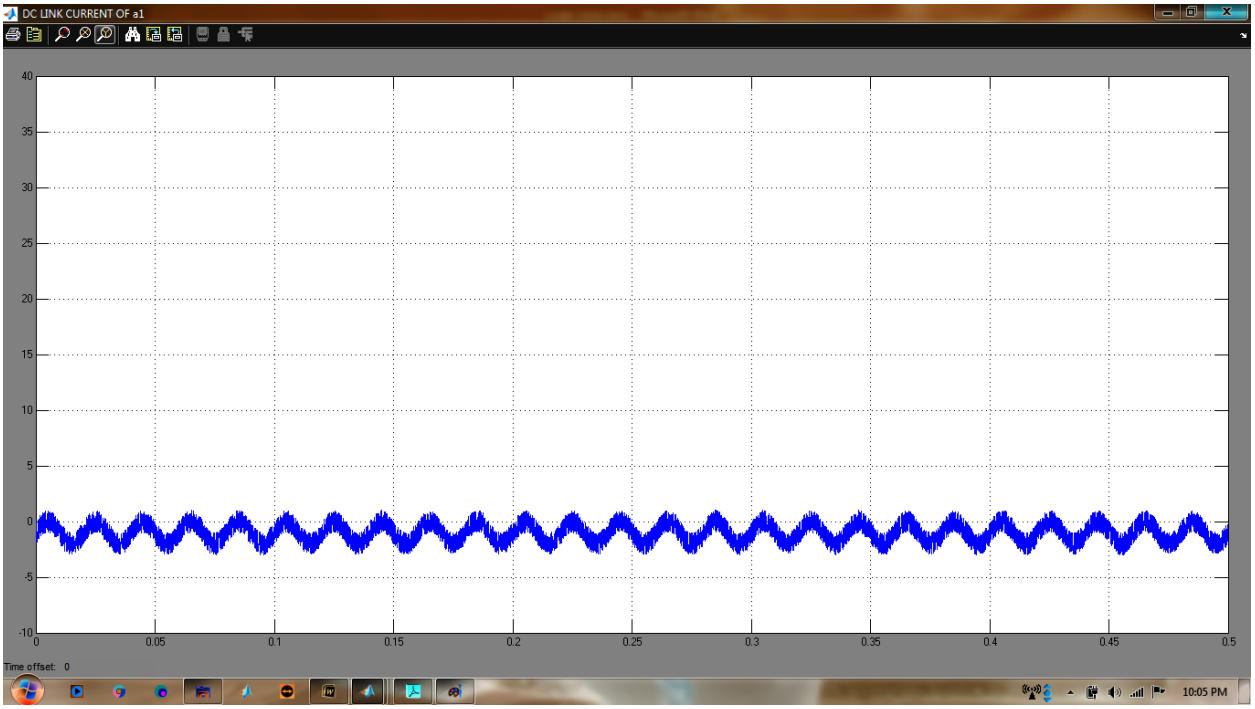
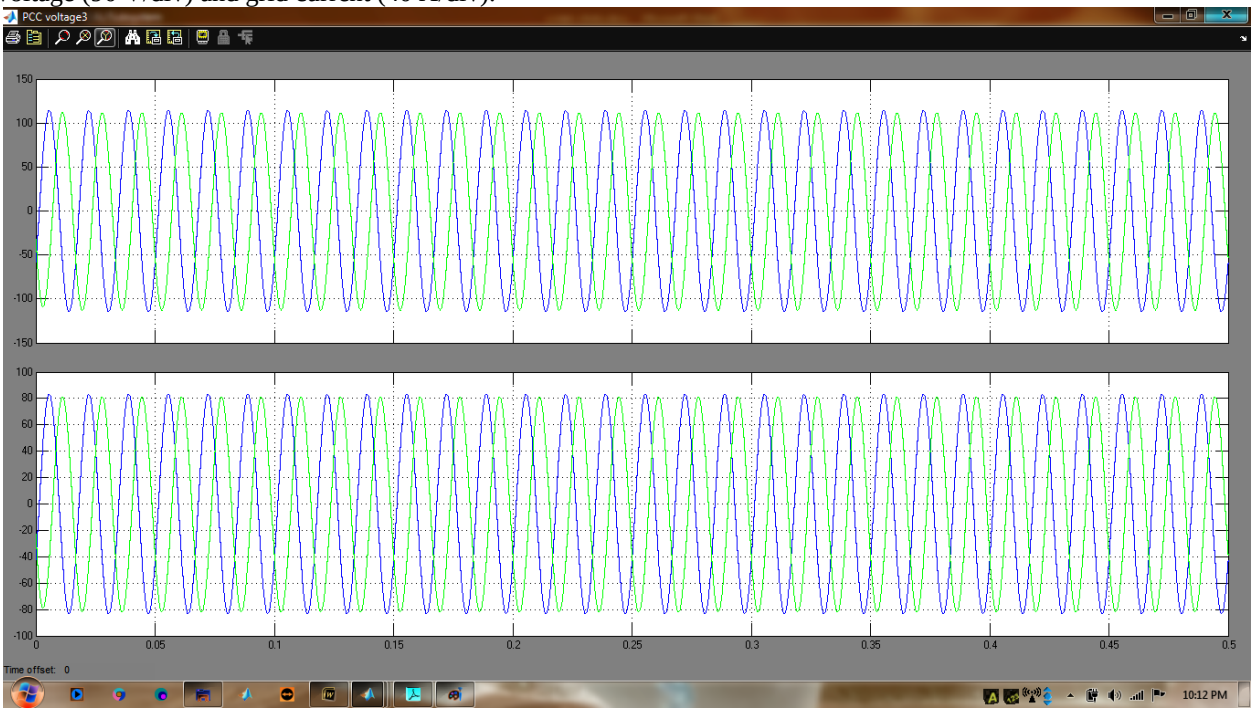


Compensation of i_{na} current under asymmetrical and sinusoidal voltage source:
PCC voltage (90 V/div) and grid current (40 A/div).



Compensation of i_{rb} current:
CHMI terminal voltage (110 V/div) and inverter current (5 A/div) of phases a and b,

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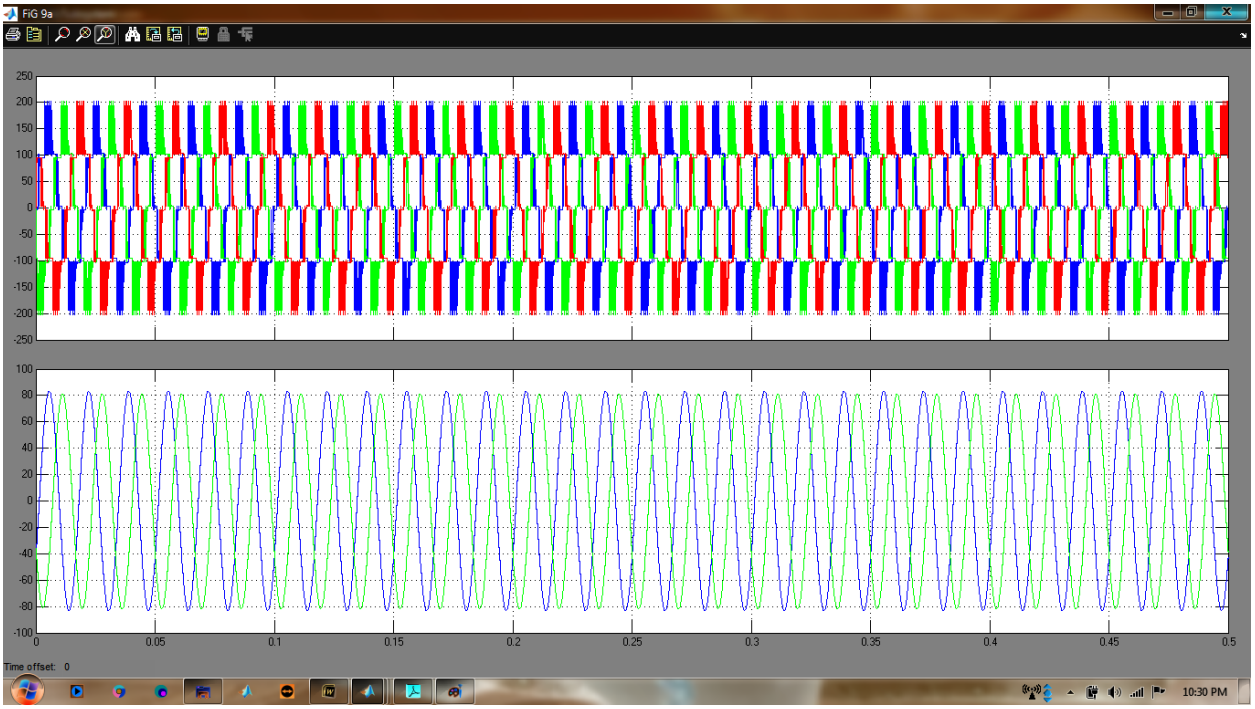
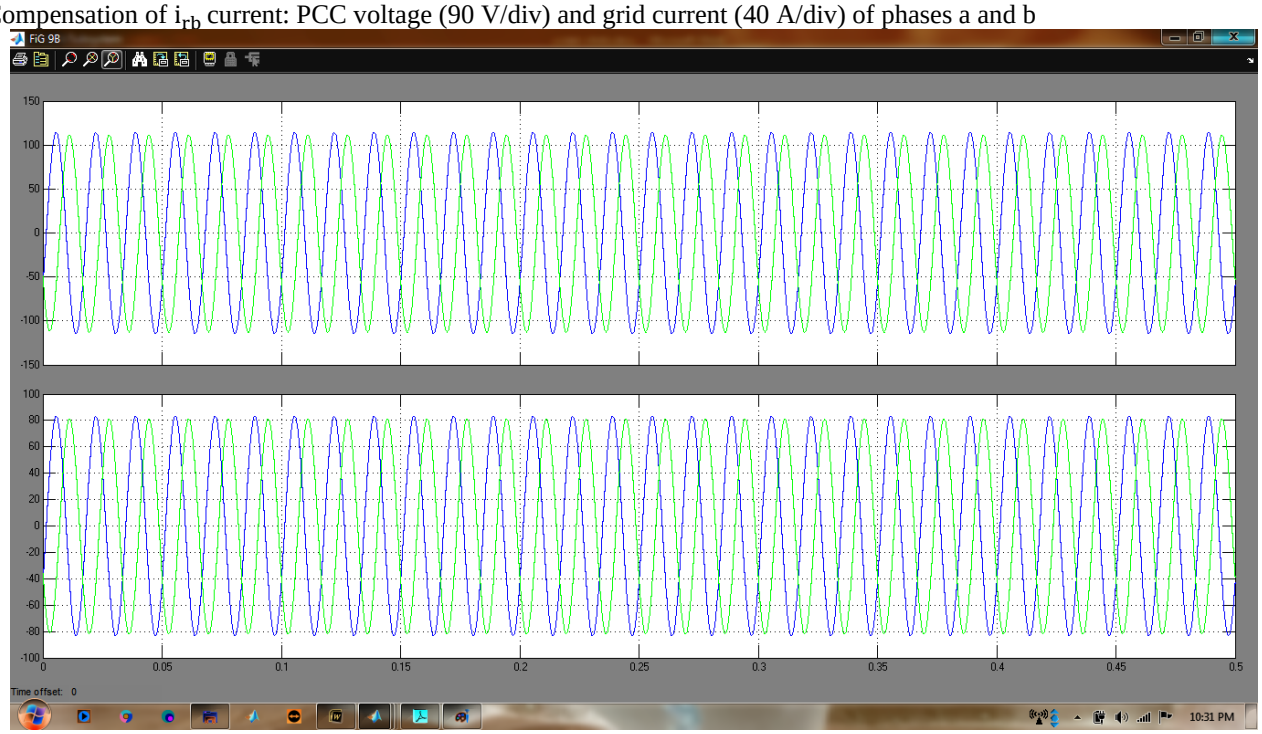


(b) Compensation of i_{rb} current: PCC voltage (90 V/div) and grid current (40 A/div) of phases a and b



V. CONCLUSION

The paper proposes the use of a cascaded multilevel shunt converter as a flexible power conditioner, aiming to selective compensation of disturbing current components extracted using the Conservative Power Theory. Using multilevel converters has several merits, e.g., the modularity in the system configuration with increased reliability, also allowing the use of independent DC link voltages.

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