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Three-Phase Grid Connected ZCT Inverter integrated photovoltaic system

Parshanaboina Bhavani B.TechIVth year
Dept of Electrical and Electronics EnggNoble college of Engg& Tech for Women

J.Siva Naik M.Hussen Assistant Professor
Assistant Professor
Dept of EEE
Collage: NETW

Dept of EEE
College: NETW

Abstract:

When ac loads are fed through invertersit required that the output voltage of desired magnitude and frequency be achieved. Low leakage current and high efficiency are two key two key indexes for transformer less PV grid – connected inverter. The transformer less inverter topologies have superior efficiency thanks to saving transformer, but their semiconductor devices are still on hard switching state at present. A variable output voltage can be obtained by varying the input dc voltage and maintaining the gain of the inverter constant. On the other hand, if the dc input voltage is fixed and it is not controllable, a variable output voltage can be obtained by varying the gain of the inverter, which is normally accomplished by pulse-width-modulation (PWM) control within the inverter. First and foremost, a novel zero current-transition (ZCT) conceptsfor the three-phase full-bridge transformerless PV grid-connected inverters are presented in this paper. Second, the zero-current turn-off for high – frequency main switches of the inverters and the zero current

Turn-on for auxiliary switches added are achieved by introducing two resonant tanks. Furthermore, a family of ZCT transformer less grid connected inverter with sinusoidal pulse width modulation is deduced.

Key words:grid connected inverter, zero current transition (ZCT), fuzzy controller, three-phase measurement, PV system.

I.INTRODUCTION

This chapter presents the background and the motivation of the thesis, continuing with a short overview of grid connected PV system. Furthermore, it details the aims of the project, continuing with a list of the main contributions and finishing with the outline of the thesisTRANSFORMER LESS PV grid connected inverters have already found widespread application in practice [1]. The higher conversion efficiency and lowerleakage current are two major pushing forces in the developof the transformer less grid-connected inverters. In order to improve theefficiency of the single phase transformer

Less grid connected inverters, two ways are developed: one is constructing multilevel circuit structure (mainly focusing on five level topology and the other using new semiconductor devices, such as SiC-type or GaN-type devices. The three-phase transformer less multilevel grid connected losses, which is beneficial to gain the efficiency [2-3]. However, the control strategy is sophisticated given the problem of voltage unbalance for the power devices and the degraded reliability of the inverter. The wide band gap (WBG) semiconductor devices will promote the development of power electronics and improve on the conversion efficiency essentially. However, at present, the fabricating technique of the new materials stays on immature still, and the rate of finished products is low. Therefore, the cost of the inverter with WBG devices would be increased significantly, which reverse with the target of "dollar per watt" initialinstallation cost for PV generation system.

Grid connected to PV system:

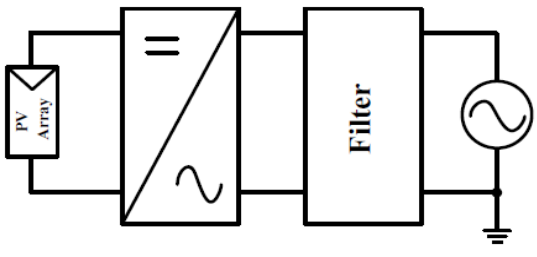
As mentioned to before, decentralized energy production using solar energy could be a solution for a balancing continuously-increasing energy needs. Grid connected PV system have had an enormous increase in their market share over the last decade. With a reasonable set of incentives, the solar photovoltaic market in the U.S. could grow more than 30% per year over the next 20 years, from 340MW of installed capacity to 9600MW [4]. This market growth is also present in other countries worldwide.

Problemformulation:

The efficiency of commercial PV panels is around 15-20%. Therefore it is very important that the power produced by these panels is not wasted, by using inefficient power electronic systems.

Overview of grid connected PV system: This chapter highlights the advantages of transformer less PV inverters compared to those with galvanic isolation. Furthermore, a summary of several transformers less PV inverter topologies is presented followed by discussion about the parasitic capacitance of the PV array, emphasizing the safety issues regarding ground leakage current due to varying voltage imposed over this capacitance [5]. PV systems connected to the low voltage grid have an important role in distributed generation systems. In order to keep up with the current trends regarding the increase in PV installation, PV inverters should have the following characteristics:LowcostSmall weights and size, due to residential installations
High efficiency
String inverters
Multi-string inverters
moduleintegrated inverters

Transformer less PV inverters: Depending on the electrical isolations between the PV panels and utility grid, the inverter can be isolated or non-isolated. This galvanic isolation is usually realized by the means of transformer, which as major influence on a grid connected PV systems' DC to AC efficiency [6-9].



Grid connected PV system with transformer less inverter

II. Circuit structure of three phase PV array ZCT inverter: In order to realize the soft-switching operation for the high frequency main switches S5 and S6 in the HS-H6-I topology, there sonant components C5a, L5a, C6a, L6a the auxiliary switches S5a, S6a (including their anti parallel diodes or, body diodes D5a and D6a), and one auxiliary diode Da are introduced to from three-phase measurement as show in fig.1(a) L5a=L6a=Lr, and C5a=C6a=Cr. The line frequency full bridge inverter consists of the switches S1, S2, S3, and S4; three phase V-I measurement make up the filter connected to the grid; D7 and D8 are a couple of clamping diode in the freewheeling diode period. The modulation pattern of the ZCT-H6-I is the same with modulation pattern of the HS-H6-I is the topology. This section focuses on the operation principle analysis of the ZCT resonant tank.

Operation principle analysis:

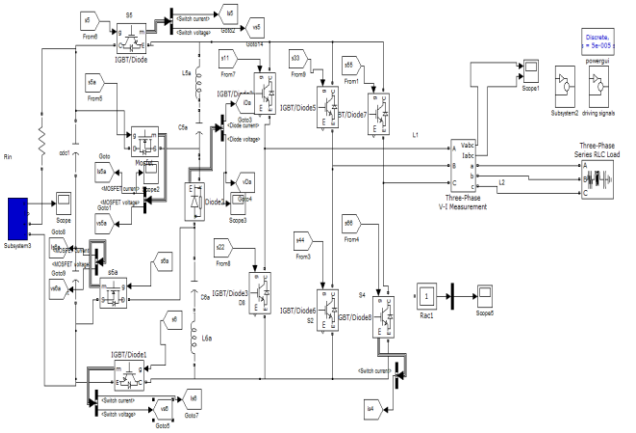
Before the analysis, the following assumptions are is all semiconductor devices are ideal switches with anti parallel diodes and the diodes are also ideal diodes without parasitic parameters. The three phase ZCT was designed by the interconnecting the three-phase inverter after resonant tank andinverter was integrated to three-phase grid**.** The filter network components like a three-phase transmission line interconnect to the three-phase load**.** The neutral point clamped connection between capacitors (Cdc1, Cdc2) and switches S5, S6 to form three-phase converter, which has operation of converting the DC output supply from ZCT network into three phase AC supply.

A10 KW of three phase load as on the network to study the operating analysis of the proposed converter the DC supply with zero current transition is directly fed to the three-phase converter to integrated grid for generation of the switching signals for the three phase converter a PWM technique has adopted. The generation of switching signals with using PWM technique was described.

The operation principle of proposed converter was verified by using MATLAB/Sims power system tool box. The switching signals are generated by PWM generator. A basic two level inverter has designed to integrated ZCT net work to a 10 KW load.

Pulse width modulated (PWM) inverters are among the most used power electronic circuit in practical application. This inverters capable of producing AC voltage of a variable magnitude as well as frequency. The quality of output voltage can be greatly enhanced so commonly used in PWM modules.

III. Simulation circuit of three-phase PV array ZCT converter:



Fig; Simulation circuit proposed three-phase grid tied ZCT transition

Circuit design of pulse width module;

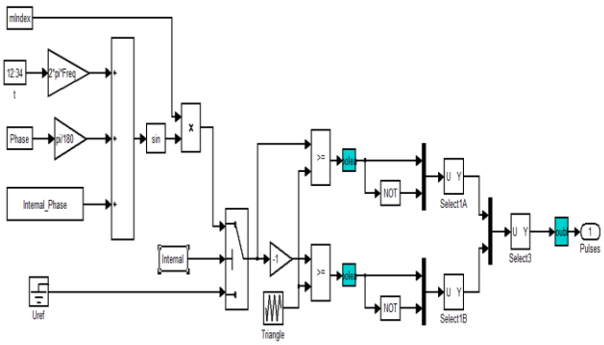
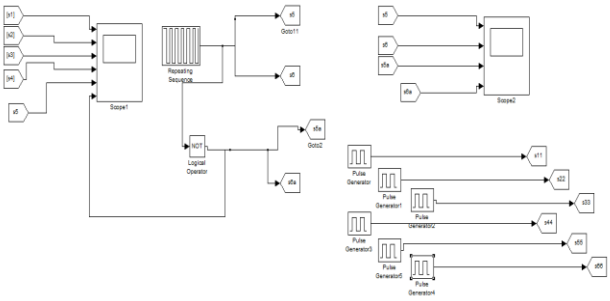
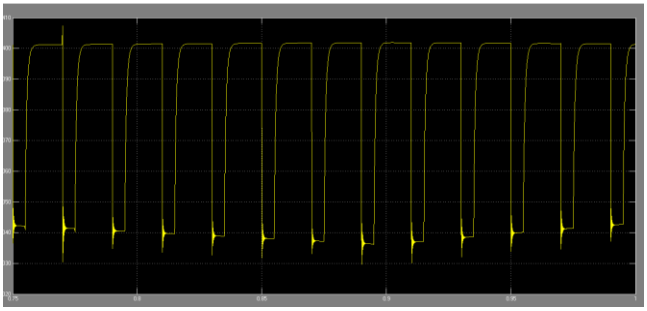


Fig: Pulse width module

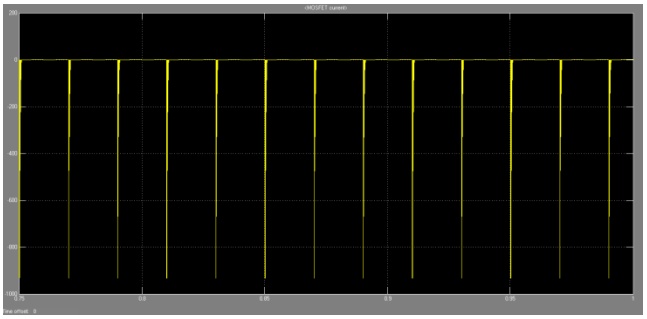
Dividing signals of the ZCT three-phase inverter:



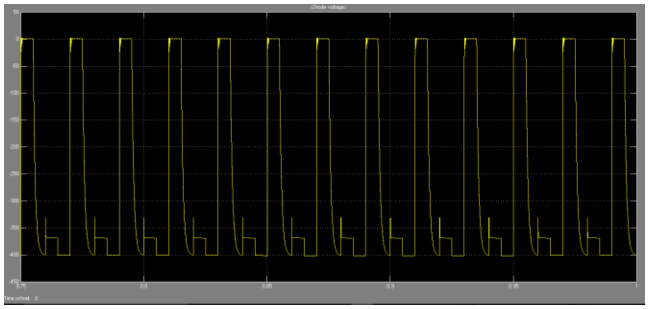
Fig;dividing signals of ZCT inverter



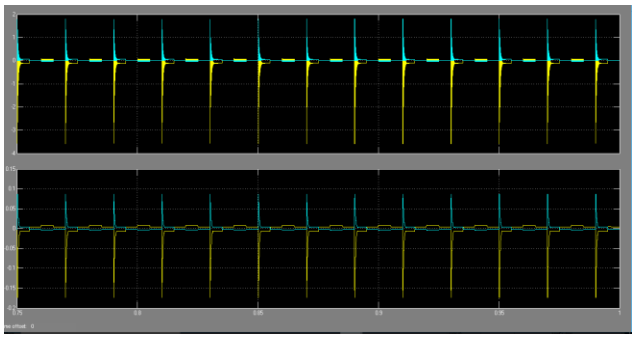
Wave firm for grid tied ZCT inverter input voltage



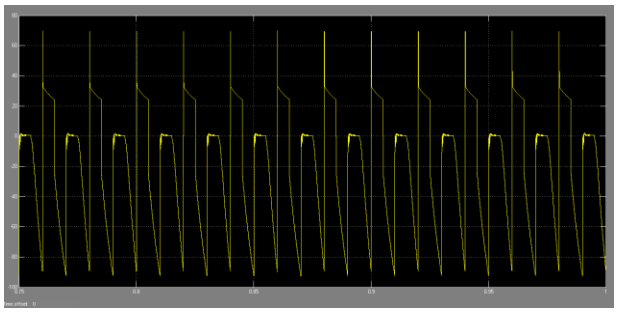
wave form for grid tied ZCT inverter mosfet current



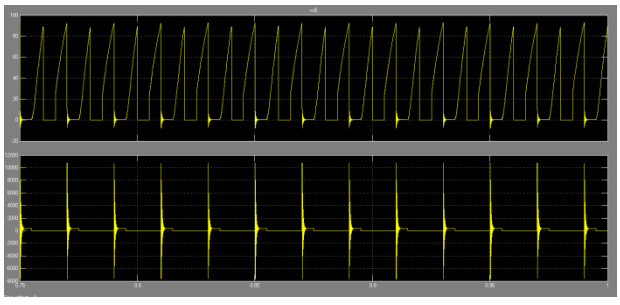
Wave form for grid tied ZCT inverter diode voltage



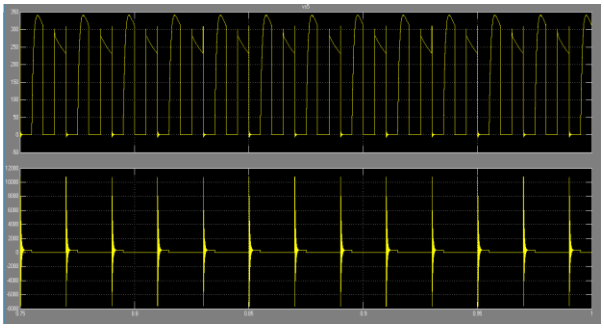
Three phase grid tied ZCT inverter Vabcs and Iabc



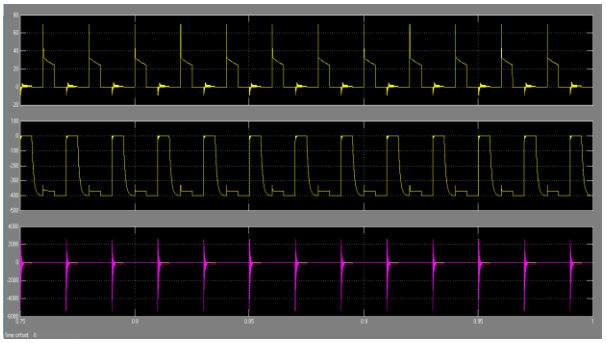
Three-phase grid tied ZCT inverter Rac1



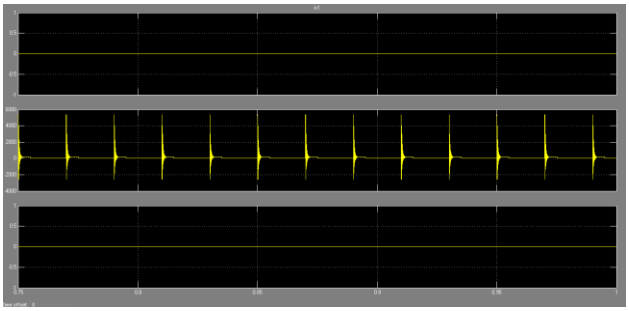
Grid tied ZCT inverter Vs5, Is5



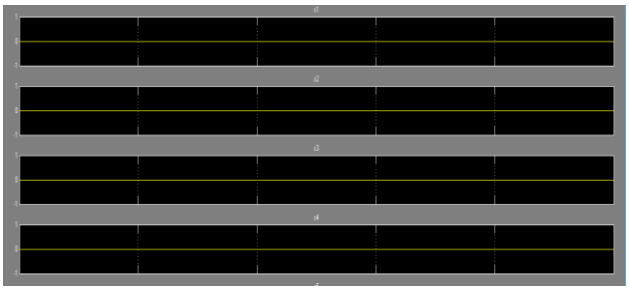
Grid tied ZCT inverter Vs6, Is6



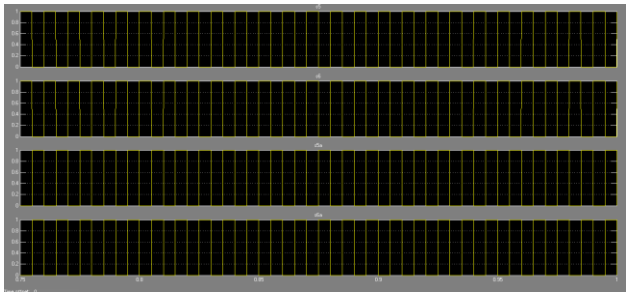
Wave form of Vs5a, Vda



Waveform of Is1, Is4



Waveform of S1, S2, S3, S4

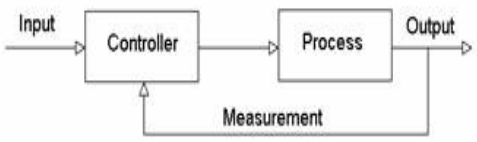


Waveforms of S5, S6, S5a, S6a

IV. Fuzzy logic controller:

There is more fuzzy logic controller then some interesting math, some impressive applications. The main application of fuzzy logic in the area of control system. An interconnection of components forming a system that will provide desired response. The process is thesystem that being controlled and can't be typically be changed. A fuzzy logic based controller will use fuzzy

membership function and inference rules to determine the appropriate process input. Fuzzy control system is a control system is based on the fuzzy logic a mathematical system that analyzes, analog input values in terms of logical variables. Fuzzy controller is very simple conceptually. The fuzzy controller is applicable for linear and non linear circuits. They consist an input stage, a processing stage, and an output stage. The input stage maps sensor or other inputs such as switches, thumbwheels and so on to the appropriate membership function and truth values. The processing stage invokes each appropriate rules and generates a result for each, then combines the results of the rules. Finally the output stage converts the combined result back into a specific control output value.

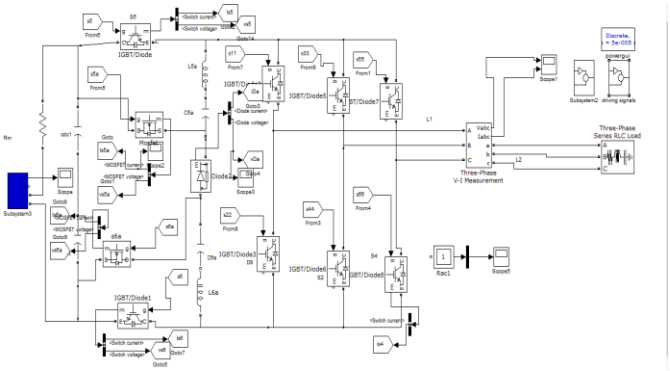


Block diagram of fuzzy control system

Symbol of fuzzy logic controller:

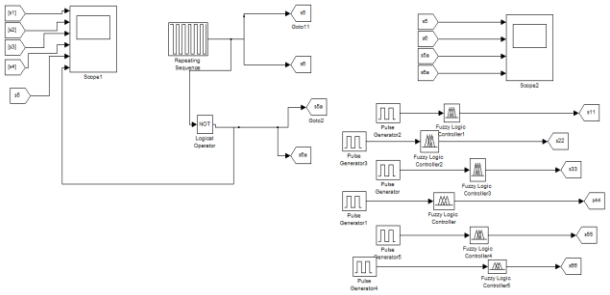
The most common shape of membership functions is triangular, although trapezoidal and bell curve also used, but the shape is generally less important than the number of curves and their placement. Typical fuzzy control systems have dozens of rules.

V. Simulation circuit of three-phase PV array ZCT converter by using fuzzy logic controller:

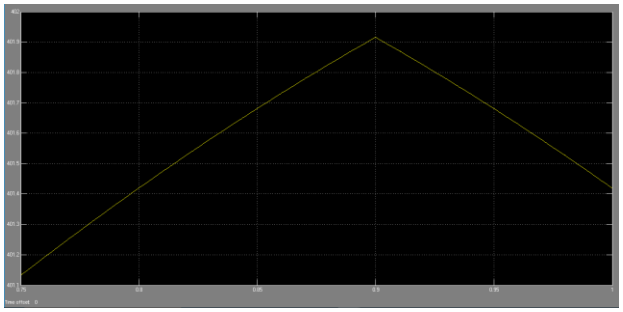


Simulation Circuit is use to fuzzy logic controller

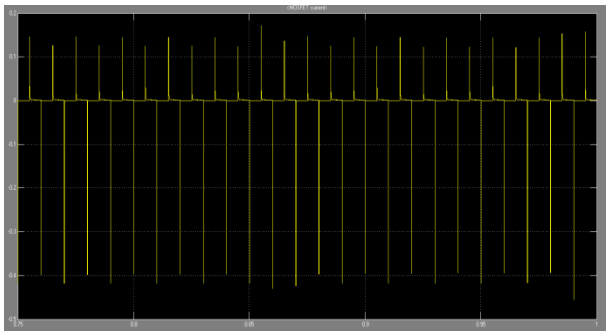
Dividing signals is use to fuzzy logic controller in the circuit:



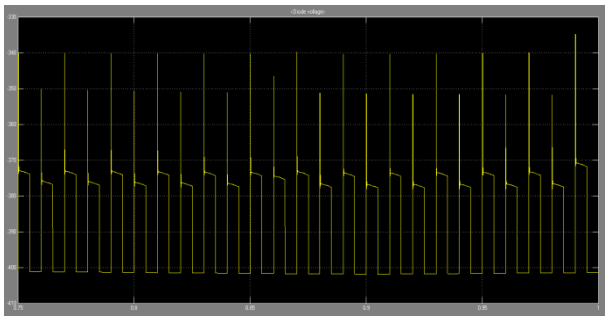
The circuit designed to the fuzzy logic controller



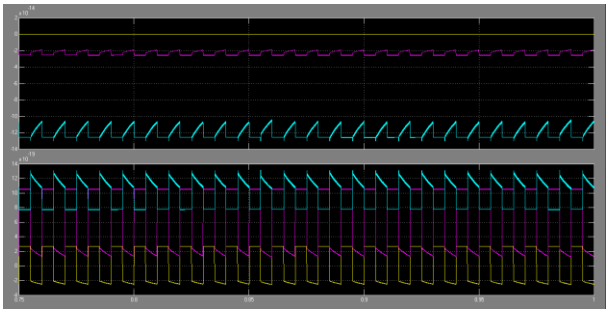
Wave for grid tied ZCT inverter fuzzy controller input voltage



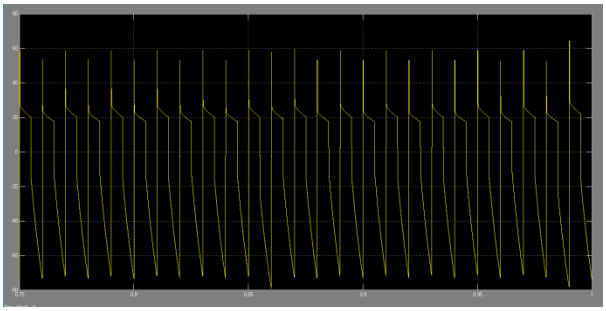
Waveform for grid tied ZCT converter is fuzzy controller mosfet current



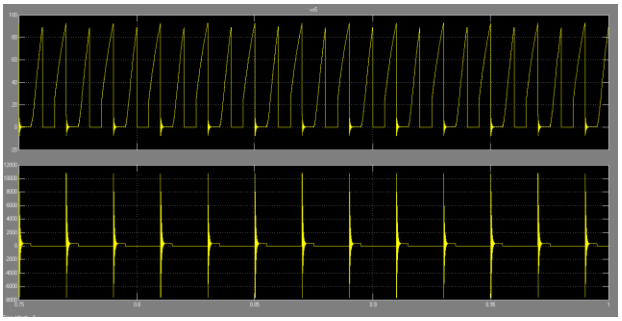
Waveform for grid tied ZCT converters fuzzy controller diode current



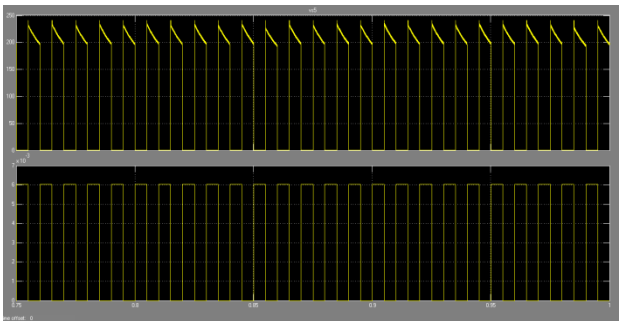
Three phase grid tied ZCT converter is fuzzy controller Vabc and Iabc



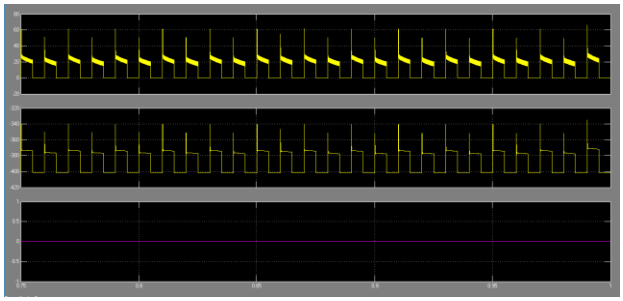
Three phase grid tied ZCT is converter is fuzzy controller Rac1



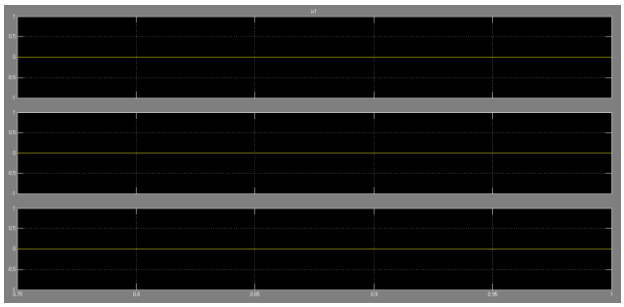
Grid tied ZCT inverter is fuzzy controller Vs5, Is5



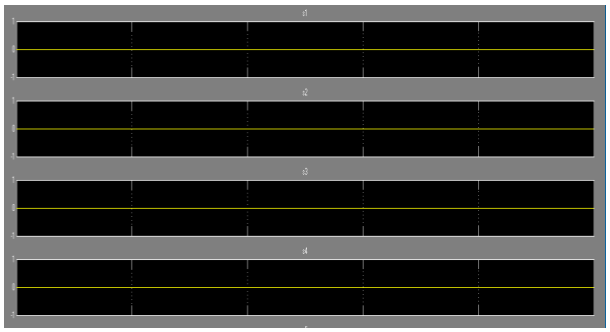
Grid tied ZCT inverter is fuzzy controller Vs6, Is6



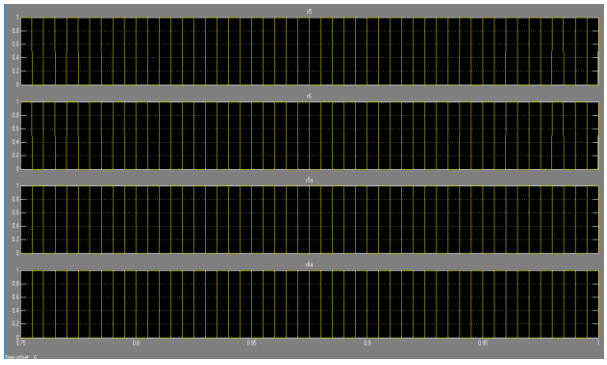
Waveforms for ZCT converter is fuzzy controller Vs5a, Vda



Waveforms for ZCT converter is fuzzy controller Is4, Is1



Waveforms for fuzzy controller switches S1, S2, S3, S4



Waveforms for fuzzy controller switches S5, S6, S5a, S6a

VI. Conclusion:

The three-phase grid connected ZCT inverter transformer less is photovoltaic system is used. Then the soft switching with constant frequency keeps the structure operating with the maximum efficiency and low leakage current losses. Then PV grid – connected to the inverter, and the size, cost, weight can be reduced. Then use to the DC-AC converters. Two factors mainly contributed with this advantage: the Continuous current flux with low ripple and the barrier formed by the three phase measurement circuit. Which the following characteristics: 1) the high frequency main switches realize zero current turn off, and the added auxiliary switches realize the zero current turn off. 2) The ZCT three-phase measurement has no influence on the differential common mode characteristics compare with hard switch counterpart.

The merits are verified by ZCT-H6-I prototype rated at 50 HZ 10 KW to 20 KW load. The proposed ZCT concept suitable for higher power level of three phase grid connected system with solar. This paper is used to the fuzzy logic controller then the fuzzy controller is applicable in the linear and non linear circuits. Fuzzy logic controllers are control the voltage harmonics. Then the produce the constant power.Then apply to the fuzzy controller is modified to the voltage level. In this paper comparison has been three-phase grid connected to the ZCT-H6 converter without fuzzy controller and three phase grid connected to the ZCT-H6 converter with fuzzy controller. Then observe to the simulation result the three-phase ZCT-H6 converter is better for the is three-phase grid connected to the ZCT-H6 converter with fuzzy controller.

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Author's biography:

P.Bhavani studying in B.techs4thyear EEE Department.From noble college of Engineering and Technology for women.From JNTUH university rangareddy (dist) Telangana State in India.

M.Hussen: ReceivedB.Tech degree in EEE department from Sri Dattha institute Engg& technology .JNTUH university, Rangareddy (dist), Telangana (State) in India, and M.Tech in electrical power system Engg&Technology from JNTUH University. He has teaching experience of 4 years &currently working as

Assistant professor in noble college of Engg& Tech for women. RR (dist), Telangana state. He published research papers in reputed international journals.

J.Sivanaik: Received B.tech degree in EEE departmentand M.Tech in Electrical power system engineering from Acharya NagarjunaUniversity Vijayawada, Krishna (dist), and Andra Pradesh state in India. He as teaching Experience of 4 years & currently working as Asst professor in Acharya NagarjunaUniversity in A.P.