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Power Quality Improvement of Switched-Mode Power Supply using Fuzzy Controlled Bridgeless Buck–Boost Converter

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Abstract: SWITCHED-MODE power supplies (SMPS) are used for powering up different parts in a personal computer (PC) by developing multiple dc voltages from a single-phase ac voltage from the power grid. Normally, a diode bridge rectifier (DBR) followed by a filter capacitor is used at the front end of these SMPS. DBR causes significant deterioration in the power quality leading to very low power factor (PF) and high harmonic distortion at the ac mains with a high crest factor of the input current. Therefore, an attempt is made here to reduce the current harmonics and to achieve high PF at the utility interface in a multiple-output SMPS by using a Fuzzy controlled bridgeless buck– boost converter at the frontend.

Keywords: SMPS (Switched Mode Power Supply, DBR (Diode Bridge Rectifier), SSPFC (Single Stage Power Factor Correction), DCM (Discontinuous Current Mode).

I. INTRODUCTION

Electric power quality may be defined as a measure of how well electric power service can be utilized by customers. Power Quality problem is an occurrence manifested as a nonstandard voltage, current or frequency that results in a failure or a mis-operation of end user equipment. To compensate harmonics conventional Passive Filters are used for specific number of harmonics. To compress total harmonic content Active Power Filters are used. For all types of power quality solutions at the distribution system voltage level FACTS also called as Custom Power Devices are introduced to improve Power Quality. Power Quality (PQ) has become an important issue since many loads at various distribution ends like adjustable speed drives, process industries, printers, domestic utilities; computers, microprocessor based equipments etc, whose performance is very sensitive to the quality of power supply and have become intolerant to voltage fluctuations, harmonic content and interruptions. The solution for some of the more traditional power quality problems can be achieved by using UPS Transient, Voltage Surge Suppressors, The electromagnetic interference filters etc. Poor Pf is the one of the most effected power quality problem. Among three basic power converter topologies (boost, buck and buck-boost), the boost converter is the one most suitable for power factor correction applications. This is because the inductor is in series with the line input terminal through the diode rectifier, However, the output voltage has to be higher than the line input voltage for a boost converter. The buck converter is seldom used as a power factor correction application, since the input current is discontinuous and it loses control when the line input voltage is lower than the output voltage. The buck-boost and fly back converters are able to control the average line input current. The diode bridge at the front end is eliminated, and two buck–boost converters are connected back-to-back so that each takes care of one half cycle of the ac supply. The bridgeless buck–boost converter is designed in DCM for single control loop and for inherent PFC.

II. LITERATURE SURVEY

This project provide the information about introduction of Multiple output SMPS in personal computer application. In recent years, the switching mode power supply (SMPS)system have been achieved the high power density and high performances by developed power semiconductor devices such as; IGBT, MOS-FET and Sic However, using the switching power semiconductor in the SMPS system, the problem of the switching loss and EMI/RFI noises have been closed up. On the other hand, the power semiconductor device technology development can achieve the high frequency switching operation in the SMPS technical area.

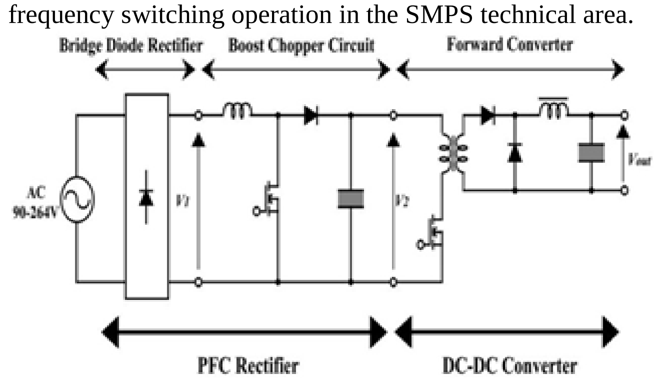

Fig.1. SMPS system configuration of research target.

The increase of the switching losses has been occurred by this high frequency switching operation as shown in Fig.1. For this solution, the soft switching technique have been attracted the great interest in recent years. Using LC resonant phenomenon, this technique can minimize the switching power losses of the power semiconductor devices, and reduce their electrical dynamic and peak stresses. However, the soft switching topology need the additional circuit components such as; active power semiconductor devices, resonant inductors, resonant capacitors. The application of soft switching technique will make the SMPS system larger size and higher cost.

III. RELATED WORK

It is observed from the available literature that the bridgeless converter-based multiple-output SMPS has not been attempted so far, particularly targeting SMPSs for PCs. Therefore, an attempt is made here to reduce the current harmonics and to achieve high PF at the utility interface in a multiple-output SMPS by using a bridgeless buck– boost converter at the frontend. The diode bridge at the front end is eliminated, and two buck–boost converters are connected back-to-back so that each takes care of one half cycle of the ac supply. The bridgeless buck–boost converter is designed in DCM for single control loop and for inherent PFC. The operating principle of the proposed bridgeless-converter-based multiple-output SMPS consists of a single-phase ac supply feeding two back to-back-connected buck–boost converters with a half-bridge VSI and multiple-output HFT at the load end as shown in Fig.2. The buck–boost converters are controlled suitably to obtain a high PF and low input current THD.

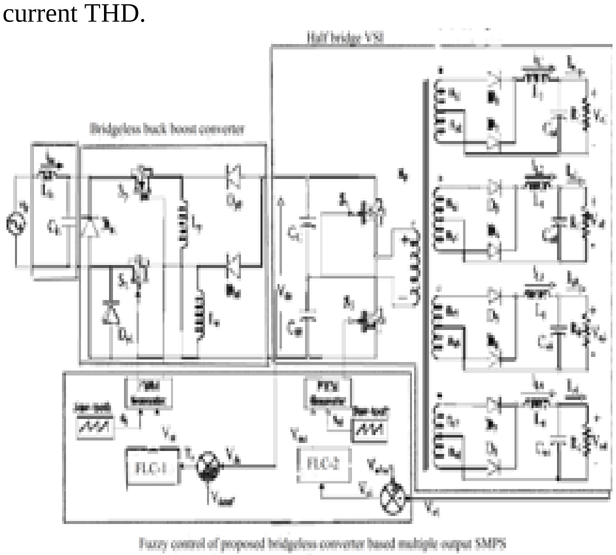

Fig.2 fuzzy controlled bridge less buck boost multiple output SMPS.

IV. PROPOSED FUZZY LOGIC CONTROLLER

FL controller is an one sort non straight controller and programmed. This kind of the control drawing closer the human thinking that makes the utilization of the acknowledgement, vulnerability, imprecision and fluffiness in the choice making procedure, figures out how to offer an exceptionally tasteful execution, without the need of a definite numerical model of the framework, just by fusing the specialists' learning into the fluffy. Fig 6 demonstrates the FL controller piece outline. This fluffy rationale control framework is in view of the MAMDHANI fluffy model. This framework comprises of four principle parts as shown in Fig.3. A fuzzy fiction interface, which converts input data into suitable linguistic values; a knowledge base, which consists of a data base with the necessary linguistic definitions and the control rule set; a decision-making logic which, simulating a human decision process, infer the fuzzy control action from the knowledge of the control rules and linguistic variable definitions; a de-fuzzification interface which yields non fuzzy control action from an inferred fuzzy control action

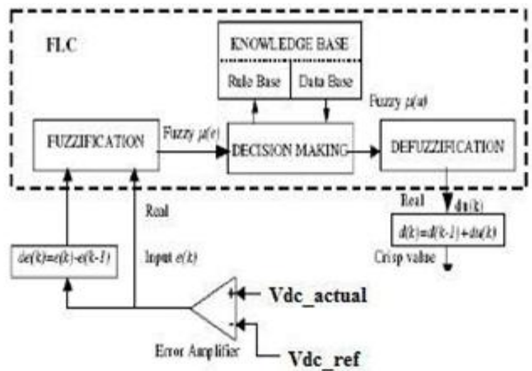

Fig.3. Block diagram of the FLC for Proposed Converter.

V. SIMULATION RESULTS

The below figs.4 to 7 shows the simulation diagrams of this system. The performance of the proposed bridge less buck boost converter fed multiple output SMPS is simulated in MATLAB/Simulink environment using sim-power-system toolbox.

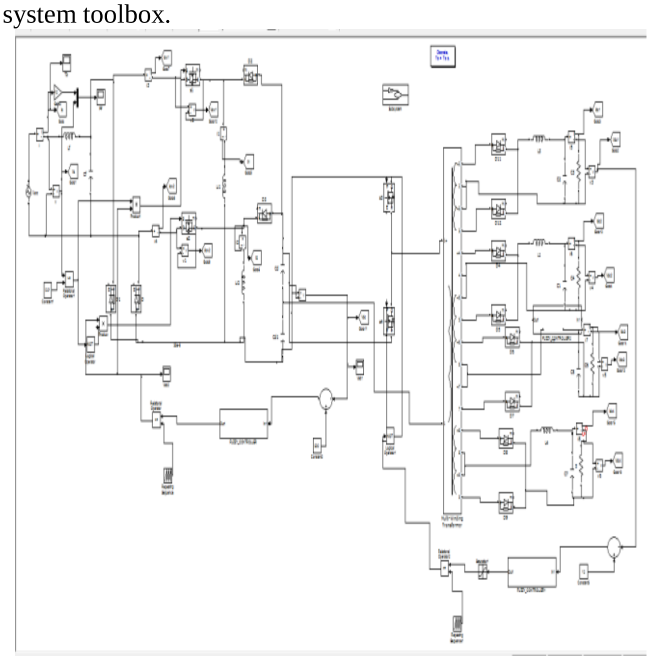

Fig.4. MATLAB/simulation proposed method of bridgeless-converter-based multiple-output SMPS with variable load with FUZZY logic controller.

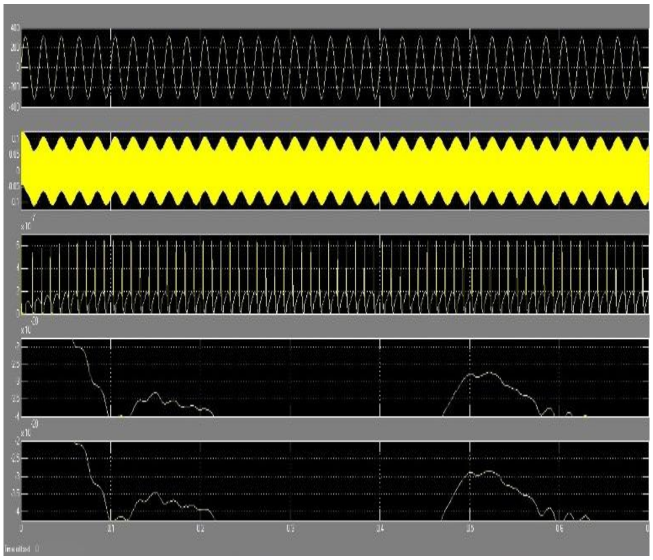

Fig.5 Voltage wave forms of fuzzy controlled bridgeless buck boost converter based SMPS.

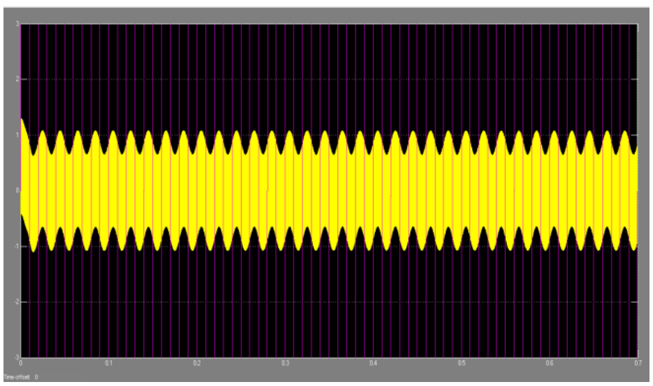

Fig.6 Simulation waveforms of power factor correction.

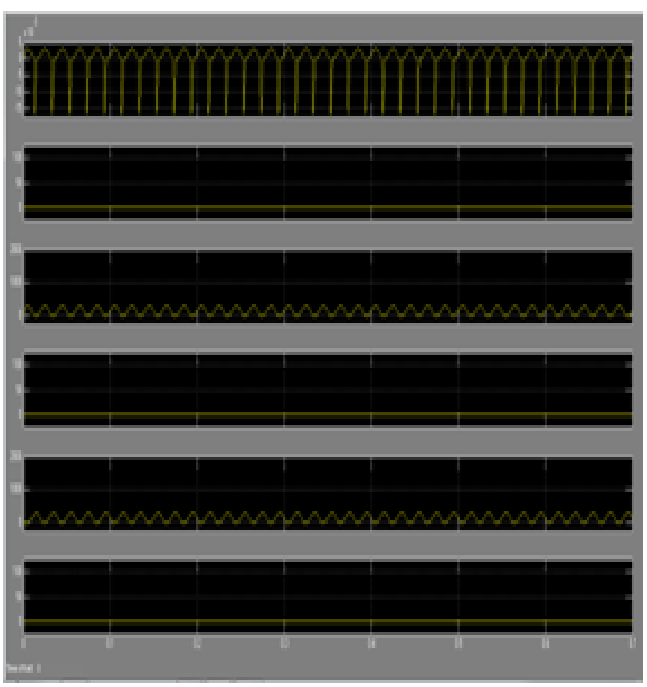

Fig.7. Simulation wave forms of Fuzzy controlled bridgeless buck-boost converter.

VI. CONCLUSION

Fuzzy controlled bridgeless-converter-based multiple-output SMPS has-been designed, modeled, simulated, and implemented in hardware to demonstrate its capability to improve the power quality at the utility interface. The output dc voltage of the first-stage buck–boost converter has been maintained constant, independent of the changes in the input voltage and the load, and it is operated in DCM to achieve inherent PFC at the single-aphasiac mains. A satisfactory performance has been achieved during varying input voltages and loads with power quality indices remaining within the acceptable limits. Finally, a prototype of the proposed bridgeless-converter based multiple-output SMPS has been developed to validate its performance experimentally. The proposed SMPS has shown satisfactory performance, and hence, it can be recommended as a tangible solution for computers and other similar appliances.

VII. REFERENCES

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