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SIMULATION MODELLING ON AN INTEGRATED NON-ISOLATED BUCK-FLYBACK AC-DC CONVERTER FOR POWER QUALITY IMPROVEMENT

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Abstract: In this proposed new converter is an inherent integration of a buck converter and a flyback converter, which operates in either fly back mode or buck mode according to whether the input voltage is lower or higher than the output voltage.In this way, the dead zones of ac input current in traditional buck PFC converter are eliminated.Therefore, the proposed integrated buck–fly back non- isolated PFC converter can achieve high PF under universal ac input range.A proposed converter will be simulated in MATLAB/SIMULINK environment.A 100-W prototype was built up to verify the theoretical analysis of the proposed integrated buck–flyback non-isolated PFC converter. Objective of this proposed topology is modeling of High power factor correction converter by integration of a buck–Fly back input current shaper with a Auxiliary fly-back converter.proposed converter operates in fly back mode when the input voltage is lower than the output voltage and operates in buck mode when the input voltage is higher than the output voltage.

Keywords:AC-DC, buck-flyback converter, harmonics currents, high power factor(PF).

1. INTRODUCTION

1.1GENERAL

Nowaday's most ac/dc power converters are forced to reduce the harmonic current to meet the IEC61000-3-2 limits. Some special power products such as lighting equipments should meet the stricter IEC61000-3-2 class C limits. Power factor correction (PFC) is a good method for providing an almost sinusoidal input current. The boost converter is the most popular topology for PFC applications due to its inherent current shaping ability. However, with universal input, usually a 400 Vdc output voltage is required for the boost PFC. The boost PFC cannot achieve high efficiency at low line input because it works with large duty cycle in order to get high-voltage conversion gain. Therefore, it is hard to increase the power density of boost PFC converter due to the thermal concern at low line input.

The power factor (PF) correction (PFC) technique is well applied to the ac/dc converters because it canprovide almost sinusoidal input current. In this way, the ac/dc power converters can meet the IEC61000-3-2 limits. For some special industrial products such as lighting equipment, the PFC converter can also help meet the stricter IEC61000-3-2 Class C limits. In the past few years, the boost PFC converter was the mostpopular topology due to its inherent shaping ability of the input current. However, the boost PFC cannot achieve high efficiency at low line because it works with large duty cycle in order to get high voltage conversion gain. Some other topologies such as the SEPIC converter can achieve high PF and reduce the output voltage stress. However, the high voltage stress of switch reduces the efficiency and increases the cost. The buck PFC converter can achieve a relatively high efficiency particularly at low input voltage due to the low average input current and rms current, while the voltage stress of the switch is also low. Therefore, the buck PFC converter hasdrawn much attention. However, it is difficult for the buck PFC converter to pass the IEC61000-3-2 Class C limits due to the dead zones in the input current which occur when the input voltage is lower than output voltage *Vo*. An improved constant on-time (COT) control for buck PFC converter is introduced in this improved COT control can help improve the PF of the buck PFC converter.

However, this improved control method needs carefully designed parameters and is still not easy to meet the limits imposed by IEC61000-3-2Class C limits at the low line input voltage. Another way to improve the PF of the buck PFC converter isto modify the structure of the conventional buck converter. According to this idea, the integrated quadratic buck–boost–buck converter was proposed in this proposed topology integrates a buck–boost input current shaper with a quadratic buck converter to eliminate the dead zones of the input current and then achieve high PF. However, the complex structure of this topology makes it unsuitable for actual applications. The buck converter can also be integrated with a flyback

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converter. Two combined buck–flyback converters were introducedin, which the dead zones of the input current can be eliminated with the auxiliary flyback converter. However, an additional diode leading to additional losses is inserted in the power loop when these two topologies operate in buck mode.

The structure of the proposed converter is very simple. It is formed by adding two rectifier diodes, one winding of the inductor, and one switch into the conventional buck PFC converter. The source nodes of the added switch *Q*2 and the buck switch *Q*1 are connected to the ground. Therefore, these two switches can beeasily driven without floating drivers. There are two different operation modes in a line period for the proposed converter. The proposed converter operates in flyback mode when the input voltage is lower than the output voltage and operates in buck mode when the input voltage is higher than the output voltage. In this way, there are no dead zones in the input current of the proposed converter[1]-[22]. Therefore, it can achieve high PF and pass the IEC61000-3-2 Class C limits easily. Moreover, the power loops of the buck mode and flyback mode are separated,and no additional component causing losses is added to the power loops. Obviously, the proposed integrated buck–fly back converter can achieve higher efficiency than the combined buck–fly back converters introduced in detailed operation principle and circuit parameter design considerations will be presented.

2. SYSTEM ANALYSIS

2.1 PRINCIPLES OPERATIONS OF INTEGRATED BUCK–FLYBACK

The integrated buck–fly back non isolated PFC converter is proposed. The proposed converter operates in flyback mode when the input voltage is lower than the output voltage and operates in buck mode when the input voltage is higher than the output voltage. Buck and Fly-back mode operation is controlled by control signal *V*ph. Control signal Vph is the result of the magnitude comparison between *V*in and *V*boundry. The driving signals *VG*1 and *VG*2 are controlled by *V*ph for the different operation modes alternately. the proposed integrated buck–flyback non-isolated PFC converter operates in buck mode when *V*ph is in high logic level, while it operates in flyback mode when *V*ph is in low logic level. Transition processes between those two modes are natural.

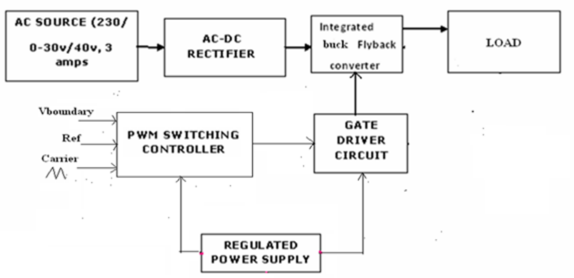

Fig. 2.1 Functional block Diagram

The block diagram of an integrated non-isolated buck-flyback converter consists of six blocks. They are known as source, rectifier, buck-flyback converter, PWM switching controller, driver circuit, regulated power supply.

SOURCE

The source used for the buck-flyback converter is an AC source. The rating of source is 230v/30v/40v, 3Amps.

AC-DC RECTIFIER

Ac-dc rectifier converts ac voltage to dc voltage for the buck and boost operation. The diodes used in the rectifier operate alternatively. They are named as D1, D2, D3, and D4.At a time any two diodes conducting.

REGULATED POWER SUPPLY

This regulated power supply provides supply for both PWM switching controller and driver circuit.

DRIVE CIRCUIT

This driving circuit gives the driving signals to drive the PWM switching controller for the pulse width modulation generation.

PWM SWITCHING CONTROLLER

This controller compares sine wave and carrier wave and generates pulse width modulation for the control signals. This pulse width modulation compared with the boundary voltage and two control pulses are generated. These two pulses used to control the diode conduction. First pulse is used for positive half cycle and second pulse is used for next half cycle.

3. SOFTWARE ANALYSIS

3.1 GENERAL

Simulation has become a very powerful tool for industrial application as well as in academics, nowadays. It is now essential for an electrical engineer to understand the concept of simulation to study the system or circuit behavior without damaging it .The tools for doing the simulation in various fields are available in the market for engineering professionals. Many industries are spending a considerable amount of time and money in doing simulation before manufacturing their product. In most of the research and development (R&D) work, the simulation plays a very important role. Without simulation it is quiet impossible to proceed further.

3.2 THE ROLE OF SIMULATION

Electrical power systems are combinations of electrical circuits and electro mechanical devices like motors and generators. Engineers working in this discipline are constantly improving the performance of the systems. Requirements for drastically increased efficiency have forced power system designers to use power electronic devices and sophisticated control system concepts that tax traditional analysis tools and techniques. Further complicating the analyst's role is the fact that the system is often so nonlinear that the only way to understand it is through simulation.Land-based power generation from hydroelectric.

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3.3 SIM POWER SYSTEMS

SimPower Systems is a modern design tool that allows scientists and engineers to rapidly and easily build models that simulate power systems. Sim Power Systems uses the simulink environment, allowing you to build a model using simple click and drag procedures. Not only can you draw the circuit topology rapidly, but your analysis of the circuit can include its interactions with mechanical, thermal, control, and other disciplines. This is possible because all the electrical parts of the simulation interact with the extensive Simulink modeling library. Since Simulink uses MATLAB as its computational engine, designers can also use MATLAB toolboxes and Simulink block sets. Sim Power Systems and Sim Mechanics share a special Physical Modeling block and connection line interface.

4. SIMULATION

4.1 SIMULATION RESULTS

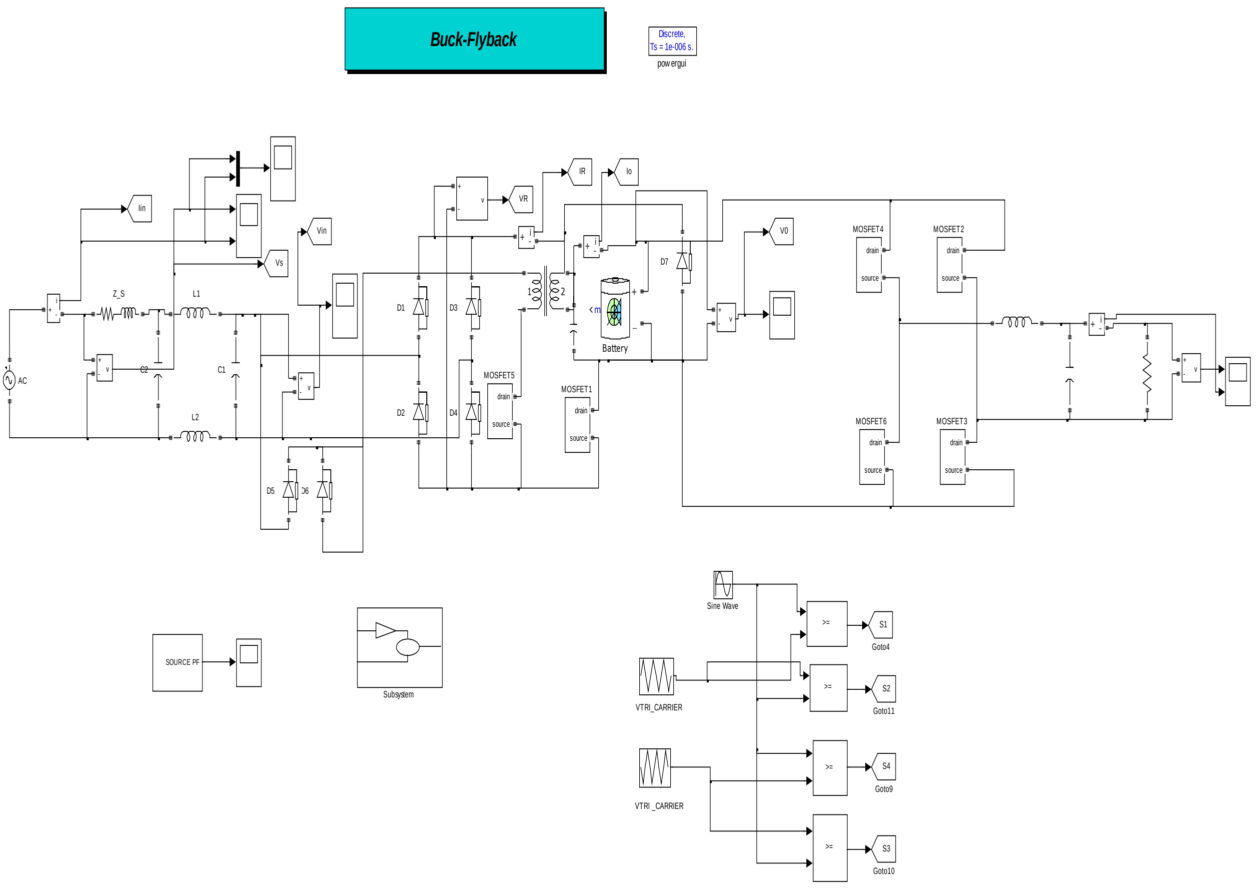

Fig .4.1Simulation circuit

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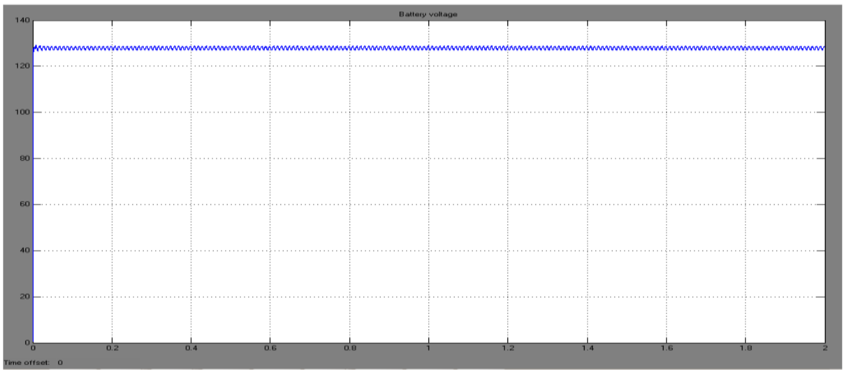

Fig.4.2 Battery voltage waveform

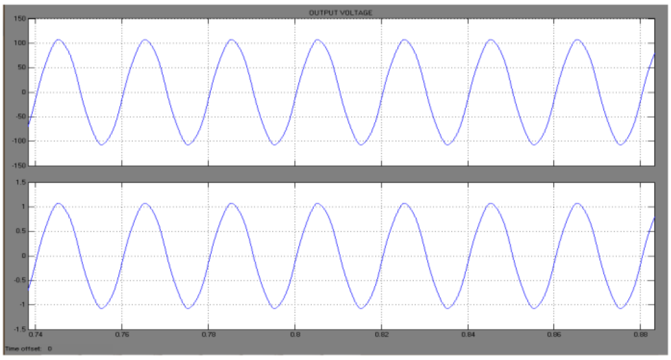

Fig.4.3 Inverter output voltage and current waveform

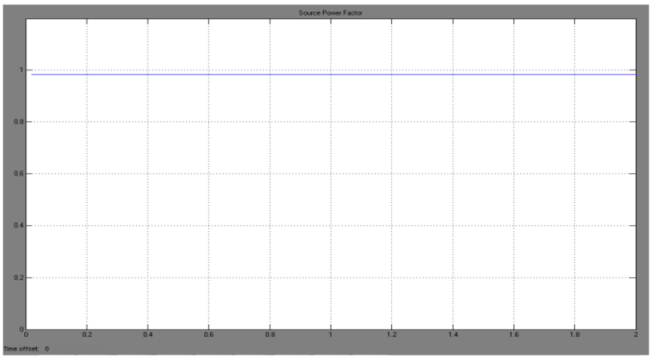

Fig.4.4 Source power factor waveform

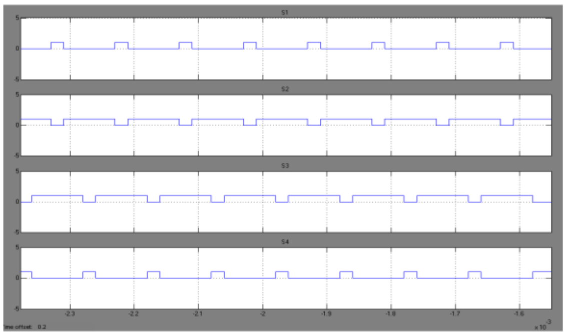

Fig.4.5 Inverter switching pulse waveform (S1-S4)

6. CONCLUSION

Simulation Modelling on An Integrated Non-Isolated Buck-Flyback AC-DC Converter For POWER QUALITY Improvement is investigated.

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BIOGRAPHIES

Dr.Govindaraj Thangavel born in Tiruppur , India in 1964. He received the B.E. degree from Coimbatore Institute of Technology, M.E. degree from PSG College of Technology and Ph.D. from Jadavpur University, Kolkatta,India in 1987, 1993 and 2010 respectively. His Biography is included in Who's Who in Science and Engineering 2011-2012 (11th Edition). Scientific Award of Excellence 2011 from American Biographical Institute (ABI). Outstandin Scientist of the 21st century by International Biographical centre of Cambridge, England 2011.Since July 2009 he has been Professor and Head of the Department of Electrical and Electronics Engineering, Muthayammal Engineering College affiliated to Anna University, Chennai, India. His Current research interests includes Permanent magnet machines, Axial flux Linear oscillating Motor, Advanced Embedded power electronics controllers,finite element analysis of special electrical machines,Power system Engineering and Intelligent controllers.He is a Fellow of Institution of Engineers India(FIE) and Chartered Engineer (India).Senior Member of International Association of Computer Science and Information. Technology (IACSIT). Member of International Association of Engineers(IAENG), Life Member of Indian Society for Technical Education(MISTE). Ph.D. Recognized Research Supervisor for Anna University and Satyabama University Chennai. Editorial Board Member for journals like *International Journal of Computer and Electrical Engineering*,International Journal of Engineering and Technology,International Journal of Engineering and Advanced Technology (IJEAT).International Journal Peer Reviewer for Taylor &Francis International Journal "Electrical Power Components & System"United Kingdom,Journal of Electrical and Electronics Engineering Research,Journal of Engineering and Technology Research (JETR),IJPS,AAMSTE, ,International Journal of Engineering & Computer Science (IJECS),Scientific Research and Essays,Journal of Engineering and Computer Innovation,E3 Journal of Energy Oil and Gas Research,World Academy of Science, Engineering and Technology,Journal of Electrical and Control Engineering (JECE),Applied Computational Electromagnetics Society etc.. He has published 155 research papers in International/National Conferences and Journals. Organized 40 National / International Conferences/Seminars/Workshops. Received Best paper award for ICEESPEEE 09 conference paper. Coordinator for AICTE Sponsored SDP on special Drives,2011.Coordinator for AICTE Sponsored National Seminar on Computational Intelligence Techniques in Green Energy, 2011.Chief Coordinator and Investigator for AICTE sponsored MODROBS - Modernization of Electrical Machines Laboratory. Coordinator for AICTE Sponsored International Seminar on "Power Quality Issues in Renewable Energy Sources and Hybrid Generating System", July 2013