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Energy Conversion Conference & Exposition 2009 Update

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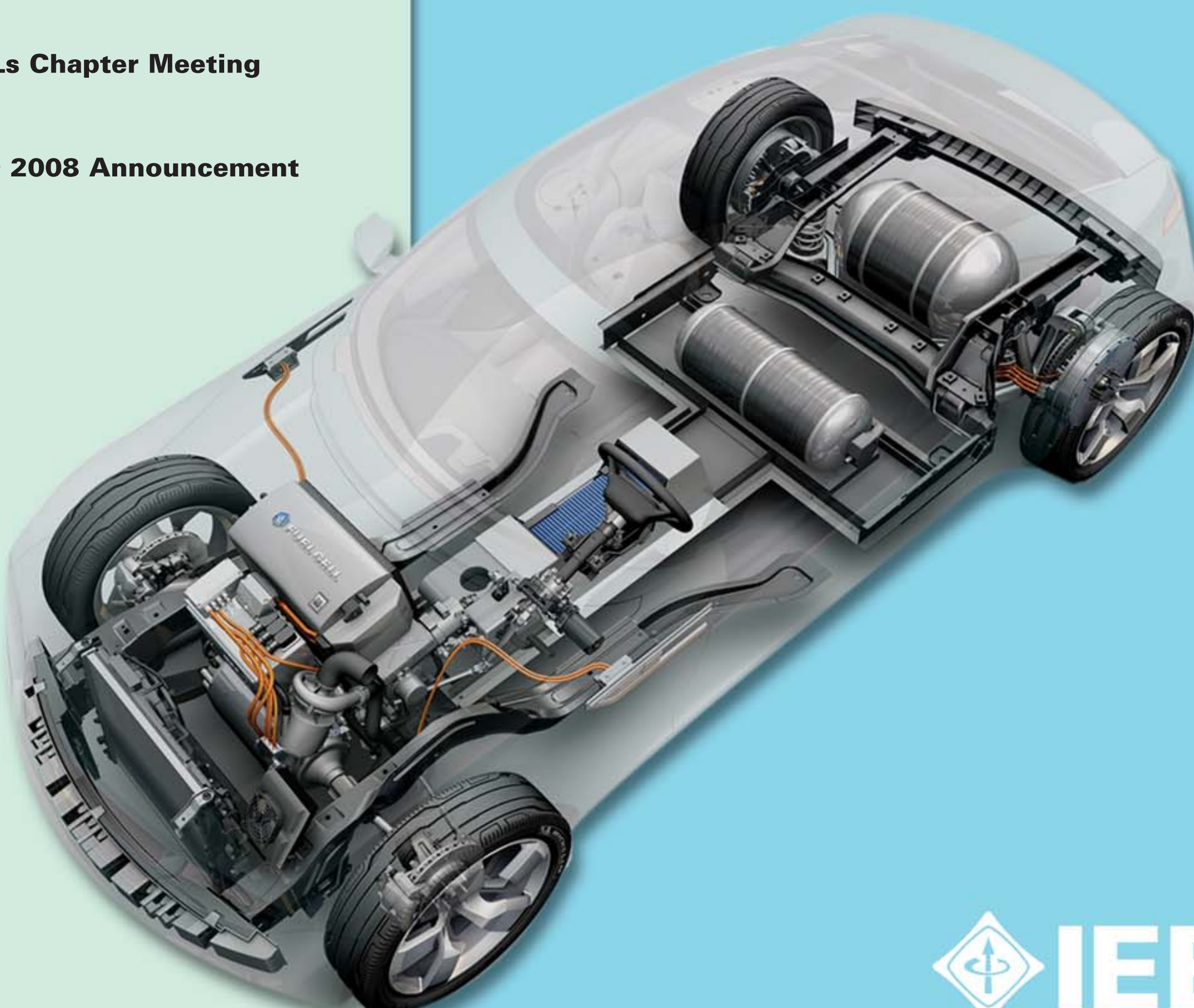
INTELLEC® 2008 Announcement



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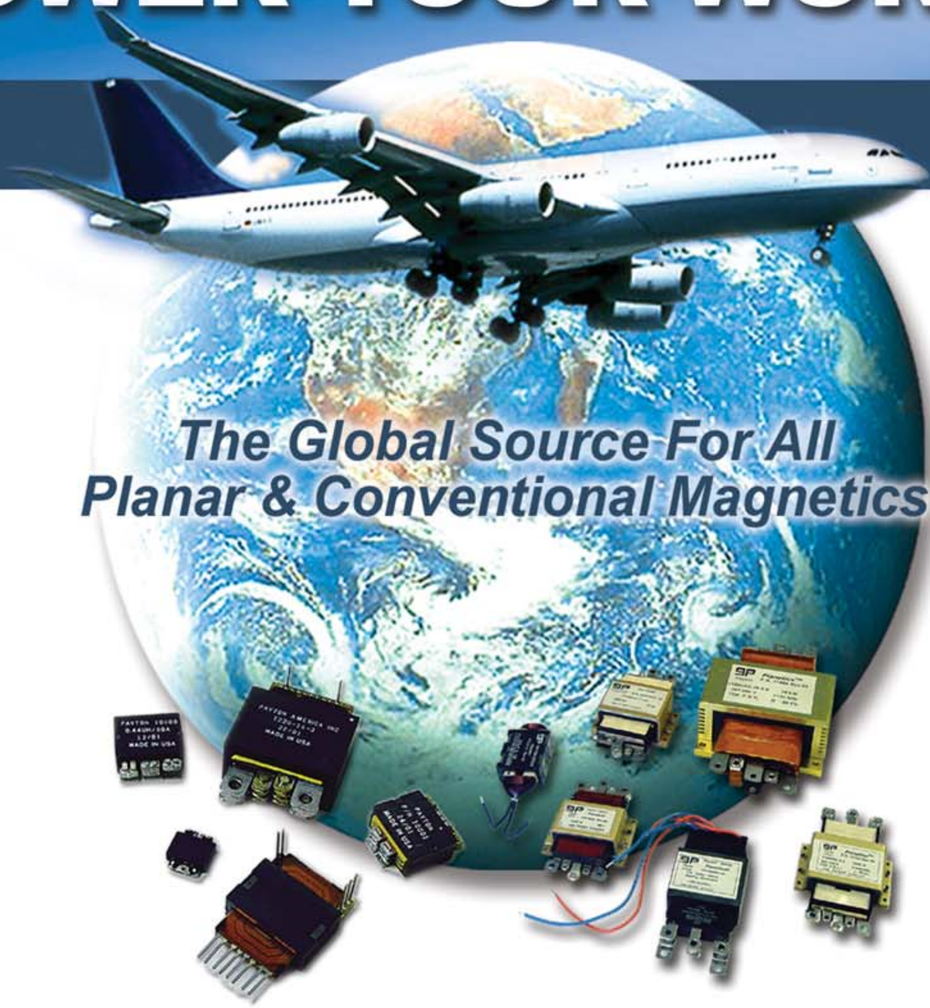

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From The Editor

John M. Miller

This issue will have fewer meeting announcements and full page second call for papers to maximize space for recent technical articles and notices to our members regarding the pending changes leading to formation of the Energy Conversion Conference and Exposition, ECCE, starting in September of 2009. For more on this topic please read the informative article by Dr. Tomy Sebastian.

Also in this issue we resume the normal content by offering two technical articles in a tips and tricks tradition. The first article by Raja and Ashok on maximum power point tracking of photovoltaic array output offers a method that enhances power production by nearly 5% over the same array with conventional tracking. The second article by Prof. Fahimi describes a very efficient ZVS converter for application to fuel cell power plants. This converter is also very applicable to one of my favorite topics, the active parallel combination of ultracapacitors with batteries. In the near future we will very likely see a need to optimize mobile electrical energy storage systems by combining the strengths of power dense, symmetric, carbon ultracapacitors with advanced chemistry battery technologies such as lithium-ion and lithium-iron-phosphate. It is my intention to present some preliminary results on the active parallel combination that uses the buck-boost converter as a buffer to the ultracapacitor branch in parallel with an energy optimized battery. Look for this in the October issue of this newsletter. Also planned for that upcoming issue will be an update on the NanoGate ultracapacitor that we first reported on in this newsletter in early 2004 (Vol. 16, Nr. 1, January 2004) by Mr. Michio Okamura. Stay tuned for those updates on energy storage components and why efficient power processing converters are so necessary.

Last, and new for this issue, will be a column on new member welcome. On behalf of all the PEL's members I wish to thank our president, Prof. Hirofumi Akagi for extending a warm welcome to these new members and to Prof. Vassilios G. Agelidis for organizing this.

Bob Myers 1931 – 2007: On 23 June 2007 we were sad to learn of the passing of Mr. Bob Myers, PEL's executive officer. The PEL's family extends heartfelt sympathy to Lee Myers during this difficult time.

John M. Miller, EIC
pelsnews@ieee.org

Chevy Volt, fuel cell version, courtesy of General Motors along with image of developmental high voltage converter used to balance voltage of fuel cell to energy storage and electric drive systems.

Power Electronics and Industry Application Societies Cooperate for the First IEEE Energy Conversion Congress and Exposition

by: Dr. Tomy Sebastian

In 2009, the IEEE Power Electronics Society and the IEEE Industry Applications Society are joining hands for a new conference. The first IEEE Energy Conversion Congress and Exposition (ECCE) is scheduled for September 20-24, 2009 in San Jose California. This conference and Exposition will combine the activities of the IEEE Power Electronics Specialists Conference and the technical sessions of the Industrial Power Conversion Systems Department (Electric Machines Committee, Industrial Drives Committee, Industrial Power Converter Committee, Power Electronic Devices and components committee) of the IEEE Industry Applications Society. These sessions currently take place at the IEEE Industry Applications Society Annual meeting. In addition to combining all relevant power electronics, devices, machines and drives activities from the two conferences, this cooperation will give the opportunity to bring engineers from industry, students and academics together to open a much needed dialogue. Energy conversion and energy savings are becoming global topics, requiring global solutions. Power electronics, devices, electrical drives and machines are key enabling technologies to employ new energy sources and realize significant energy savings in many application areas, ranging from household appliances, industrial equipment, regenerative energy systems, automotive power trains, transportation propulsion systems, as well as electrical distribution and transmission systems. The IEEE PELS and IAS societies, with support from IEEE Technical Activity Board, decided to bundle their conferences to bring research in power electronics and application engineering together in a unique way.

The Energy Conversion Congress and Exposition will provide a forum for the exchange of information among practicing professionals in the energy conversion business. The emphasis is to bring together the users and researchers of energy conversion systems and sub systems with emphasis on the technical content of the papers and on the quality of the exposition. The scope of the conference interests include all technical aspects of the design, manufacture, application and marketing of devices, circuits, and systems related to electrical energy conversion technology.

The conference will include technical sessions with unmatched technical quality, industrial sessions showing latest developments from industry, tutorials that cover wide topics, an industrial exposition to showcase new technologies and products. Furthermore, participants can enjoy exciting panel discussions, keynote speeches from experts in relevant areas, industrial tours and excellent social events.

Volunteers from both societies are working hard to put together a memorable event in 2009. More information will follow. If you want to be a volunteer, please contact the Conference General Chair, Dr. Tomy Sebastian at t.sebastian@ieee.org or the Steering Committee Chair, Prof. R. De Doncker at dedoncker@ieee.org. More information will also be available at the conference web site, www.ecce2009.org

President's Column

Dear New PELS Members,

I welcome all of you who have joined the IEEE Power Electronics Society from various parts of the world. As you may know, the mission of the Power Electronics Society is the development and effective application of power electronics technology. This technology encompasses the use of electronics components, the application of circuit theory and design techniques, and the development of analytical tools toward efficient electronic conversion, control and conditioning of electric power.

What you can do for the Society as a member is to participate in technical conferences, present your papers at these conferences, have your papers published in the prestigious IEEE Transactions on Power Electronics, offer to serve as a paper reviewer, plan to join the PELS AdCom and/or your PELS Local Chapter, and so on (we have more than 50 Local Chapters in the world!). Among them, I think that one of the most important activities as a new member is to participate in technical conferences and to get into the company of your contemporaries by networking at these meetings.

I am looking forward to seeing each of you at PELS-sponsored or cosponsored conferences as soon as possible!

Hirofumi (Hiro) Akagi
IEEE PELS President

New Members of the Power Electronics Society

Last Name	First Name	Country Name
AL-SHAMMARI	HAJHOUJ	SAUDI ARABIA
ZHAO	ZHENYU	CANADA
KINJO	TATSUTO	JAPAN
HERBER RAMIREZ	JUAN JOSE	MEXICO
MASSOUD	AHMED	EGYPT
RIETZ	ROY	UNITED STATES
BANSAL	MANJU	INDIA
CIOBOTARU	MIHAI	DENMARK
ARANAS	JASON	UNITED STATES
PARK	JAE DO	UNITED STATES
BEHAN	SEAN	UNITED STATES
KAYSER	KENNETH	UNITED STATES
FARTHING JR	ANTONIO	UNITED STATES
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BHATTI	NAVDEEP	UNITED KINGDOM
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FERNANDEZ	CRISTINA	SPAIN
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RAUTE	REIKO	GERMANY
SANZ	MARINA	SPAIN
KIM	SANG-MIN	KOREA
BORNMANN	MARKUS	GERMANY
PARK	SUNG YEUL	UNITED STATES
VAHEDI	MIHDI	UNITED STATES
SCARPA	VLADIMIR	BRAZIL
FOARD	WYATT	UNITED STATES
ANDREASSEN	PAL	NORWAY
ZINOVIADIS	GEORGE ZINOVIOS	GREECE
MILLER	CLINT	UNITED STATES
JUNG	TAEUK	KOREA
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K	RAVIPRASAD	INDIA
RICHARDS	SEAN	UNITED STATES
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Scope of the Conference

The 7th International Conference on Power Electronics (ICPE' 07) will be held at the Daegu Exhibition and Convention Center, Daegu, Kroea, from October 22 to 26, 2007. ICPE is the technical forum fully dedicated to Power Electronics and related areas.

- Power Semiconductor Devices
- DC-DC Converters
- Inverters and Inverter Control Techniques
- Motor Drives
- Rectifiers and AC-AC Converters
- Renewable Energy
- Power Quality and Utility Applications
- Automotive Applications and Traction Drives
- Energy Storage
- Control Techniques Applied to Power Electronics
- Modeling, Analysis, and Simulation
- Consumer Applications
- Other Power Applications

Paper Submission

The digest should be written in English, double-spaced, and 4 pages maximum. Please start your paper with the title and choice of topic categories and do not include any personal information in digest. Paper submissions will be accepted electronically. An abstract of 300 words maximum and author' s name(s), affiliation(s), contact author and his/her mailing address, and telephone and fax numbers should be provided via a web submission system. Detailed instructions will be available on the ICPE'07 website.

Important Dates

Deadline for Digests	April 30, 2007
Author' s Notification of Acceptance	June 15, 2007
Deadline for Final Manuscripts	August 31, 2007

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IEEE IAS/PELS/IES Joint German Chapter meets in Mannheim

Dr. Omid Forati Kashani

Continuing its meeting programs, the IAS/PELS/IES joint German chapter had its first meeting in 2007 on 8th and 9th of March in Mannheim, Germany. Mannheim is a city which its name has been mentioned as the village "Mannenheim" in documents for the first time in 766 A.D. It was in 1606, when the elector Friedrich IV. has founded the quadratic form of the Old Town of Mannheim. Today Mannheim is a city with more than 300,000 residents and one of the most important connecting points of the German ICE high speed train routes in various directions. The hosts of the meeting in Mannheim were the Rhein-Neckar-Verkehr GmbH and the Bombardier Transportation GmbH.

The Rhein-Neckar-Verkehr GmbH (RNV) was the host of the meeting on the first day. The meeting began with a short introduction by the new chapter chair, Prof. Heinz van der Broeck. After that, an introduction to the RNV was given by Mr. Günther Quaß, the managing director of RNV. RNV has been established as an alliance of five regional transportation companies in the region Rhein-Neckar. The motivation for an alliance has been mainly the reduction of costs for each of the allied companies. For example each company has the opportunity to use the buses and trains of the other members of the alliance. By that an optimized distribution of vehicles in the region has been reached. In this manner it has been possible to offer more services for the passengers although the total number of buses and trains in the alliance has been reduced in recent years. Another aspect is the reduction of costs for maintenance, which is done by RNV.

In the second part of the first day meeting a lecture was given by Dr. Michael Steiner of Bombardier Transportation. His lecture was about the MITRAC Energy Storage with ultracapacitors, which has been developed at Bombardier in Mannheim. With this system a part of the brake-energy will be stored in ultracapacitors during deceleration of the vehicle. The stored energy will be used for the next acceleration. For example in a train on a DC-grid with a storage system of 1 kWh, the stored energy will reduce the energy consumption from the grid about 30 %. Another effect is the reduction of the fluctuations of the line voltage during braking and acceleration. For example the line voltage fluctuations will be reduced by nearly 50 % in the above mentioned DC-grid with the same storage system. Another application of the storage system is the short range catenary free drive of tramways. For example the stored energy can drive the tram in parts of the city, where the installation of the overhead lines are difficult. Another application can be in tunnels without any lines or when the lines in the tunnel are disconnected because of a line fault. Also trams with such a storage system can pass the parts of the overhead lines, where voltage is shut down in case of line maintenance.

After the theoretical part the participants got the opportunity to drive in a tram which was provided with such a storage system. The measurements have been shown and explained when the train was driving in the city.

Participants in front of the tram provided with MITRAC Energy Storage

The city tour ended in the maintenance hall of the RNV, where we saw the converters and ultracapacitors on the roof of the train along with a short demonstration of the catenary free drive. The first day of the meeting ended with a dinner in Best Western Hotel Steubenhof where the participants have had some talks and discussions around the tables.

Box with ultracapacitors on the roof of the tram

The second day of the meeting began with the introduction of the Bombardier Transportation in Mannheim by Dr. Peter Gratzfeld, the director of the projects and vice manager of the site. Bombardier Inc., originally established as a producer of small jet planes, is one of the biggest manufacturers of transportation trains worldwide. Headquarters of Bombardier Inc. are located in Canada but the headquarters of Bombardier Transportation are located in Berlin, Germany. In the Mannheim site there are departments for the development and production of converters for trains. After the introduction we visited the production hall, where the technicians assemble and test the converters for traction applications.

The audience listening to the lecturers at Bombardier

In the technical part of the lectures Dr. Steiner gave more details about storage system with ultracapacitors. For example, for a catenary free drive of 500 m and a velocity of 30 km/h a storage system of 3 to 3.8 kWh is needed. Another aspect was the comparison of the ultracapacitors with the Nickel Metal Hybrid (NiMH) batteries. The investigations have shown that the usage of the ultracapacitors is preferred when the charge and discharge cycles are high. For example batteries aren't suitable for 2 million braking and acceleration cycles per 10 years. As another application field of ultracapacitors storage system the diesel generator train was presented. The stored energy in the ultracapacitors during braking can reduce the fuel consumption and therefore the costs.

In the second part of his lecture Dr. Steiner introduced the investigations on the middle frequency topology which replaces the bulky main transformer for traction applications. Although the middle frequency topology reduces the energy consumption nearly up to 3 to 4 % in comparison with the conventional transformer there aren't any traction systems until now delivered with this topology. This is especially because of the high costs of IGBTs and low energy costs. For this item there are more investigations needed. These investigations will be done within the "Railenergy" committee of the European Union.

As the last lecturer Dr. Hilmar Lorenz of Bombardier introduced the hardware and modular structure of the software for the control of the converters. He introduced also the control method of "Direct Flux Control (DFC)" which was developed by Bombardier in Mannheim.

The last part of the meeting was the IEEE-Business part, which was chaired by Prof. van der Broeck. The reports about the chapter activities and finances in the last chapter board period (2 years) were presented by the junior past chair Prof. Andreas Lindemann and the treasurer Dr. Mark Bakran. Also the next scheduled meetings in 2007 were presented. There are three other meetings in this year planed. For more details please visit our website at: http://www.ewh.ieee.org/r8/germany/ias-pels/index.html.

Dr. Forati Kashani is with Siemens AG in Nuremberg and a member of the IEEE IAS/PELS/IES joint German chapter.

Modified PAO Algorithm for Maximum Power Point Tracking of PV systems

Raja. P, Student Member IEEE and Ashok. S, Senior Member IEEE
Department of Electrical Engineering
National Institute of Technology Calicut

Abstract:-.*The maximum power point of solar Photovoltaic (PV) system depends on solar irradiation and temperature. As the load and the insolation are varying dynamically, the maximum power tracking becomes complex for the systems. The solar cell will deliver the maximum power when the load impedance matches with the source impedance under a given solar irradiation and temperature. In this paper an improved method of perturbation and observation algorithm is proposed to track the maximum power from the photovoltaic system. The proposed method is faster, accurate and suitable for rapid changes in load and ambient conditions. Simulations using the modified algorithm show an increase of approximately 4.8% energy output.*

Index Terms- Solar PV, maximum power point tracking, perturbation and observation algorithm,

I. INTRODUCTION

Renewable energy sources offer a promising solution to the energy crisis. Photovoltaic system converts solar energy into electrical energy using solar cells. The major drawbacks of solar PV systems are its high initial cost and the low efficiency. Also the performance of the solar cell depends on the variation in solar radiation, ambient temperature and the load connected. Under this scenario, maximum power extraction from the solar cells is essential. Different methods are reported for maximum power point tracking (MPPT). MPPT will increase the energy output of the photovoltaic cell under a given solar irradiation and temperature. Basic method for tracking the maximum power is to rotate the solar panel mechanically in a way such that maximum solar radiation is allowed to fall on the panel perpendicularly always. Being complex for large systems, the maximum power under given solar insolation and temperature is usually traced by electrical methods. Impedance matching between source and the load shall be obtained for the maximum power transfer. When the impedance of the connected load to the PV system is less than the source impedance, solar cell behaves as a constant current source, otherwise as a constant voltage source [1]. A power electronic converter is connected with controls to regulate the voltage and current levels, between solar panel and the load as shown in Fig.1. Different MPPT methods are reported by controlling the duty parameters of the converter based on the algorithm followed [2].

The voltage feedback method (VFM) is the simplest MPP tracking method [3]. It is based on regulating the array output voltage according to a fixed reference approximately 76% of the array open circuit voltage [4]. But frequent measurement of the open circuit voltage by interrupting the normal operation makes this method less attractive and feasible. In Power Feedback method, maximizing the array power is achieved by an MPP tracker without the prior knowledge of the array characteristics. This method can be implemented using an algorithm that finds the local maximum of the array output power. Perturbation and Observation method (P&O), Incremental Conductance Method are most widely used power feedback methods. Incremental variation of power with voltage is calculated in PAO method to determine the maximum power point (MPP) [5]. The duty cycle of the converter is varied in small steps in such a way that the impedance offered by the converter varies; comparing the value of power obtained with that under the previous condition. It can't track the MPP when the irradiance changes rapidly; and it oscillates around the MPP. The Incremental Conductance method can track MPP under rapidly varying atmospherics conditions, but less accurate and slow leading to energy loss, due to increased complexity of the algorithm by computing the incremental variation of current with voltage at every stage, comparing the value of incremental conductance of the solar cell [6]. Fuzzy based controller algorithm reported need selection of several parameters with trail and error basis [7]. Voltage-based and current-based computational methods for MPPT were reported with simulated studies [8]. Hybrid algorithm with variable step-size initially and PAO or incremental conductance method finally, was also published with improved results of energy saving [8]. ANN based algorithm for MPPT of PV systems was available for solar power electric vehicles [9].

This paper proposes a simple algorithm to track the maximum power point for solar PV system at a faster rate, under rapidly changing atmospheric conditions. The basic algorithm followed in the proposed method is PAO, modified to suit the rapidly changing atmospheric conditions without losing accuracy and speed.

II. PROPOSED ALGORITHM

When the solar irradiation changes, the algorithm varies the duty cycle with its own speed and hence no where it bothers whether the present operating condition is at maximum power operating region or at least nearer to it. So the value of power output will be always less than that it could have yielded. Moreover the variation of duty cycle at a particular instant might cause an increase in power. But the real reason for the increase of power shall be the increased solar irradiation. Hence for a wrong perturbation also the algorithm observes an increase in power and thus moves the duty cycle in a wrong direction for the succeeding iterations. The same is depicted in the Fig.2

In the proposed algorithm, each iteration has three distinct duty cycles and three measured values of power. The iteration starts with a duty cycle and the corresponding power is measured. Then, the duty cycle is changed to the one that is one step less than the first and its corresponding power is measured. Finally the duty cycle is changed to one step more than the first one and its power is also measured. All the three measured powers are compared and the one, which is the highest, is chosen as the starting value for the next iteration, i. e. its duty cycle becomes the starting one for the next iteration. Whenever the power change is greater than a preset value, the step value for the duty cycle is made to a higher value to track maximum power quickly.

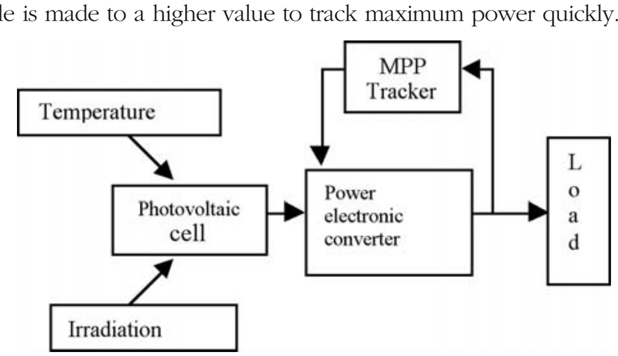

Fig. 1. Block Diagram representation of maximum power point tracking

By this method, the system will be operated at the nearest point of maximum power point always. i.e., its accuracy is more, compared to both the incremental conductance and perturbation and observation method. Under rapidly varying atmospheric conditions, the proposed method yields more energy output compared to the conventional PAO method. Fig 3 shows the flowchart of the proposed modified PAO method with details as follows.

D = duty cycle for the converter

D1 = initial value of duty cycle

step = increment value for the duty cycle

V(k),V(k+1),V(k+2) = voltage corresponding to the respective duty cycles at the consecutive changes

I(k), I(k+1), I(k+2) = current corresponding to the respective duty cycles at the consecutive changes

P(k), P(k+1), P(k+2) = power corresponding to the respective duty cycles at the consecutive changes

ε = the duty cycle step value at steady state

L=preset value for checking the large change in the working condition

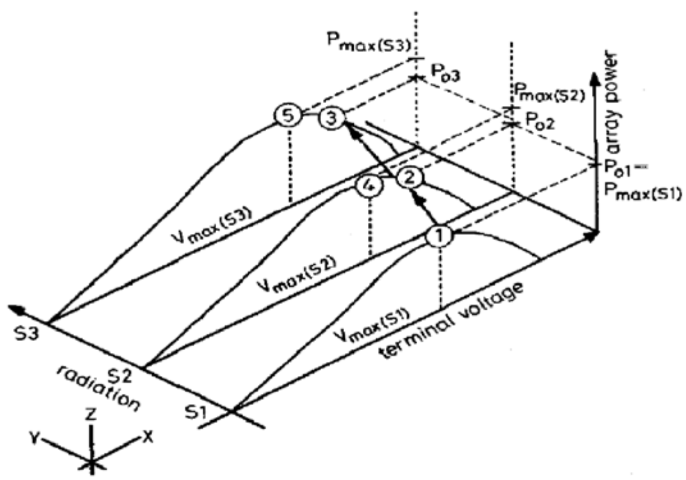

Fig.2 Deviation of PAO algorithm from MPOP

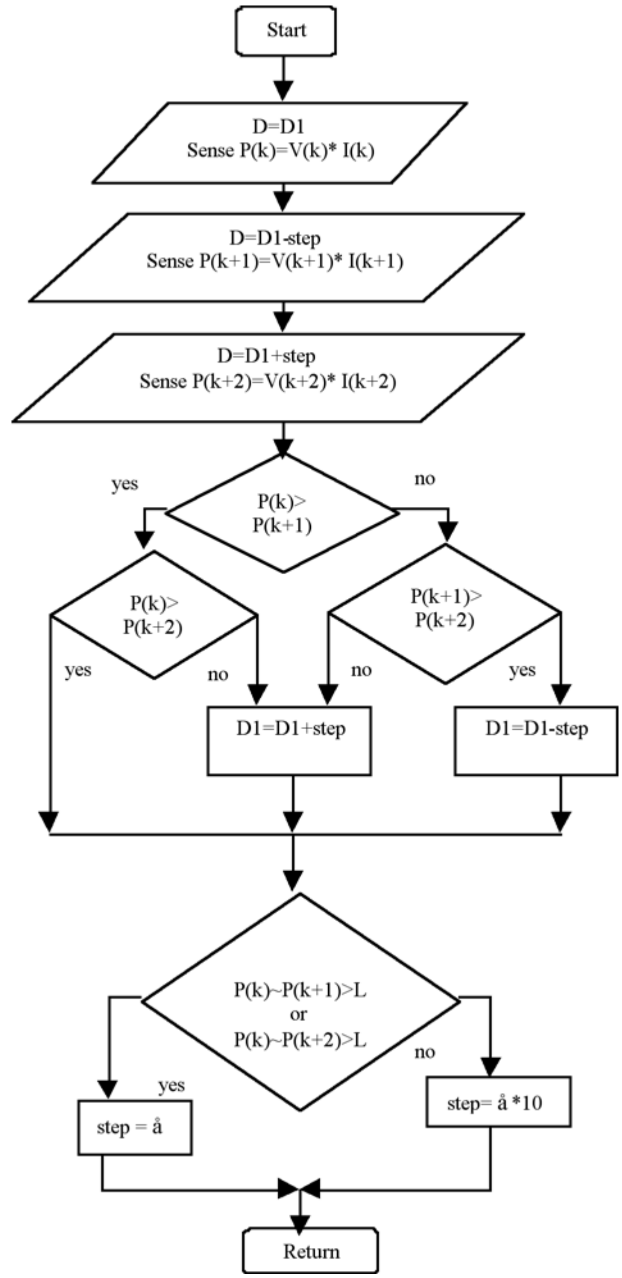

Fig. 3. Flow chart for the modified PAO algorithm

III. SIMULATION MODEL

The basic equation of the photovoltaic cell is given by the following characteristic equation.

$$I_0 = I_{ph} - I_{sat}\left[e^{\frac{q}{AKT}(V_0+I_0R_{se}} - 1\right] - \frac{V_0 + I_0R_{se}}{R_sh} \quad (1)$$

The equivalent circuit of a photovoltaic cell connected to a load is shown in Fig.4. Boost converter, capable of delivering a voltage, which is higher than the voltage generated by the solar panel usually required by the load conditions, is used in the circuit.

The expression for the duty ratio α of the converter is given by

$$\alpha = \frac{i_C - i_L}{\frac{T_s}{2_L}v_s + MT_s} \quad (2)$$

where i_C = Capacitor current, i_L= Inductor current

T_s = Switching time period

M = Slope of the artificial ramp included to avoid sub harmonic oscillations

The averaged switch current i_Q is given by

$$i_Q = \alpha\, i_L = i_L \frac{i_C - i_L}{\frac{T_s}{2L}v_s + MT_s} \quad (3)$$

The averaged diode voltage v_d can be expressed as

$$V_d = \alpha V_0 \frac{i_C - i_L}{\frac{T-s}{2_L}V_s + MT_s} \quad (4)$$

The state space differential equations can be derived from the above expressions as

$$L\frac{di_L}{dt} = v_s - v_0\left[1 - \frac{i_C - i_L}{\frac{T_s}{2L}v_s + MT_s}\right] \quad (5)$$

$$C\frac{dv_0}{dt} = i_L\left[1 - \frac{i_C - i_L}{\frac{T_s}{2L}v_s + MT_s}\right] - \frac{v_0}{R} \quad (6)$$

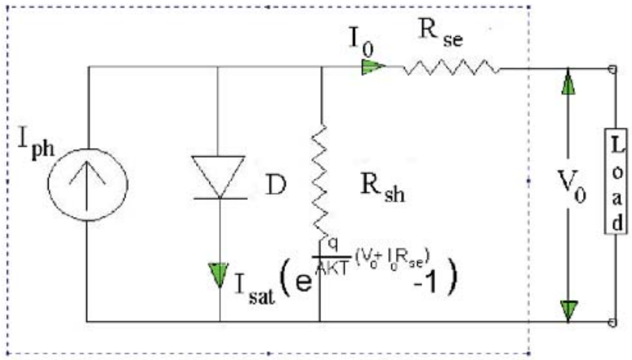

Fig. 4. Equivalent circuit for a photovoltaic cell.

IV. SIMULATION RESULTS

The photovoltaic system is modeled as per its characteristic equation and built in Matlab/Simulink simulation software. The ratings of the PV panel is adopted from the specifications of MSX40 i.e., 40W, 2.34A, 17.1V of the size 770x500x50mm. Converter specification used in is with input 18Vmax, 2.3 Imax and output 36Vmax, 2.3 Imax. The irradiation and temperature variations are measured in a village school in Chittoor, Andhra Pradesh, India and variations for an average day is shown in Fig. 5. The maximum power point tracking is simulated for both conventional PAO method and modified PAO method.

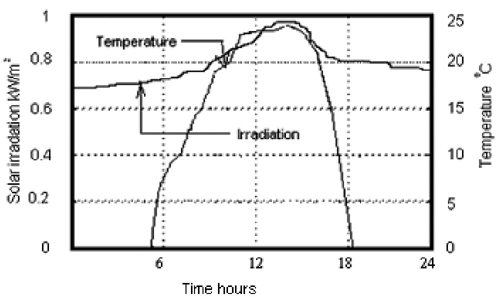

Fig. 5. Irradiation and Temperature for an average day

Both the methods will converge within few milliseconds to the maximum power point and Fig 6 shows the plot of MPP for the day. From the conventional PAO method, the energy output for a typical day is obtained as 263.9 Wh, where as it is 328.9 Wh from the proposed modified PAO method. Here the load condition is maintained constant at 30W. Table.1 shows the comparison of energy delivered by PV system for the day under two methods of MPPT.

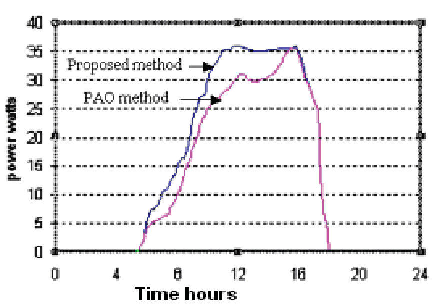

Fig. 6. Power obtained from simulation result for both modified PAO and conventional PAO method.

Separate simulations are conducted to check the performance of modified algorithm under abrupt load changes. When abrupt changes in load are made at 9th and 15th hours as shown in Fig 7 under constant ambient conditions, the step value of the duty cycle gets varied under modified PAO algorithm, to a higher value for a small period so that it tracks the maximum power faster than the conventional PAO method. In Fig. 8, at 9th hour the power output of the solar panel suddenly drops to a very low value and from that point, both the algorithms start perturbing the power at different steps reaching the maximum power at different times. This is because, at the starting of 9th hour, the duty cycle corresponds to the one, which will lead to a maximum power of 28 W, which is required by the previous load condition. At the instant of 9th hour, the load condition changes to 20 W for which the duty cycle cannot change abruptly to its requirement. The proposed algorithm yields about 4.86% more energy due to faster convergence. Experimental set up for constant load condition is shown in Fig. 9.

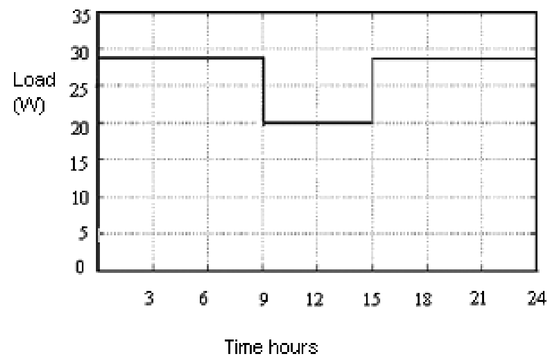

Fig. 7. Load curve with abrupt changes

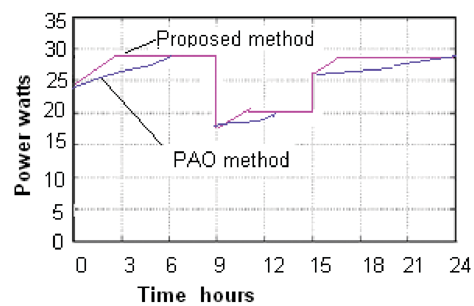

Fig. 8 Comparison of power output using both PAO and proposed modified PAO method for abrupt load changes

Table.1 Comparison of Energy output delivered by PV system for a day

Load condition	Energy Output (kWh/day)	
	Conventional PAO method	Proposed method
Constant load	263.9	328.9
Fluctuating load	705.5	739.8

V. CONCLUSION

In this paper a modified perturbation and observation method is proposed which is fast, accurate and suitable for rapidly changing atmospheric conditions. The simulation results under abrupt load variations and changing ambient conditions show that modified PAO method can enhance the power output from the PV system

Fig 9. Experimental set up

due to faster convergence towards MPP. The energy output of the PV system for a typical village school is increased by approximately 4.8% with MPPT using the proposed algorithm.

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High Efficiency and Compact DC/DC Converter for High Power Fuel Cells Systems

Abstract – *Fuel cells are considered strong contenders for future energy generation. One of the core challenges in the use of this technology has been design of dc-dc converter that provides good regulation of output voltage and is cost-efficient. This paper presents a converter topology that enhances efficiency of the system by reducing switching losses at higher frequencies by implementing a ZVS scheme. Owing to a simple control strategy and no requirements for expensive components, overall cost of the system has been reduced. Experimental and theoretical results are included to validate our claims.*

I. INTRODUCTION

Driven by the need to produce ever more power while reducing the harmful by-products of conventional generating technologies, fuel cells are being branded as the future of energy generation devices. It is believed that the distributed generation market will be between 10 and 30 billion US dollars by 2010 [1]. Due to environmental concerns, more effort is now being put into the clean distributed power. Geothermal, solar, photovoltaic, and wind generation, as well as fuel cells that use hydrogen, propane, natural gas, or other fuels to generate electricity without increasing pollution [1]-[3] are some of the prime contenders.

Fuel cell provides an elegant means of harnessing the chemical energy of the fuel directly into electrical energy. This technology finds widespread application in the areas such as vehicular technology, distributed generation for on-site stationary power, remote power for off-grid locations and portable power [4]-[5].

However besides the obvious advantages of a fuel cell system in terms of higher efficiency, fuel diversification and environmental friendliness, this source produces widely varying low dc voltage. This variation is incompatible with the existing utility and shows slow dynamic response for sudden load change. Consequently, a conversion device is necessary as part of the fuel cell system. Major issues in the introduction of this unit include a reduction in efficiency, loss of reliability, and increased cost. This paper presents a dc-dc converter arrangement that focuses on these issues and exhibits the following enhancements:

- Reduced switching losses due to implementation of Zero Voltage and Zero current switching schemes (ZVS & ZCS respectively).
- Increased efficiency: An improvement to the conventional design of the converter has shown an improvement in efficiency by 5%.
- Higher reliability due to simple control in dc-dc converter.
- Improved cost-effectiveness: It does not involve extensive computations and therefore can be controlled using a microprocessor rather than an expensive DSP.

Preliminary circuit simulation results are included in this paper along with efficiency plots and characteristics of the converter to validate the analysis. Further the circuit topology, steady-state operating are illustrated and discussed.

II. FUEL CELL SYSTEM

By definition, a fuel cell is an electrochemical device similar to a battery. The only difference is the fact that it is designed for continuous replenishment of the reactants consumed; i.e. it produces electricity from an external fuel supply as opposed to the limited internal energy storage capacity of a battery. Some features of the fuel cells which make it an attractive contender in the power sector are:

- High efficiency- The system is nearly double the simple-cycle efficiency of conventional gas turbine and reciprocating engine power generation technologies. Due to the ability to integrate power production in dwelling areas, efficient use of the waste heat is possible.
- Fuel diversification- This technology uses hydrogen which can be made from virtually any fossil fuel source, from biomass, and from electricity derived from wind or solar energy instead of oil.
- Durability and maintainability- A mature unit is typically designed to function for up to 20 years of plant life and operates for about 40,000 hrs between overhauls.
- Zero emission and silent operation making it suitable for any location.
- Safe to operate and maintain in urban areas.

The typical structure of a fuel cell for a power application is illustrated in figure 1. It comprises of a low-voltage fuel cell as the primary source, a dc/dc converter to obtain regulated high voltage DC, and a dc/ac inverter to obtain ac voltage.

Fuel cells produce unregulated direct current or DC power. Most devices and appliances require regulated DC or AC power to operate. To accommodate the low dc voltage of fuel cells (22 ~ 50V) to the required split 120V/240V single phase ac voltage, a typical fuel cell based power conditioner has two parts; dc/dc converter and dc/ac inverter, while a battery/ultra capacitor is utilized to improve load dynamics.

III. CONVERTER TOPOLOGY

The converter system implements a simple control scheme using a quasi-resonant switching arrangement which results in a reduction in switching losses in the circuit at high frequencies thereby

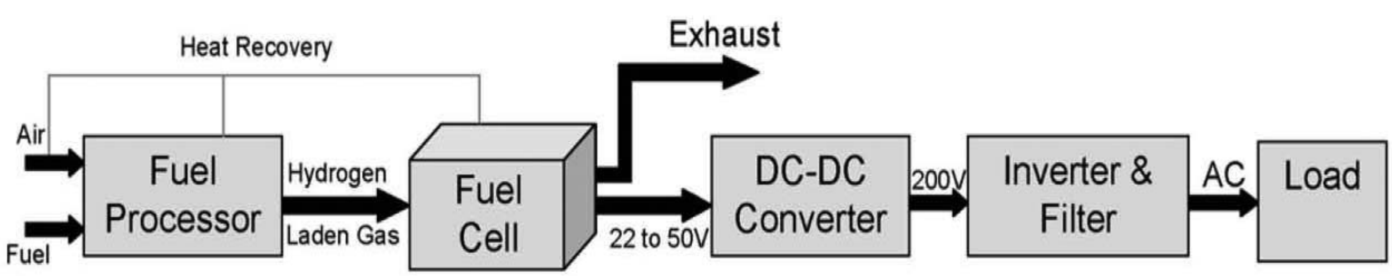


Figure 1: Block diagram illustrating a typical fuel cell system

improving the efficiency of the system. Additionally, the control circuitry employed in this system is simple and does not require expensive signal processors thereby making the overall system very cost-efficient. Following sub-sections describe the converter configuration, topological states/operating modes, and the control scheme implemented. Simplicity of the approach adds to the practical applicability of this arrangement.

A) Converter configuration

Figure 2 and Table 1 shows the circuit layout and system parameters of the 1kW fuel cell quasi-resonant power converter unit. The DC voltage input varies in a wide range from 22 to 50V and a corresponding output DC voltage is maintained at 200V. The boost or the step-up converter is used in fuel cell/battery powered devices, where the load side requires a higher operating voltage than the source can supply.

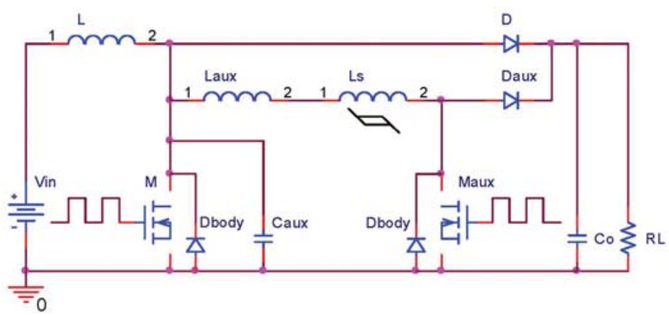


Figure 2: Quasi-resonant power converter for 22 – 50V input and 200V fixed output

Implementation of ZVS (Zero Voltage Switching) is done by sensing when the drain voltage of the main MOSFET (Metal Oxide Field Effect Transistor) switch has reached approximately zero volts, and resets the pulse width of the switching signal. To directly sense the drain voltage (~200V) of the main switch, a blocking diode is connected between ZVS and the high voltage drain. In the implementation of the quasi-resonant soft switching an additional auxiliary MOSFET (Maux), diode (Daux), and inductor (Laux) of smaller rating compared to the main power MOSFET (M), diode (D) and inductor (L) are used. Using the current sense transformer method, the internal current synthesizer circuit buffers the inductor current during the switch on-time, and reconstructs the inductor current during the switch off-time. In addition, this arrangement also provides improved signal to noise ratio and negligible current sensing losses.

Table I. System Parameters of Quasi-resonant Converter

S.No.	Parameter	Value	Units
1	Output Capacitor (Co)	400.0	uF
2	Inductor (L)	200.0	uH
3	Auxiliary Inductor (Laux)	8.5	uH
4	Auxiliary Capacitor (Caux)	660.0	pF
5	Saturation Inductor (Ls)	0.0	H
6	Load Resistor (RL)	66.5	Ohms

B) Implementation of soft switching scheme

In converter of Fig 2 a soft turn-on of the main current carrying switch is attained by adding an auxiliary switch. Average current mode control method allows for stable, low distortion AC line current programming without the need for slope compensation. In addition, active snubbing or ZVS (Zero Voltage Switching) significantly reduce diode reverse recovery and MOSFET turn-on losses, resulting in lower EMI emissions and higher switch operating efficiency. Using a PWM generator and a logic circuit, gate signal is generated to turn the auxiliary switch ON for a short duration to allow soft turn-on of the main switch Fig 3. The main MOSFET (M) switch turns on after auxiliary MOSFET (Maux) turns off. Soft turn-off of the main MOSFET switch is attained by using a capacitor (Caux) connected in parallel with the switch. The auxiliary switch is turned ON using zero current switching (ZCS) and turned OFF by hard-switching.

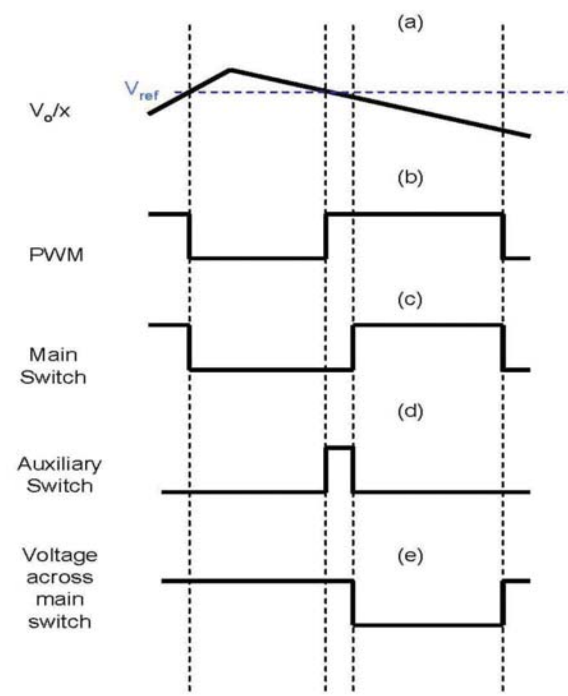
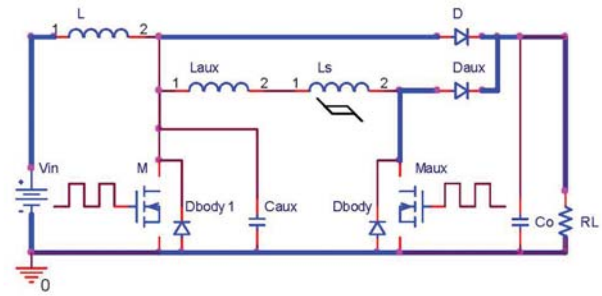


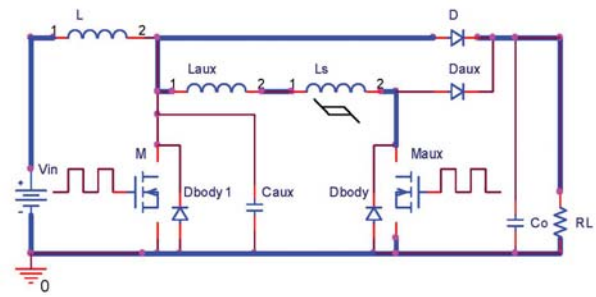
Figure 3: Soft-switching strategies using an auxiliary MOSFET to impose ZVS during turn-on of the main switch

C) Operational Modes

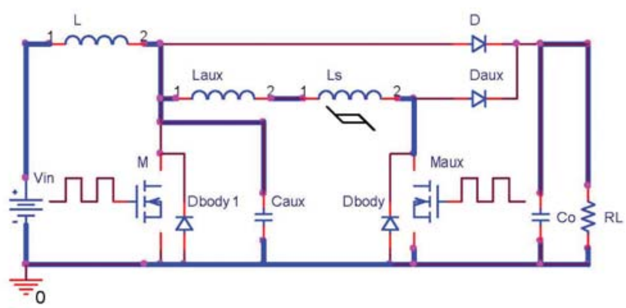
The operating modes/topological states of the soft switching quasi-resonant converter are given in Fig 4. Initially, the input voltage (Vin) is directly connected to the output load (RL) as shown in Mode 1. However, at the beginning of Mode 1 the auxiliary diode (Daux) has reverse recovery current due initial charging of the diode junction capacitance. This may be effectively reduced by using Ultrafast or Hyperfast diodes with low reverse recovery currents. During Mode 1 the auxiliary MOSFET switch (Maux) is on as in the switching pattern in Fig 3d. When the short lived reverse recovery current of Daux ceases, the current flowing through diode (D) transfers to the branch with auxiliary inductor (Laux) and the MOSFET switch (Maux) as in Mode 2 followed by the discharge of the auxiliary snubber capacitor (Caux) in Mode 3 to enable zero voltage turn off of main MOSFET (M) at the end of the switching duty cycle. The high output capacitor (Co) maintains the output voltage during this Mode 3. The freewheeling of Diode (Dbody1) in Mode 4 and 5 maintains a zero voltage across main MOSFET (M) that enables zero volt turn on in Mode 6. At the end of the duty cycle in Mode 7, the main MOSFET (M) turns off with zero voltage as the auxiliary capacitor (Caux) sinks the voltage across the switch (M) at turn off. The cycle ends with Mode 8 with the source connected directly to the load and the inductor (L) discharges into the load boosting the output voltage.



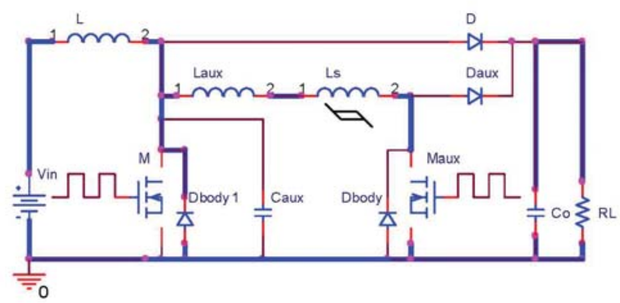
Mode 1 (Maux, D = ON; M, Daux = OFF)



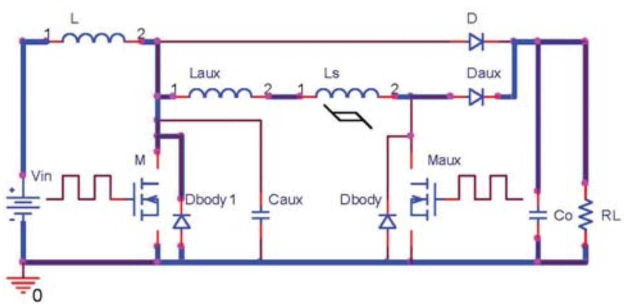
Mode 2 (Maux, D = ON; M, Daux = OFF)



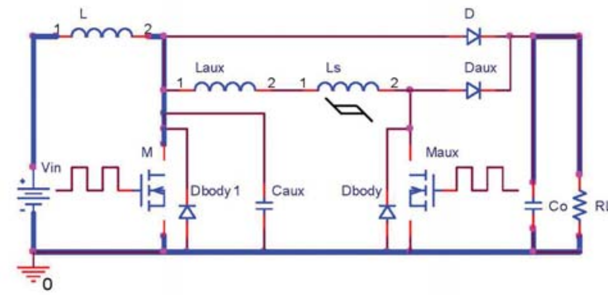
Mode 3 (Maux = ON; D, M, Daux = OFF)



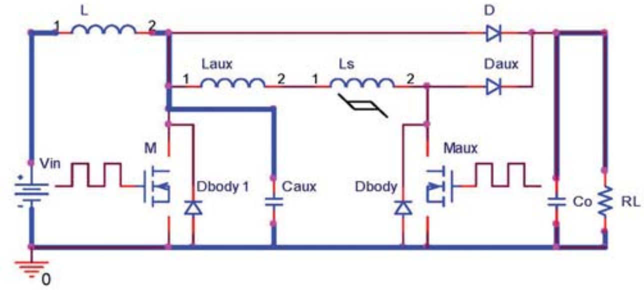
Mode 4 (Maux, Dbody1 = ON; Daux, M, D = OFF)



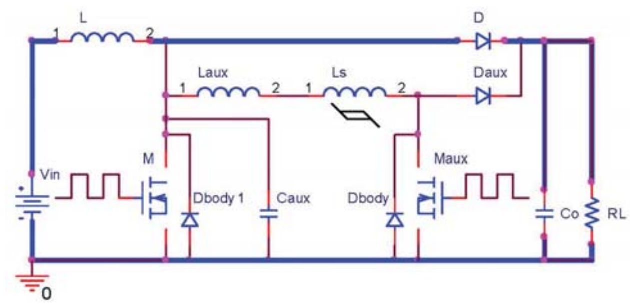
Mode 5 (M, Daux = ON; Maux, D = OFF)



Mode 6 (M = ON; D, Maux, Daux = OFF)



Mode 7 (D, Maux, M, Daux = OFF)



Mode 8 (D = ON; Maux, M, Daux = OFF)

Figure 4: Operational Modes of the converter using auxiliary MOSFET switch for soft switching main MOSFET.

IV. ANALYSIS AND RESULTS

A 1kW fuel cell system from Ballard Systems is used to test the quasi-resonant circuit to provide a 200V output. The fuel cell provides an unregulated DC output which is fed to the input of the quasi- resonant converter Fig 5. The fuel cell use 99.999% dry hydrogen gas at approximately 18 SLPM (Standard Liters per Minute) at 1 to 1.5 bars (14 to 22 PSIG (pound per square inch)) to generate 1kW power. The system is self contained with a control system that increases the hydrogen fuel and air intake based on the current drawn from the fuel cell.

Figure 6 shows the response time of the fuel cell system that is found to decrease with increasing load. In addition, the variation of the fuel cell time constant with frequency is given in Fig 7.

To investigate the operating characteristics of the fuel cell system, the fuel cell output is connected to a regulating DC-DC boost converter supplying approximately 100 watt load to a 66.5 Ohm load with 73.5V output voltage. At a switching frequency of 100 kHz, the fuel cell system output voltage is constant at 35.9V DC and a current of 2.7A with 0.6A ripple Fig 8. At 10 kHz switching frequency under the same load conditions the fuel cell output current has a ripple of 1A, approximately 33%. However, drawing large ripple currents from the fuel cell would damage the cell stacks and

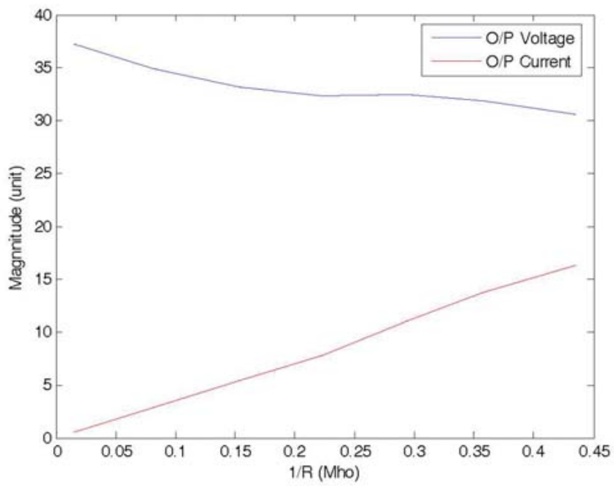


Figure 5: Variation of O/P Voltage and Current at Fuel Cell System

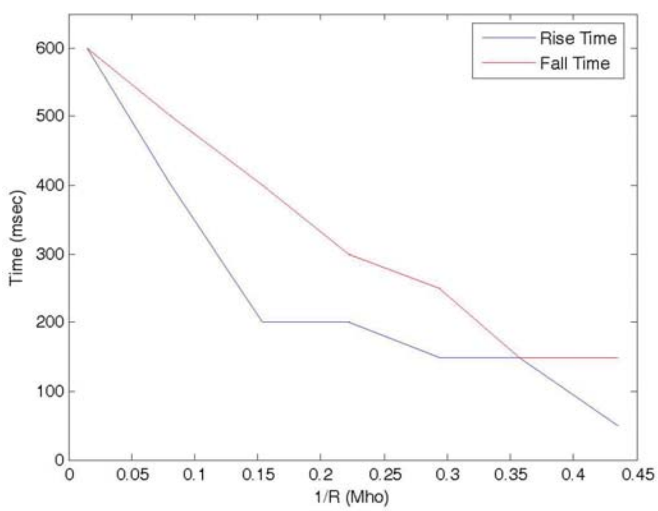


Figure 6: Change in Fuel Cell System Response Time with Load

are to be limited to 24% maximum ripple for this system. Thus, operation of switching converters at high frequencies would reduce the current ripple drawn from the fuel cell system. In addition, the output voltage of the fuel cell system is nearly constant at 35.9 V at 10 kHz but has a low frequency oscillation of few hundred Hz with peak to peak amplitude of 1V which is not observed at 100 kHz. Use of a boost converter topology with an inductor at the input further facilitates lowering the current ripple drawn from the fuel cell system without the need for separate input filters. The change in the average current drawn from the fuel cell system does not change substantially with increasing frequency but the current ripple at the output fall substantially from 45% at 10 kHz to 16% at 60 kHz, but there is no significant change in current ripple beyond 60 kHz and is nearly constant beyond 100kHz Fig 10 and Fig 11. Thus, operation at high frequencies would facilitate better operation of the fuel cell system. However, operation at high frequencies results in increased switching losses in the converter leading to lower efficiencies when hard switching Fig 12. Figure 12 shows this efficiency for hard switching fall from nearly 99% to 96% over the frequency range of 25 to 125 kHz. Above this frequency, operation of the converter result in significant efficiency fall besides problems in establishing correct switching when using current control. Use of quasi-resonant converter that enables soft switching of the main power switch (MOSFET, M) lowers the switching losses. The efficiencies at low frequencies (25 kHz) is not significantly different from hard switching, but is able to maintain an efficiency of above 96% for frequencies up to 200 kHz Fig 12.

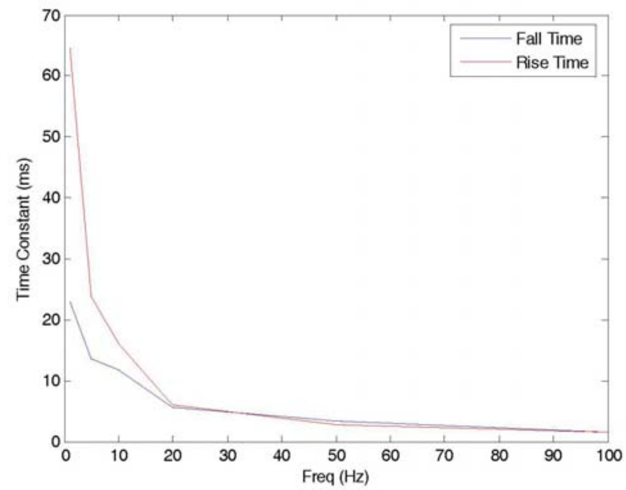


Figure 7: Change in Fuel Cell System Time Constant with Converter Switching Frequency

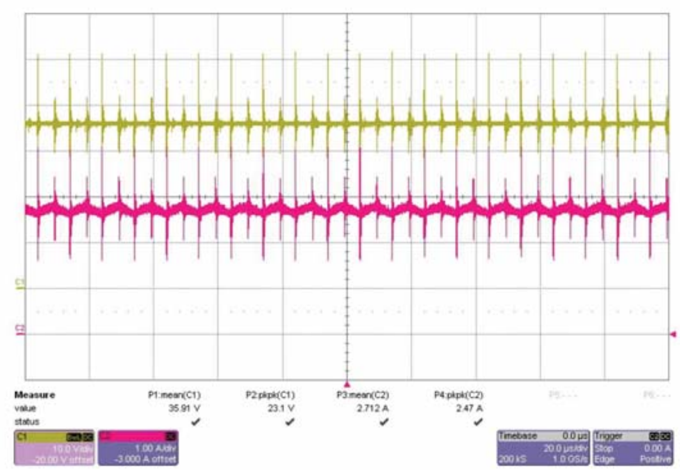


Figure 8: Fuel Cell System O/P Voltage & Current at 100 kHz

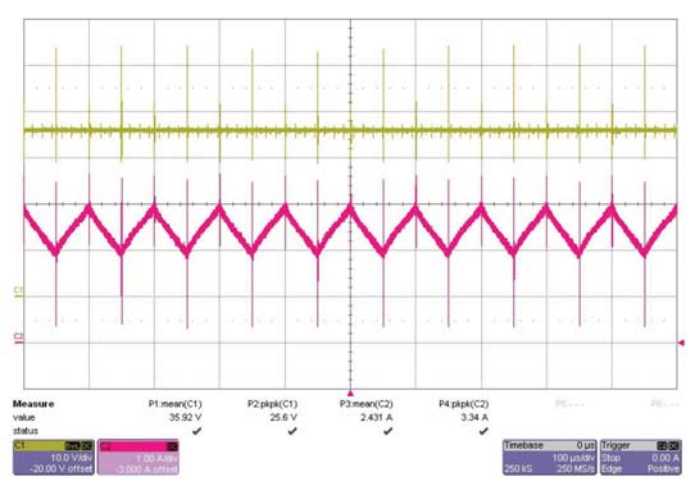


Figure 9: Fuel Cell System O/P Voltage & Current at 10 kHz

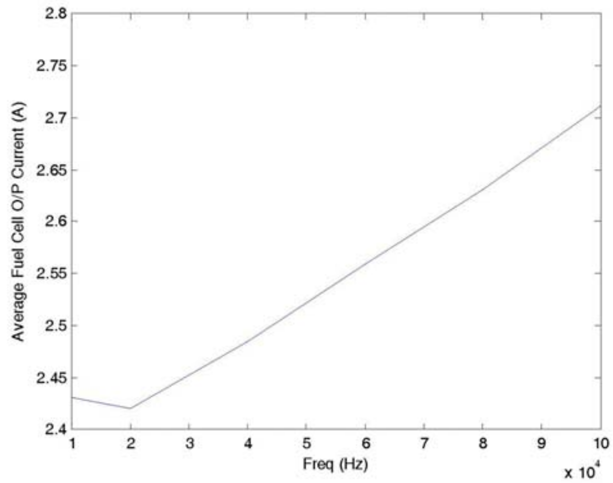


Figure 10: Variation of average current output from fuel cell with freq

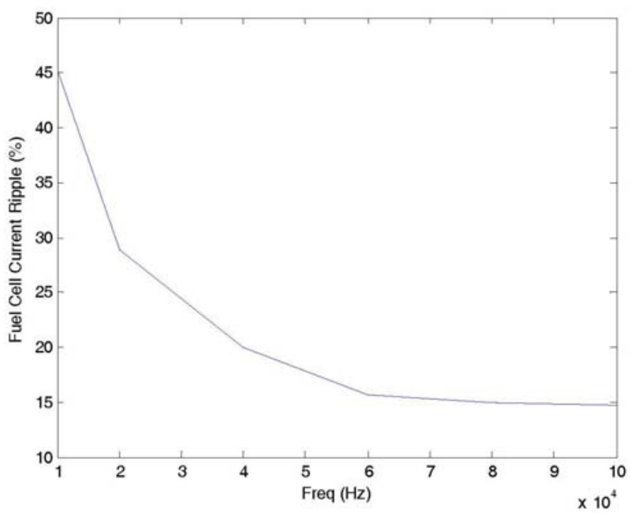


Figure 11: Variation of current ripple drawn from fuel cell with freq

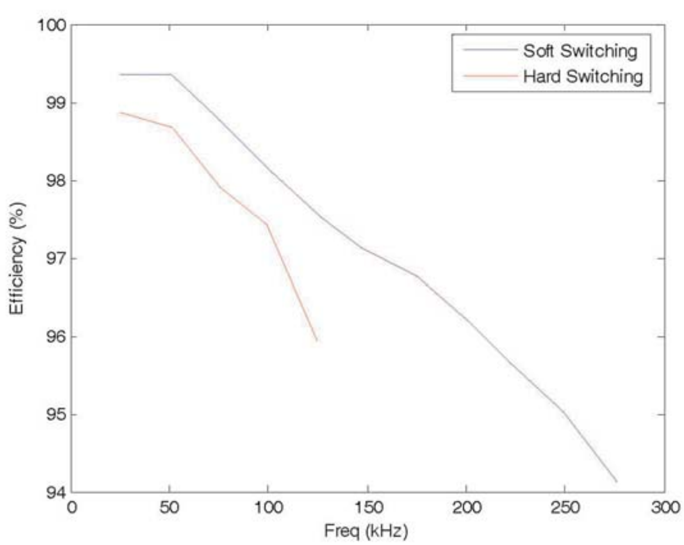


Figure 12: Measured Efficiency Vs Freq for Hard and Soft Switching

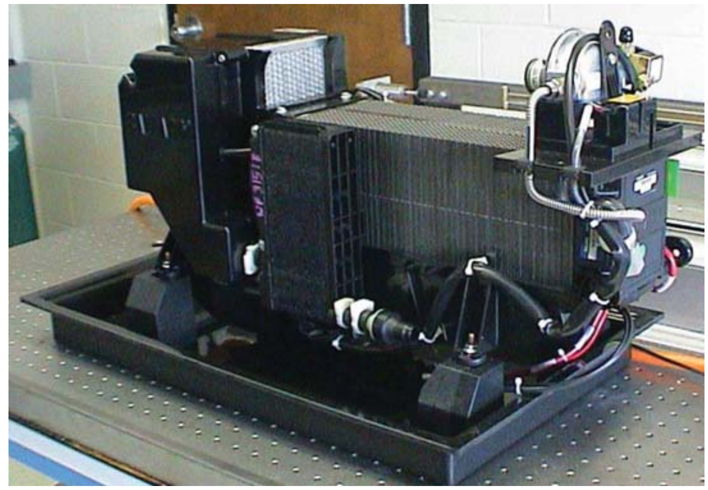


Figure 13: Experimental fuel-cell setup used for implementation and analysis.

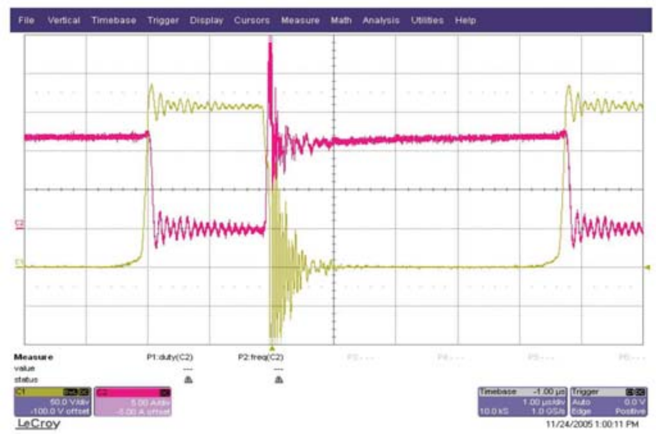


Figure 14: Hard switching of the converter at 142kHz with 71% duty cycle

The 1.2kW fuel cell system from Ballard is used for analysis Fig 13. To illustrate the waveform of hard switching at 142 kHz, the measured current through and voltage across the main MOSFET (M) is show in Fig 14. The input to the converter is 60V. During turn on a voltage of 200V is observed across the switch while the current rises to 10A. Similarly, during turn off, the voltage across the switch increases to approximately 175V before the MOSFET (M) current falls from 10A.

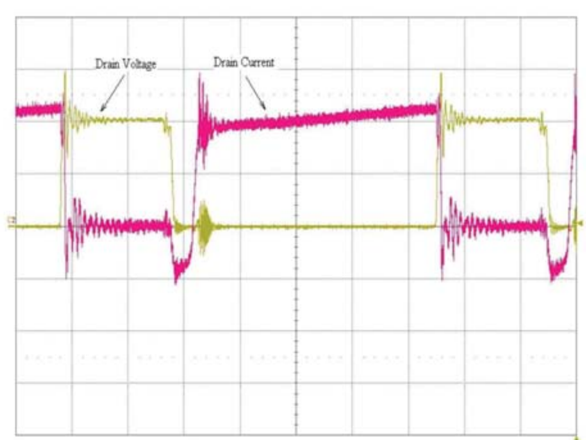


Figure 15: Soft switching of the converter at 142kHz with 71% duty cycle

Fig 15 shows the current and voltage of the main MOSFET (M) under soft switching at 142 kHz with the same duty cycle. Prior to MOSFET (M) turn on the current is negative 3A (Fig 15) due to the conduction of the anti-parallel diode (Dbody1) with MOSFET (M) that causes in freewheeling of the current as the converter is in MODE 4 and MODE 5 of Fig 4. This results in the fall in the voltage across the MOSFET (M) to zero while the current is negative 3A. The current then increases to 10A through the MOSFET (M). The waveform indicates a steady increase in the current from 10A to about 12A when the MOSFET (M) is ON due to building up of energy in the main inductor (L). At main switch turn off, the auxiliary capacitor (Caux) attempts to establish a zero voltage across the switch (M) which lasts for less than 35 ns (nanoseconds) during which time zero voltage turn off is not observed distinctively on the 5 microsecond/division scale of the oscilloscope. Use of a larger auxiliary capacitor would ensure a zero voltage turn off of MOSFET (M). A gate resistance of 5.1 Ohms is used for the MOSFET. Increasing the gate resistance would lower the noise that is observed during the turn on and off of the switch.

IV. CONCLUSION

This paper presents the design of a converter topology which allows the improvement in efficiency, reliability, and the cost-effectiveness of the system. Owing to the implementation of soft-switching schemes, the switching loss has been minimized with the converter maintaining an efficiency of 96% at frequencies up to 200 kHz.

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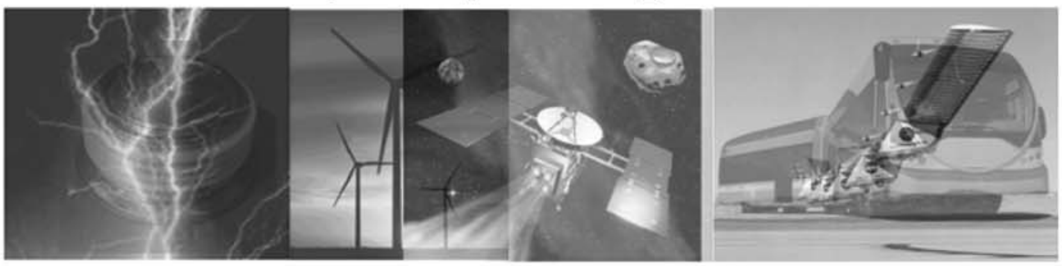

The IEEE Power Electronics Specialists Conference (PESC) is an annual international conference that provides a forum for research results, which advance fundamentals and principles of power electronics technologies. PESC includes: technical sessions, tutorials, and informal discussion sessions. PESC08 will be held at Sofitel Chapsis hotel and convention center in the island of Rhodes, Greece. The island of Rhodes is considered to be one of the most popular summer resorts of Europe and can be reached by airplane from all over the world. The island of Rhodes is situated at the cross roads of two major sea routes of the Mediterranean between the Aegean Sea and the coast of the Middle East. The Sofitel Chapsis hotel and convention center is a 5-star hotel located 5 minutes from the city of Rhodes and 15 minutes from Rhodes International Airport.

Topics of Interests

Design, control, analysis, modelling, of power electronics systems, power converters (DC-DC, AC-DC, DC-AC, AC-AC), motor drives and components, semiconductor devices and technologies, magnetic devices and materials, energy storage elements, power quality and utility interface issues, aerospace power applications, intelligent systems, integration and packaging, distributed generation and renewable energy systems, emerging power electronics technologies, and all other aspects of the field.

Paper Submission/Tutorial offering/corporate Sponsorship

Instructions will be available on the PESC08 web site: www.pesc08.org
Please note, PESC policy specifies that each paper must have at least one author registered in full.

Important Dates

- Submission of abstracts and Digests: November 9th, 2007
- Author's notification: February 15th, 2008
- Submission of Final Manuscript: April 18th, 2008

For further information, please contact

Dr Stefanos Manias, General Chair, National Technical University of Athens, Greece
manias@central.ntua.gr
Dr Vassilios Agelidis, Technical Chair, University of Sydney, Australia, v.agelidis@ee.usyd.edu.au

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APEC 2008

23rd Annual IEEE Applied Power Electronics Conference and Exposition
February 24th–February 28th, 2008 at the Austin Convention Center, Austin Texas

Announcement and Call for Papers

APEC 2008 continues the long-standing tradition of addressing issues of immediate and long-term interest to the practicing power electronics engineer. Outstanding technical content is provided at one of the lowest registration costs of any IEEE conference. APEC 2008 will provide a) the best power electronics exposition, b) professional development courses taught by world-class experts, c) presentations of peer-reviewed technical papers covering a wide range of topics, and d) time to network and enjoy the company of fellow power electronics professionals in a beautiful setting. Activities for guests, spouses, and families are abundant in the Austin area.

Papers of value to the practicing engineer are solicited in the following topic areas:

AC-DC and DC-DC Converters
Single- and Multi-Phase AC-DC Power Supplies, DC-DC Converters (Hard- and Soft-Switched)

Power Electronics for Utility Interface
Power Factor Correction, Power Quality, Electronics and Controls for Distributed Energy Systems

Motor Drives and Inverters
AC and DC Motor Drives, Single- and Multi-Phase Inverters, PWM Techniques

Devices and Components
Semiconductor Devices, Magnetic Components, Capacitors, Batteries, Sensors, Interconnects, Device Integration

System Integration
Packaging, Thermal Management, EMI and EMC

Modeling, Simulation, and Control
Device, Component, Parasitics, Circuit and System, CAD /CAE Tools, Sensor and Sensor-less Control, Digital Control

Manufacturing and Business Issues
Production Processes, Quality, Design for Manufacturability, Material Procurement, Supplier Qualification

Power Electronics Applications
Automotive and Transportation, Aerospace, Lighting, UPS, Power Generation and Transmission, Telecommunications, Military

Please note the following dates:

July 20, 2007	**Deadline for submission of digests**
October 5, 2007	**Notification that a paper was accepted or declined**
November 30, 2007	**Final papers and author registrations are due**

Digest Preparation: Prospective authors are asked to submit a d igest explaining the problem or need to be addressed by the paper, the major results, and how this is different from the closest existing literature. Papers presented at APEC must be original material and not have been previously presented or published. The principal criteria in selecting digests will be the usefulness of the work to the practicing power electronics professional. Reviewers also value evidence of completed experimental work. The digest must be double spaced in 10-point or larger font and a maximum of five pages including any abstract (optional), figures, and tables. Referencing within the digest should be done by number (i.e. [1]), but the list of references is to be submitted online separately from the digest. The digest should not include any author names or affiliations. For further details please visit www.apec-conf.org.

Authors should obtain any necessary company and governmental clearance prior to submission of digests. Digests will be sent to multiple reviewers; therefore "Confidential" and "Proprietary" information should be omitted. If a digest is accepted, a final manuscript and author-registration payment must be received by the deadline above or the paper cannot be published in the Proceedings or presented at the conference. Manuscripts exceeding seven pages are subject to extra page charges (approximately $100 for each page over seven).

Reviews: APEC relies upon a peer review process to ensure the quality of the technical content. To he lp maintain the high quality of the program, please contribute a few hours to review digests in your area of expertise by registering at www.apec-conf.org (under "Participating in APEC").

Calls for Special Presentations, Professional Education Seminars, and Exhibitor Seminars will be posted at www.apec-conf.org.

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IEEE
VPPC 2007

September 9-12, 2007, Wyndham Hotel, Arlington, Texas, USA

Co-sponsored by: IEEE Vehicular Technology Society (VTS) and IEEE Power Electronics Society (PELS)

Call for Papers

2007 IEEE Vehicle Power and Propulsion (VPP) Conference

The 2007 IEEE Vehicle Power and Propulsion (VPP) Conference is located in Arlington, Texas, USA.. VPP conference will include sessions in different technical tracks and potential authors are invited to submit their papers on the following or related topics.

VPP Track 1: Vehicular Electric Power Systems and Loads
VPP Track 2: Vehicular Power Electronics and Electromechanical Actuators
VPP Track 3: Advanced Vehicles
VPP Track 4: Energy Storage Components/Systems
VPP Track 5: Modeling, Analysis, Dynamics, and Control

Papers should make a timely contribution to state-of-the-art technology, be of high technical and editorial quality, and be devoid of commercialism. Papers should not have been published elsewhere and, if accepted, should not be released for publication through other media. All authors must obtain company and government clearance (if necessary) prior to submission of paper proposals. Authors of accepted VPP papers must submit signed copyright transfer forms to IEEE.

Paper Submission Guidelines:
Prospective authors of papers are asked to submit their paper proposals through the conference Web site (http://www.vppc07.com/). Each paper proposal must include:

- Technical track number and name, paper title, name(s) of author(s), business affiliation(s), mailing address(es), phone and fax numbers, and e-mail address(es). If there are multiple authors, the corresponding author must be clearly identified.
- An abstract of 50-100 words and a digest of 3-5 pages (including figures and tables) stating the objective of the paper, outlining the problem requiring solution or the method of approach to research, being explicit with respect to the type of data to be included in the full paper, and summarizing the conclusions being made. The digest must not exceed 5 pages in length. The conference program committee may make reassignment of accepted papers to different sessions, if necessary.

Deadlines

April 1, 2007: Submission of paper proposals (abstracts and digests)
June 1 , 2007:Author's notification of acceptance
August 1, 2007: Submission of camera-ready manuscripts

Organizing Committee:

VPP'07 General Chair: Dr. Babak Fahimi, University of Texas at Arlington, EML: fahimi@uta.edu
VPP'07 Program Chair: Dr. G. Suresh, GM Research and Development center, EML: suresh.gopalakrishnan@gm.com
VPP'07 Seminar and Invited Speaker Chair: Dr. C.S. Edrington, Arkansas State University, EML: cedrington@astate.edu

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Denver Chapter Presents Microcontroller Seminar For Power Supply Engineers

Bob White
Chair, Denver Chapter
IEEE Power Electronics Society

Digital control and digital power management are being used in more and more commercial power supply applications. For example, most server power supplies today have a serial data bus connection to allow the host system to control and monitor the power supply. Yet most power supply engineers have little training and experience in digital design, including the use and programming of microcontrollers.

To help local power supply and analog engineers acquire basic microcontroller skills quickly and at low cost, the Denver Chapter of the IEEE Power Electronics Society held a two day, hands on seminar this past April on using and programming microcontrollers. The only way to effectively learn this material was to actually write, compile and debug code and that is what this seminar offered.

The seminar format was to first introduce a topic in a short lecture and then immediately reinforce the lesson with a laboratory exercise. Exercises required the seminar participants to write code in C language, compile the code, program the device, and then debug the code until the lesson's objective was achieved. The first couple of lessons introduced the participants to the integrated development environment (IDE), the mechanics of writing and compiling their code, running code simulations to check for bugs, and transferring the program from their computer to a microcontroller.

After the introductory lessons, the seminar took a step by step approach to programming a full featured, working buck converter. The first step involved programming a microcontroller to provide a reference voltage to set the output voltage to the desired value. In subsequent lessons, seminar participants learned how to write the code to calibrate the output to a precise value, for soft-starting the converter with a desired delay and ramp time, setting up output overvoltage and overtemperature protection, checking the code for errors using checksums and cyclical redundancy checking, and the basics of communicating over the I_C bus.

Microchip Technology played an important role in the success of the seminar. Microchip generously donated to the Chapter the hardware and software needed for the seminar. Each seminar participant was able to keep the hardware and software and to use to continue their education after the seminar. The hardware and software provided included a PICkit™ 2 Debug Express kit (which included a PICkit 2 debugger and device programmer as well as a microcontroller demonstration board), the buck converter board with a microcontroller, a PICkit Serial Analyzer (with microcontroller demonstration board), the MPLAB® IDE software, and an extended evaluation period C language compiler from the Hi-Tech Software company. In addition, Microchip donated the time of two instructors for two days to teach the class. The Denver Chapter is very grateful to Microchip Technology for its support of the seminar.

Comments from the attendees after the seminar were uniformly enthusiastic ranging from "Fantastic" to "Very useful" to "I learned what I really needed to learn". Bob White, Chapter Chair, said "It is very important for the Society and its Chapters to support its members working in industry. Providing continuing professional education, such as this seminar, is one of the best ways the IEEE, the Society and the Chapter can provide value to our members and the engineering community at large. The Denver Chapter is very proud of what we were able to accomplish with this seminar."

The Denver Chapter, although only founded in December 2004, has been quite active. The microcontroller seminar is the second major technical training event it has held – the first was Professor Middlebrook presenting his Structured Analog Design course in a two day seminar. The Chapter also has been holding meetings six to seven times a year with speakers covering a range of technical and professional development topics. Technical topics in the past winter and spring's meetings have included recent advances in lighting technology; modeling and analysis of coupling in multi-winding magnetic devices; EMI/EMC regulations and measurements including a tour of an EMI measurement facility; and digital control and digital power management of power electronics. The most recent meeting featured Dr. Don Morris, retired from Agilent/HP, giving an informative and engaging talk on the history of innovation, economics, and how the migration of technology jobs across the globe today is a repeat of something that has happened over and over again in the past.

The Chapter maintains a Web site at http://www.denverpels.org which has the latest information on upcoming meetings and selected presentations from recent meetings.

Seminar participants hard at work writing, compiling and debugging their code.

Keith Curtis of Microchip Technology was the lead instructor for the seminar.

IEEE TRANSACTIONS ON POWER ELECTRONICS

CALL FOR PAPERS

Special Issue on Power Electronics for Wind Energy Conversion, 2008

Prospective authors are invited to submit manuscripts for review to be published in this issue. Topics to include:

- Topologies of power converters for wind turbines
- Operation and control of doubly fed induction generator systems for wind turbines
- Power electronic interface for permanent-magnetic and field excited synchronous generators based wind turbines
- Modelling and simulation of power electronic systems with wind turbines and windfarms
- Fault monitoring and predictive maintenance of power electronic based wind turbine systems
- Protection of power electronic systems for wind turbines
- Planning and configuration of wind farm power systems
- Ride-through capability of wind turbines with power electronic systems
- Power electronics for integration and control of wind turbines in power systems
- Small wind turbine systems for standalone and grid-connected applications
- Future trends of wind energy conversion and power electronic applications

NEW: Paper submission deadline: April 1, 2007
Planned publication date: May 2008

All the papers must be submitted, in electronic format through the Manuscript Central at http://mc.manuscriptcentral.com/tpel-ieee as described in the web http://www.pels.org

All papers must be clearly marked 'Special Issue on Power Electronics for Wind Energy Conversion, 2008'

When uploading your paper, please indicate under step 4 - *Details & Comments* - that your paper is for 'Special Issue on Power Electronics for Wind Energy Conversion, 2008'

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Meetings of Interest

The 38th IEEE Power Electronics Specialists Conference, PESC'07, is scheduled for 17-21 June, 2007 at the Hilton in the Walt Disney World® Resort, Orlando, FL. PESC'07 is sponsored by IEEE PEL's. Deadline for abstract and digest submission is 10 Nov. 2006. General Chair is Prof. Issa Batarseh, batarseh@mail.ucf.edu and technical program chair Prof. John Shen, johnshen@mail.ucf.edu. For more information visit the website at www.pesc-conf.org.

42nd International Universities Power Engineering Conference (UPEC 2007), will be held at the University of Brighton, U.K. UPEC2007 is being hosted by the Faculty of Science and Engineering, University of Brighton, UK, September 4-6, 2007. It will be located at the University's Falmer campus. PO address is: School of Engineering, The University of Brighton, Cockcroft Building, Lewes Rd, Brighton, BN2 4GJ, UK, Tel: +44 1273 642 234, Fax: +44 1273 642 301. The Conference organizer is Dr. Peter Howson (E-mail: P.A.Howson@bton.ac.uk).

12th European Conference on Power Electronics and Applications, EPE2007, is scheduled for 2-5 Sept. 2007 in Aalborg, Denmark. Intending authors should note these deadlines: receipt of synopses by 1 Nov.1, 2006, notification of acceptance March 1, 2007, final review May 15, 2007. Further information can be found at http://www.epe2007.com/

4th Vehicle Power and Propulsion (VPP) Conference is announced for Arlington, Texas from 9-12 September 2007 at the Wyndham Hotel in Arlington. Prospective authors are directed to the website for further details: http://www.vppc07.com/ and notified to submit proposal via that site. Important dates: April 1, 2007 for submission of the paper proposal (abstract and digest); June 1, 2006 author's notification of acceptance; August 1, 2007 for submission of camera-ready manuscript. VPP'07 general chair: Dr. Babak Fahimi, University of Texas-Arlington: fahimi@uta.edu VPP'07 is co-sponsored by PEL's.

9th Brazilian Conference on Power Electronics, COBEP'07, is scheduled for 30 Sept to 4 Oct. 2007 at the Carlos Gomes Theatre, Blumenau, SC, Brazil. COBEP'07 is sponsored by the Brazilian Power Electronics Society and co-sponsored by IEEE PEL's. Deadline for abstracts is 15 April 2007. For more information contact the Conference General Chair, Prof. Eduardo Deschamps at cobep@furb.br or technical program chair, Prof. Adriano Peres at cobepct@furb.br or visit www.furb.br/ppgee

INTELEC® Rome 2007 will take place from 30 Sept. to 4 Oct. at the Rome Marriott Park Hotel, Rome, Italy. INTELEC (International Telecommunications Energy Conference - www.intelec.org) is an annual conference which examines and analyzes the latest developments in telecommunications energy systems and related power processing devices and circuits. Organising Secretariat Studio Ega srl Viale Tiziano 19 – 00196 Roma, e-mail intelecexhibitions@ega.it

OPTIM-2008 venue: Biannual (in same Mountain Resort), on Power Electrical and Electronics Enginnering; May 22-24, 2008, Brasov, Romania and technical co-sponsored by IEEE – IAS, IES, and PEL's. For details please visit: http://info-optim.ro and http://optim.8m.com. Also, see the announcement in this issue.

39th IEEE Power Electronics Specialists Conference, PESC08 will take place on the island of Rhodes, Greece from 15-19 June 2008. Form more information please visit PELs website or contact PESC08 General Chair, Dr. Stefanos Manias (IEEE IAS/PELs/IES Greece Section Chair) at National Technical University of Athens, manias@central.ntua.gr

5th Vehicle Power and Propulsion (VPP) Conference is announced for 3-5 September 2008 in Harbin, China. Correspondence may be directed to: vppc2008@hit.edu.cn. VPP'08 general chair: Prof. C.C. Chan, Harbin Institute of Technology. Abstracts with contact details should be submitted by 1 March 2008. VPP'08 is co-sponsored by PEL's.

Book Review: Instantaneous Power Theory and Applications to Power Conditioning

by Hirofumi Akagi, Edson Hirokazu Watanabe, Mauricio Arades

IEEE Press, 2007, 389 pages

This book presents a deep review of the instantaneous active/reactive power theory and its applications for the understanding and designing of active power filters in both shunt and series configurations. The book also shows how this theory can be used for combined shunt-series filters and FACTS (Flexible AC Transmission System) devices. This book introduces many important concepts in the field of active filtering, which are usually widely spread in several technical papers. Having all this information in one book is a great and unique contribution for students in their last year of graduation, for graduated students and for engineers in general dealing with harmonic pollution problems. The book consists of the following chapters:

1. Introduction. (Concepts and Evolution of Electric Power Theory. Applications of the p-q Theory to Power Electronics Equipment. Harmonic Voltages in Power Systems. Identified and Unidentified Harmonic-Producing Loads, Harmonic Current and Voltage Sources. Basic Principles of Harmonic Compensation. Basic Principles of Power Flow Control.)

2. Electric Power Definitions: Background. (Power Definitions under Sinusoidal Conditions. Voltage and Current Phasors and the Complex Impedance. Complex Power and Power Factor, Concepts of Power Under Non-Sinusoidal Conditions - Conventional Approaches. Electric Power in Three-Phase Systems.)

3 The Instantaneous Power Theory. (Basis of the p-q Theory. The p-q Theory in Three-Phase, Three-Wire Systems. The p-q Theory in Three-Phase, Four-Wire Systems. Instantaneous abc Theory. Comparisons between the p-q Theory and the abc Theory.)

4 Shunt Active Filters. (General Description of Shunt Active Filters. Three-Phase, Three-Wire Shunt Active Filters. Three-Phase, Four-Wire Shunt Active Filters. Shunt Selective Harmonic Compensation.)

5. Hybrid and Series Active Filters. (Basic Series Active Filter. Combined Series Active Filter and Shunt Passive Filter. Series Active Filter Integrated with a Double-Series Diode Rectifier. Comparisons Between Hybrid and Pure Active Filters.)

6 Combined Series and Shunt Power Conditioners. (The Unified Power Flow Controller (UPFC). The Unified Power Quality Conditioner (UPQC). The Universal Active Power Line Conditioner (UPLC).)

The book is easy to read, rigorous in the introduction and definition of the power theory and the material flows logically throughout the text. Almost every chapter of the book features several good practical examples with experimental results, together with details of the control block diagrams, discussions of some control problems and their interesting solutions to active power filter applications. The book is unique and very interesting also from this point of view. Last but not least, the book is written by the leading experts in this field, who have given the major and pioneering contributions to the development and application of active power filters. Thus, I do strongly suggest the book for any undergraduate, graduate students, practicing power electronics engineers, and new researchers dealing with the design, application and implementation of active power filters or FACTS devices.

Prof. Paolo Mattavelli
University of Padova

Paolo Mattavelli received the Ph. D. degree in electrical engineering from the University of Padova (Italy) in 1995. From 1995 to 2001, he was a researcher at the University of Padova, From 2001 to 2005 he was an Associate Professor with the University of Udine, leading the power electronics laboratory. Since 2005 he has been with the University of Padova in Vicenza with the same duties.

His major fields of interest include analysis, modeling and control of power converters, digital control techniques for power electronic circuits, and power quality issues.

He serves as an Associate Editor for IEEE Trans. on Power Electronics, IPCC Trans. Chair for IEEE Trans. on Industry Applications and Member-at-Large of PELS Adcom.

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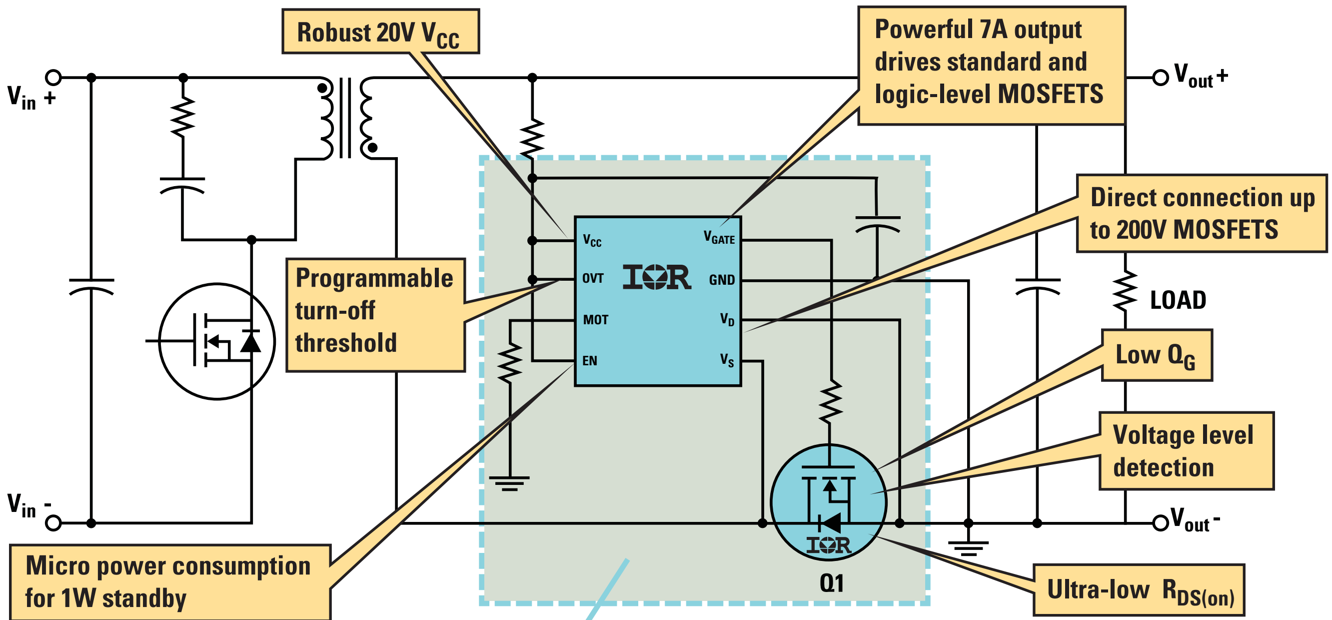

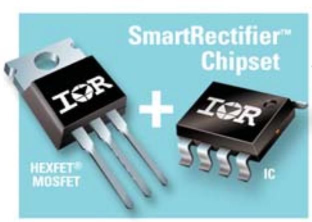

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Part Number	Package	V_{CC} (V)	V_{FET} (V)	Sw. Freq. Max. (kHz)	Gate Drive	V_{GATE} Clamp (V)	Sleep Current Max. (μA)
IR1167A/SPbF	DIP-8/SO-8	20	<=200	500	+2A/-7A	10.7	200
IR1167B/SPbF	DIP-8/SO-8	20	<=200	500	+2A/-7A	14.5	200
IR1166/SPbF	DIP-8/SO-8	20	<=200	500	+1A/-3.5A	10.7	200

MOSFETS

Part Number	V_{DSS} (V)	$R_{DS(on)}$ max @ 10V (mΩ)	Q_G(typ/max) (nC)	Package
IRFB3206PbF	60	3.0	120/170	TO-220
IRFB3207PbF	75	4.1	120/170	TO-220
IRF7853PbF	100	18	28/39	SO-8

Design Tools

A data sheet, application notes, technical papers, and online design software are now available on IR's myPower™ site (http://www.irf.com/design-center/mypower/).

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