

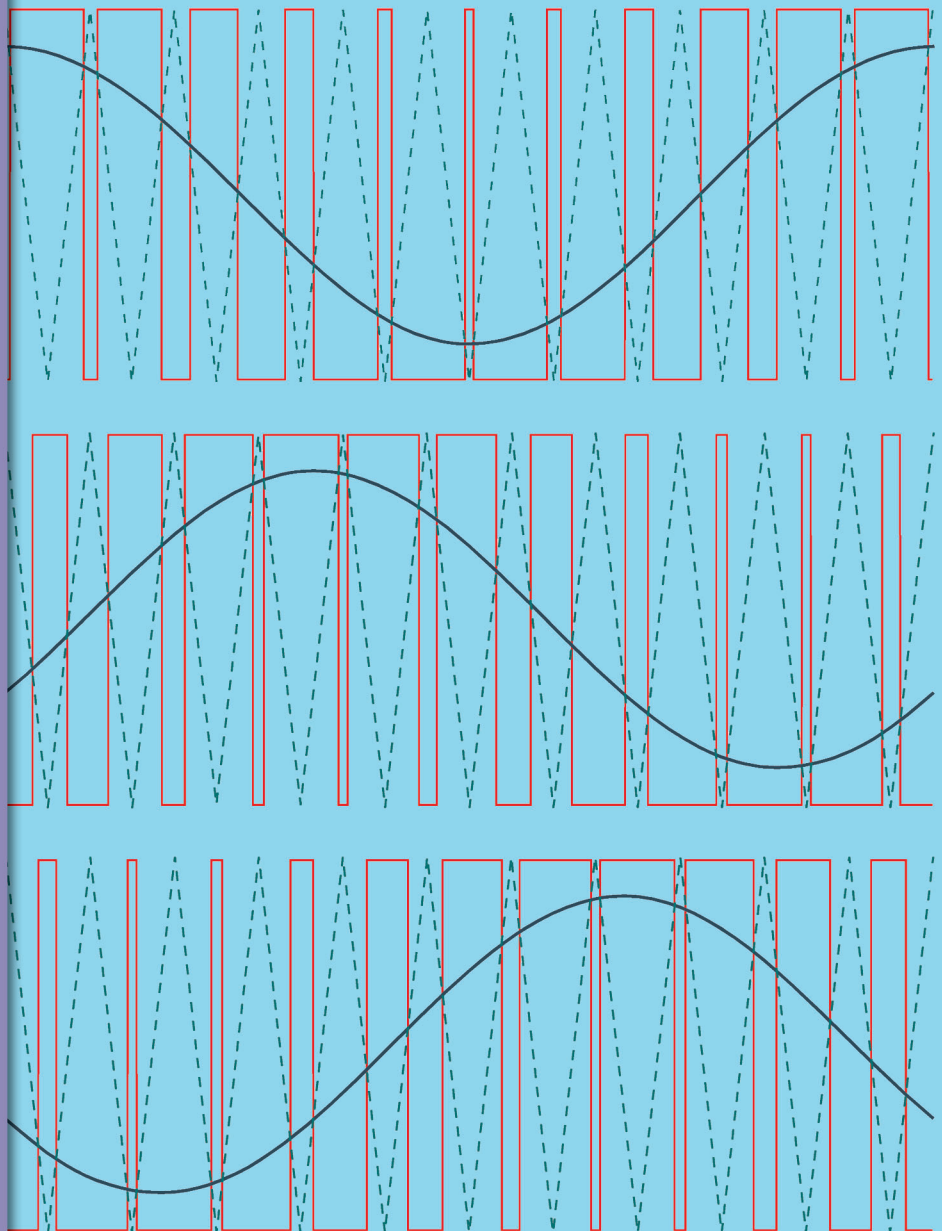


POWER ELECTRONICS SOCIETY NEWSLETTER

Fourth Quarter 2004
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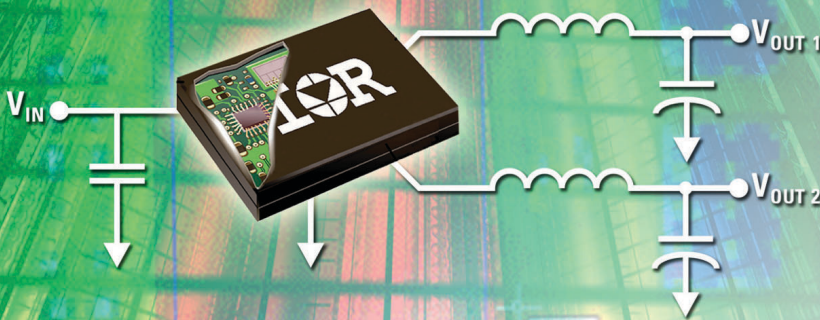
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President's Message



Well here it is, my last letter to you, as my two year term as president winds down.

There's some good news near the end of this letter, so you can either skip there directly, or plow on.

In the last two years much has changed in the IEEE. There have been changes which we expected to impact on the levels of society membership, and indeed we have been seeing declines at about 6% per annum. The changes have been in the way we get our IEEE publications, and how we pay for them.

I know that in the "olden days" (about 3-4 years ago) society membership gave you very low cost access to paper copies of your society's journals. I was at one stage a member of 4 societies and I had a pile of unopened journals on the floor in my office that at one point reached about 1.5 meters. Here was tangible evidence of the benefits of society membership, when access to those same paper journals in Institutional libraries was a matter of setting aside time to make the journey, do battle with the parking, the layout within the building, deciding what to photocopy, etc.

Then along came the IEEE/IEE Electronic library (IEL). If you were fortunate and worked for a large Company/Institution you got access at your desk, on your PC, to ALL the journals from IEE and the IEEE, plus standards! Why bother with societies?

And then along came the Members Digital Library (MDL). Here for \$US 420 per annum IEEE members can get electronic access to all the IEEE journals. While it's a lot more cost than a few society memberships, it's also a lot more access. Some employers have clearly been supporting

their staff with this access, and a very small university in Australia managed to "buy" a membership for a graduate student. A far better deal for both of them than buying separate journals!

I must say that one of the extraordinary benefits of being president of a society is the access to IEL you are given during your tenure. It has revolutionized the way I work, it is so easy now to not only find a paper, but to read the reference list, and then immediately get access to nearly all of those references so you can easily track down the significant contributors, check sources etc, all from your keyboard. I am now convinced that if I am ever at a place without access to IEL, MDL purchase will be obligatory for me. For MDL subscribers, again, what is the value in joining the societies?

So we sit in our PELS meetings, saying we have increased membership fees (as directed by IEEE central to approximately cover costs), we have taken away the paper, (giving you electronic access to the society journal only) and all these other options are opening up. I'm amazed at how faithful our members really are!

The Good News. When you reinforced for us that access to conference proceedings was an issue, our mission was clear. Now when you get your membership brochure in the next few weeks you will see that we are giving you access, bundled with your membership fee, to the proceedings, (as before) plus the letters, (which we used to charge for), plus the complete file (including history) of our PESC conferences.

While it is not in the brochure, We are planning and working so that by the time the year 2005 starts we will be able to offer you a second bundle, of all of our other financially sponsored conferences and meeting proceedings, (APEC, INTELEC, IEMDC,

COMPEL, TPEL, and SDEMPED; I'm guessing that if these are of interest to you, you will recognize the acronyms; if not check <http://www.pels.org/Comm/Meetings/Meetings.html#Workshops>) for a fee which is being calculated as we speak.

Post Script, politics. In two years I have seen the importance of the Technical Activities Board, (the umbrella for all the societies and councils), and how it is beaver-ing away to manage change, financial issues etc. While to some, TAB might be seen as roughly one third of IEEE (alongside the big Regional Activities Board and mid size Educational Activities board and then some other smaller operations), TAB is the economic engine of the IEEE. Phil Krein who served as our society president 1999-2000, and currently is Division 2 Director (a seat on the overall board controlling the IEEE, representing a subset of societies, of which we are one), is now standing for what is called the VP elect of TAB, to be the chair of TAB in 2006. While his opponents are worthy, we have never before to my knowledge had a Power Electronics person stand for this position, and Phil is the right kind of person to carry forward all the things we are striving for. If you get this before October 31st, vote! (Oh and BTW, the corridor gossip tells me that the constitutional changes proposed are really important and necessary fixes).

Dean Patterson

patterson@ieee.org

Ph +1 402 472 6849

President IEEE Power Electronics Society

Visiting Professor

University of Nebraska, Lincoln

EE Dept, 209 N WSEC, PO Box 880511

Lincoln NE 68588-0511, USA

IEEE Power Electronics Society Officers

Dean Patterson, President

Ron Harley, V.P. Operations

F. Dong Tan, V.P. Meetings

Steven B. Leeb, Treasurer

<http://www.pels.org>

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News Items should be sent to: Dr John M. Miller, PELS Newsletter, Editor-in-Chief, J-N-J Miller Design Services, PLC, 3573 East Gatzke Road, Cedar, MI. 49621, USA; TEL: +1 231 228 5011; FAX: +1 231 228 7250; EMAIL: pelsnews@ieee.org. Deadlines for copy are March 15, June 15, September 15 and December 15. Email

submission of items in MS-Word or plain-text format preferred. MS-Word and plain-text (straight ASCII) submissions on 3.5" diskette are welcome, as are CDROMs, and should be accompanied by a backup hardcopy. Fax submissions are acceptable, but are least desirable. Include caption with all photos identifying event and individuals in a back-row, left to right, front-row, left to right, etc method. Full-page calls for papers and announcements of PELS-supported conferences are welcome and should be sent as both high-quality hardcopy and MS-Word files. Please indicate all trademarked items, such as INTELEC®, APEC® with the registered trademark symbol, "®".

Technical items should be sent to: Prof Juan Carlos Balda, PELS Newsletter Associate Editor, University of Arkansas, 3217 Bell Engineering Center, Fayetteville, AR 72701, USA; TEL: +1 479 575 6578; FAX: +1 479 575 7967; EMAIL: jbalda@uark.edu

Advertising queries should be sent to: Mr Mal Elgar (West and Central USA & International) TEL: +1 909 289 5231; FAX: +1 909 883 8337; EMAIL: Mal.Elgar@verizon.net

Or

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The Newsletter in PDF format is posted at the PELS website approximately three weeks sooner than paper copies can be delivered. To receive email notification when the internet version is available, go to <http://www.pels.org/Mailing/MailForm.html> and provide your email address. Additionally, the email notification sometimes includes timely announcements that are not in the printed newsletter.

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From The Editor

John M. Miller



This issue marks the completion of my first year as editor-in-chief of this newsletter. It has been my pleasure to work with this vital and always interesting society and to share with our members the news, events and technical tips and tricks articles that characterize the PEL's newsletter. It is my goal to ensure that our newsletter is fresh with recent happenings and timely announcements. To that end I encourage all of you to please forward me items of interest to the society, of significant personal awards and also topics of broader interest such as book reviews, significant per-

sonal awards and other recent happenings.

I also welcome feedback from you, the reader, on the newsletter layout, article content and advertisements. In particular, we have had some comments on the cover art and whether or not this format should be retained, or as some have suggested, that we consider some different graphic to distinguish each issue. What are your thoughts? There has also been some concern that the printed copy is not reaching our European and Asian members in a timely manner and that topic is being addressed. For timely access to the newsletter I ask that readers please visit the PEL's website at www.pels.org and click on newsletter for the most up to date copy. At the website members can also find links to sister societies to PEL's.

There are two news items in this issue that have been topics of recent news. One is the matter of plagiarism and guidelines for authors that is being announced by the IEEE Publications Products Services Board, PSPB. Mr Bill Hagen the manager of IEEE Intellectual Property Rights has published the relevant guidelines and that letter is contained in this issue. The second topic of longer standing concern deals with the now resolved matter between the U.S. Treasury Office of Foreign Assets Control or OFAC. In this issue Ms Celia Desmond of IEEE Technical Activities Board summarizes the OFAC issue and how it was resolved. We can all benefit by being aware of these activities and how our IEEE has been responding to such global issues.

Aachen Meeting Minutes

Officers			
President Operations V.P. Meetings V.P. Treasurer Senior Past President Junior Past President Division II Director		Dean Patterson Ron Harley F. Dong Tan Steven Leeb Philip Krein Thomas Habetler Philip Krein	
Members at Large (and terms)			
2002-2003-2004		2003-2004-2005	
Hirofumi Akagi Frede Blaabjerg Johann Kolar David J. Perreault Jose Rodriguez Keyue Ma Smedley		Issa Batarseh Jan (Braham) Ferreira Shu-Yuen (Ron) Hui, Pallab Midya Istvan Nagy Alex Stankovic	
2004-2005-2006			
Maria Cotorogea Pfeifer Rik W.A. DeDoncker Paolo Mattavelli Hardus Odendaal Toshihise Shimizu Charles Sullivan			
Operations Committees			
Automotive Power Awards Chapter Development DC Systems TC Simulaton.Modeling & Control TC Constitution/Bylaws Education Activities ETTC Fellow Evaluation History Intersociety Liaison Long-Range Planning Membership/Publicity		John Shen Randy Frank Vassilios Agelidis Jose Cobos AntonelloMonti Shu Yuen (Ron) Hui Leon Tolbert Bill Goethe Thomas Habetler Enrico Santi Marcelo Simoes Philip Krein Sudip Mazumder	Motor Drives TC Newsletter Power Packaging Publications Rectifiers/Inverters TC Region 8 Liaison Region 9 Liaison Region 10 Standards Transactions Electronic Media Diagnostics TC Dist. Generation TC
Alfio Consoli John Miller Douglas Hopkins Alex Stankovic Fang Z.Peng Bruno Allard Gerardo Escobar Valderrama Tatsuo Sakai Alan Mantooth Daan van Wyk Grahame Holmes Gerard Capolino Liuchen Chang			
Meetings	F. Dong Tan	Telecomm Energy	Katsuichi Yotsumoto
PESC Steering	W. G. Hurley		Mark Jacobs
President's Committee			
Nominations		Thomas Habetler	
PELS Executive Office			
Executive Director		Robert Myers	PELS Office Lee Myers

Guests: Patrick Chapman, University of Illinois, Tom Jahns, Past President, Ralph Kennel, PESC'04 Technical Program Chair

President Dean Patterson convened the meeting at 9:10 a.m. at Kasteel Bloemendal in Vaats, The Netherlands, near Aachen. He began with a round of self-introductions. Minutes for the AdCom meeting of 22 February, 2004, in Anaheim were approved as was the agenda for this meeting. Patterson confirmed appointment of a new Region 9 liaison – he is Gerardo Escobar Valderrama of Mexico, replacing Miguel Velez-Reyes.

MOTIONS

- Adopted a program to package PELS Transactions, conferences and workshops into two separate packages, one to be free to members and one with an extra fee in electronic format and authorized the President to proceed with implementation.
- Accepted a budget for APEC'05 and approved an APEC operating report.
- Approved technical sponsorship for ISPSD, UPEC and Norpie conferences.
- Agreed to the concept of a joint conference with IAS in 2009 to replace PESC and the IAS Annual Meeting.
- Authorized the editor of the Newsletter to increase pages for an issue to accommodate editorial and advertising needs.
- Asked that a certificate of appreciation be prepared and presented to Pat McGoldrick for his work with the PELS webpage.
- Approved an expenditure of \$260,000 to be the permanent sponsor of the proposed William E. Newell IEEE Technical Field Award.
- Established an award for continuing excellence for PELS chapters to be given as circumstances warrant.
- Appointed five new Distinguished Lecturers and replaced one of them, Rik DeDoncker, with Dean Patterson because presidential duties will keep DeDoncker fully occupied.
- Approved revisions to PELS Constitution and Bylaws.

PRESIDENT'S REPORT

Patterson reported on developments at the IEEE Technical Activities Board meetings in Kansas City the past week and announced that Institute income had increased dramatically and the financial ship appears to have been righted. He said the Society has a present reserve of \$1.5 million. Societies which planned well are all right financially, Patterson said, while others are still burdened. He said circumstances will change as new publishing procedures are implemented with an adjustment of both income and expenses as the Institute moves away from print and concentrates on electronic products.

Conference publications are moving rapidly to electronic format and access to the IEEE Xplore programs has grown with more than one million documents in the pro-

gram's data base, Patterson reported.

Patterson reported on his program to establish electronic access to PELS transactions, conference records and electronic letters as a service to members. IEEE, he said, has agreed to his plan. Two packages are planned – 1. Transactions and Letters and PESC conferences and 2. All other sponsored conferences and workshops (initially APEC, PESC, INTELEC, IEMDC, COMPEL, TPEL, WPAT, and SDEMPED). **MOTION: Tom Habetler moved adoption of the program**, Krein seconded and the motion was approved. Patterson said IEEE will require a charge for the second of the two packages and suggested an unspecified ceiling on any charge to members for publications dating back to the first electronic records in 1988. The concept was approved in principle and the President asked that discussions of financial implications be held via email. He said preliminary reports have estimated the cost between \$7,000 and \$12,100 per subscriber based on an IEEE recommendation. **MOTION: Krein moved to authorize the President to proceed with development of electronic packages.** After a second, the motion was adopted.

In another development, the Intelligent Transportation Systems Council has become a Society. Patterson said there is no conflict with the Vehicular Technology Society because the latter has shifted its emphasis to mobile and wireless communications.

DIVISION II DIRECTOR

Krein reviewed highlights of the IEEE Board of Directors meeting earlier in the week and said he is trying to encourage societies to better manage their reserves. After some big deficit years in the early 2000s, the deficit was small in 2003 and 2004.

He outlined the changes in the Book Broker program and the new procedures for buying and using electronic media from conferences. IEEE will purchase a CD ROM from a conference and will not charge the societies if print copies are required. Conferences are suggested to budget \$1,000 as a Book Broker royalty and \$1,000 for production of CD ROMs.

OPERATIONS

Ron Harley introduced a list of sitting chairs of PELS technical committees and said he is reviewing activities.

- TC on Transportation Power Electronics
John Shen
Johnsengin@mail.ucf.edu
- TC on DC Power Supply Systems
Jose A. Cobos
Cobos@upmdie.upm.es
- TC on Electronic Transformers
Bill Goethe
Scjx12a@prodigy.com
- TC on Motor Drives
Alfio Consoli

Aconsoli@diees.unict.it

- TC on Power Packaging
Douglas Hopkins
d.hopkins@ieee.org
- TC on Rectifiers and Inverters
Fang Peng
Fzpeng@egr.msu.edu
- TC on Simulation, Modeling & Control
Antonello Monti
Monti@engr.sc.edu
- TC on Education
Leon Tolbert
tolbert@utk.edu
- TC on Telecommunications Energy
Mark Jacobs; W. B. "Bill" Brecht
igjacobs@earthlink.net,
bbrecht@trojanbattery.com
- TC on Diagnostics
Gerard Capolino
gerard.capolino@u-picardie.fr
- TC on Distributed generation
Liuchen Chang
lchang@unb.ca

MEETINGS

PESC 09 – Habetler outlined a proposal to combine PESC and sessions of the IAS Annual Meeting in 2009 in an Energy Conversion Congress – designed to replace both the Annual Meeting and PESC at least in 2009 and perhaps in other future years. The two societies would be 50-50 partners in the Congress with co-chairs from each society. Discussions centered on location in Kansas City or Cincinnati in the latter part of September or early October. Habetler said Mark Nelms has agreed to handle finance and Jerry Hudgins is taking a major role in negotiations between PELS and IAS.

CONTINUING PROGRAMS

Energy Challenge – Organization and programs for the 2005 competition are under way.

A two-day workshop is planned for Seattle in October during the IAS Annual Meeting. The Power Engineering Society, a sponsor the first three competitions, will withdraw for 2007 to concentrate on other student activities.

PESC'05 Steering – Habetler, reporting for Ger Hurley, said the PESC Steering Committee had a long discussion of the conference fee and paper policy, a result of the multi-paper fee charged by PESC'04. He said the committee adopted a policy specifying one full registration must be associated with every paper (a change from any kind of registration) with no limitation or surcharge for additional papers.

PUBLICATIONS

Transactions – Frede Blaabjerg presented the transactions report in the absence of Daan van Wyk. He reported more than 700 papers have been received since the first of the year. The turnaround time from sub-

continued on page 9

APEC® 2005

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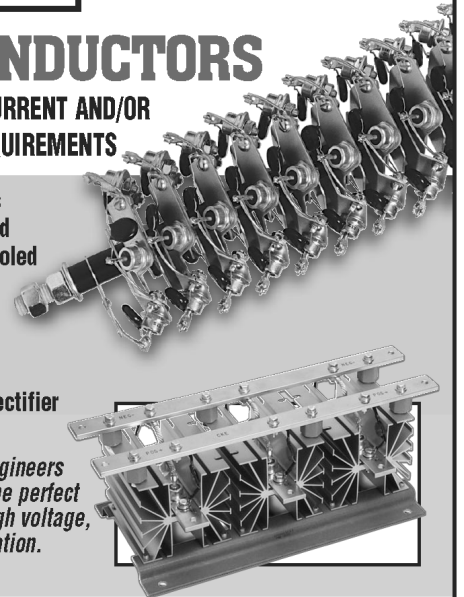
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COMPEL'04 Review

By Phil Krein



The 2004 IEEE Computers in Power Electronics Workshop (COMPEL'04) drew more than 50 international researchers in digital control, computer simulation and design tools, real-time power converter operation via microprocessors, and other computer applications. The workshop, held at the University of Illinois at Urbana-Champaign,

was larger than most previous meetings. About 40 papers were presented over three days, with panel discussions associated with each presentation session. A highlight of the workshop was an evening discussion session on "Sampling and Switching in Power Electronics: Fallacies and Realities of Nyquist Rates in Power Conversion." Panelists there showed that switching does not necessarily imply a sampling effect. The common notion that power converter controls can function only up to half the switch-

ing frequency is not based on a Nyquist constraint but rather on an engineering need to manage aliasing effects. As is traditional for COMPEL, the proceedings are completed after the workshop has concluded. The proceedings will be available later this year through the IEEE catalog system.

*Prof Phillip Krein
IEEE Division II Director
pkrein@ieee.org*

The 8th IEEE Workshop on Power Electronics in Transportation



WPET 2004

Sponsored by IEEE Power Electronics Society & IEEE Southeast Michigan Section
In collaboration with IEEE Vehicular Technology Society & Society of Automotive Engineering (SAE)

October 21-22, 2004

(Immediately after Automotive Electronics Convergence Conference 2004)

Sheraton Detroit Novi

Novi, Michigan, U.S.A.

POWER THE FUTURE OF VEHICLES!

The 8th biennial IEEE Workshop on Power Electronics in Transportation (WPET2004) will be held on Thursday-Friday, October 21-22 in the Detroit area at the Sheraton Detroit Novi. Sessions will discuss electrical machines and control, inverters and converters, devices and EMI, and system and testing. The keynote luncheon speaker on Oct 21 will be Dr. Anand Sankaran from Ford Motor Company who will present "Power Electronics in the Hybrid Escape: Challenges and Success."

Please join us at this biennial event to:

- Learn more about the latest development in automotive power electronics
- Participate in the informative and stimulating panel discussion on emerging and enabling technologies
- Meet and network with peers from OEMs, suppliers, government, and universities.

For more information on the technical programs and registration procedure, please go to
<http://www.engin.umd.umich.edu/ECE/~WPET/>

Or contact Dr. John Shen at 407-823-0379 or johnshen@mail.ucf.edu.

Power Electronics Letters Summary

By Phil Krein



The IEEE Power Electronics Letters electronic publication is now in its second year. There are 14 papers published in the first two 2004 issues. Issue 1 includes two proposed methods for photovoltaic maximum power point tracking, a method for determining grid impedance for improving active filter performance, a modulation modification to provide control of the neutral-point voltage in a three-level, three-phase, clamped-neutral inverter, a current estimation method suitable for dc-dc converters in discontinuous mode, a characterization of output distortion in multi-level inverters,

and an integrated magnetics design that cascades buck and push-pull dc-dc topologies. Issue 2 includes a multi-solution approach to harmonic elimination switching control, an active filtering method suitable for common-mode chokes, an approach for digital phase control in resonant inverters, a thyristor-based method for controlling field weakening in surface permanent magnet machines, a coupled inductor design that alleviates the right-half-plane zero challenge in boost dc-dc converters, a quadratic switching boundary control method that yields high performance buck dc-dc converters, and a digital compensation technique that allows a digital switching audio amplifier to achieve distortion levels of 0.006% without an outer analog feedback

loop. The associate editors have worked diligently to make the publication process quick: the average paper in these issues was in process 14 weeks from the day of submission to the day the complete manuscript was delivered to IEEE Publications for formatting and posting. We encourage your submissions. Please see information on the PELS web site, <http://www.pels.org>, for details. PELS members can subscribe to the electronic version for US\$10 per year. (Editor comment: please note that beginning in 2005, all PELS members will receive a free subscription to IEEE Power Electronics Letters as an additional service to members).

*Prof. Phillip Krein
IEEE Division II Director
pkrein@ieee.org*

Continued from page 5

mission to notification is averaging six months, a vast improvement over five years ago. Blaabjerg said to reduce publication time by more requires the strengthening of references. Krein suggested consideration of a move of the transactions to Manuscript Central at an initial setup charge of \$10,000 and an annual operating fee of \$10,000. He said Manuscript Central would result in a reduction of expenses over current budgets. **ACTION: van Wyk will be asked to seek full information from Manuscript Central.** There was one comment that any change might take place when van Wyk steps down as editor.

Electronic media – Grahame Holmes and Pat McGoldrick have managed the PELS website for about two years and with the completion of negotiations to move the hosting function to IEEE, they will be stepping down. Moving the hosting requires a change in many formats and files but Holmes said McGoldrick is about to com-

plete alterations and the transfer should be ready for implementation in several weeks. Holmes said the website needs major upgrades of content and graphics and a new webmaster needs to step in and make the changes.

Krein said there are two generally independent functions that require two persons in the webmaster program- 1. Electronic media editor to design and implement pages and links, and 2. One who can interface with INTELEC and its needs and links. Formation of a web committee was proposed with Issa Batarseh suggested as one member.

AWARDS The elevation of the William E. Newell award to a technical field award was reviewed with Patterson introducing material from Awards Chairman Randy Frank specifying that a selection committee will be appointed and supervised by IEEE. This would mark a change from the Society practice the past several years of naming alternating past winners of the Newell as a selec-

tion committee. Patterson said PELS would have input but not the final decisions. Krein recommended codifying the nominations process developed by Chris Riddleberger and adapting it to IEEE guidelines.

The award will carry a cash prize of \$10,000 and become the IEEE technical field award for power electronics, a move that would expand the scope of potential recipients beyond the membership of PELS. Two financing approaches are available for field award 1. establishment cost of \$23,000 the first year and \$13,000 for each year thereafter or 2. \$260,000 to fund the award in perpetuity

Constitution/Bylaws – Ron Hui reviewed revisions to the PELS Constitution and Bylaws sent to members with the required 30-day notice. Major changes included Society-wide voting for at-large AdCom candidates, establishment of a position of President-Elect and two-year terms for officers who will continue to be elected by AdCom members.

OFAC – Background

Provided by the IEEE Transnational Committee

Note: On 2 April 2004, IEEE received a ruling from OFAC that resolved U.S. embargo-related publishing issues for the IEEE. The decision confirmed IEEE's argument that its entire scholarly publishing process is exempt from OFAC restrictions. IEEE immediately resumed its normal publication process, including copy and style editing, for authors worldwide. IEEE is now focusing its resources on an assessment of unresolved membership issues to determine those that may require further clarification from OFAC.

One of these unresolved issues is restrictions on scholarly collaboration. IEEE President Arthur Winston reported at the June, 2004 Board of Directors' meeting that "this concerns IEEE because it is a membership issue that transcends publication authorship and could be seen to inhibit a broad range of activities that are normally associated with participating as a member of a professional society."

The information below provides the background leading up to the April 2004 OFAC ruling and the current status of issues affecting membership.

OFAC stands for United States Department of the Treasury's Office of Foreign Assets Control (OFAC). In 2001 IEEE, during a transfer of funds for a conference to be held in Iran, was informed by a financial institution that the transfer could not occur due to OFAC restrictions. IEEE researched OFAC embar-

goes and found that they could impact our normal business operations including member services and publishing activities for individuals in certain countries. Needless to say, IEEE was not at all pleased with this knowledge, so staff and volunteers have been actively working with the US government and the publishing industry to determine what needs to happen to allow us to continue our business as usual.

With knowledge of the embargoes, IEEE informed members residing in, Cuba, Iran, Libya and Sudan — countries sanctioned by OFAC — that, because of OFAC regulations, those members would not be able to take advantage of member benefits and services; only print subscriptions to IEEE publications could be provided with membership.

Certain aspects of editing of papers and manuscripts submitted to IEEE publications also were affected by these regulations. So, in December 2002, IEEE sent a request for OFAC to exempt its entire publishing process. After many months of discussions and providing additional information to OFAC, on 30 September 2003, OFAC confirmed that IEEE could publish articles from authors in Iran and that the IEEE peer review process was entirely exempt from the Iranian embargo rules. But OFAC also said IEEE needed a license for editing. On 6 October 2003, IEEE provided supplemental information to OFAC, reiterating our position that the entire publishing process for authors in all

embargoed countries should be exempt. At the same time, IEEE also requested that OFAC issue a license to enable us to carry on our normal publication process if an exemption was not possible. After the ruling, IEEE continued to receive papers, send them to editors and reviewers for peer review and publish those that met its publication standards without style and copy editing.

While awaiting the decision about the October request, IEEE took a leading role to help other scholarly publishers understand its experience with OFAC regulations by organizing a special summit of scientific, technical and medical publishing organizations, which was held on 9 February 2004 in Washington, D.C. At that meeting, David Mills, OFAC chief of licensing, encouraged the groups represented to work together to help OFAC better understand the academic peer review process.

After the meeting, IEEE continued discussions with OFAC. On 2 April, IEEE received the ruling mentioned at the note at the top of this document that exempted our entire scholarly publishing process from OFAC restrictions. IEEE has been the subject of a number of news stories worldwide during recent months about this issue. Since many of these stories contain inaccurate information, IEEE has been communicating the facts on the IEEE OFAC web page at <http://www.ieee.org/ofac>.

Please continue to monitor this Web page for updates to all aspects of this situation.

Emerging Silicon-Carbide Power Devices Enable Revolutionary Changes in High Voltage Power Conversion

By: Allen Hefner, Ranbir Singh, Jason Lai

INTRODUCTION

Recent breakthroughs in Silicon Carbide (SiC) material and fabrication technology have led to the development of High-Voltage, High-Frequency (HV-HF) power devices with 10-kV, 15-kHz power switching capability. Programs are underway to demonstrate half-bridge modules with 15-kV, 110-A, 20-kHz capability in the next few years. The emergence of HV-HF devices with such capability is expected to revolutionize utility and military power distribution and conversion by extending the use of Pulse Width Modulation (PWM) technology to high voltage applications.

Wide bandgap semiconductors such as SiC have long been envisioned as the material of choice for next generation power devices [1]. Although wide bandgap semiconductor materials have superior properties, the realization of power device quality substrates and fabrication technologies required overcoming many technical challenges. The rapid advances in single crystal SiC over the last decade have ushered in a new era of wide bandgap power semiconductor devices. In 2004, Dr. Calvin Carter of Cree Inc. received the US National Medal of Technology from President George W. Bush for: "his exceptional contributions to the development of Silicon Carbide wafers, leading to new industries in wide bandgap semiconductors and enabling other new industries in ... more efficient/compact power supplies, and higher efficiency power distribution/transmission systems."

Currently, there are significant efforts underway to accelerate the development and application insertion of the new HV-HF SiC devices needed for commercial and military power conversion and distribution applications. The goal of the ongoing Defense Advanced Research Projects Agency (DARPA) Wide Bandgap Semiconductor Technology (WBST) High Power Electronics (HPE) program directed by Dr. John Zolper is to develop 15-kV class power semiconductor devices enabling future electric ship, more electric aircraft, and all electric combat vehicles. DARPA is particularly interested in developing the power electronics device technology deemed necessary to enable 2.7 MVA Solid State Power Substations (SSPS) for future Navy warships.

The benefits of HV-HF semiconductor technology have also been identified by the

Electric Power Research Institute (EPRI) including advanced distribution automation using solid-state distribution transformers with significant new functional capabilities and power quality enhancements. In addition, HV-HF power devices are an enabling technology for alternative energy sources and storage systems. The emergence of HV-HF power devices presents unique opportunities and challenges to the power electronics industry in specifying the device requirements and establishing PWM converter topologies for high voltage applications.

HIGH VOLTAGE POWER CONVERSION APPLICATIONS

Figure 1 shows the application ranges for the majority of power semiconductor devices indicating shaded areas where SiC is likely to have an impact in the near future. Generally the power device market size decreases with increasing voltage and current requirement. Presently the market size for the relatively lower voltage and current **Power Supply** area is several times larger than for all other applications combined with device sales of approximately \$5B/year. For higher voltage applications such as **Motor Control** and **Traction**, the device current requirements typically increase as the voltage requirement increases due to the large power requirements in these applications. An exception to these trends is in the power distribution area where the **HV-HF Power Conversion** would require devices for a wide range of current ratings and the market size could be relatively large. However, the HV-HF Power Conversion market has not yet developed due to the 6.5 kV voltage limit and slow switching speed of high voltage Silicon power devices.

Over the last two decades, PWM power conversion technology, with its superior efficiency and control capability, has changed the way power is converted in almost all low

and medium voltage power conversions applications from 100 V to 6.6 kV. Due to fundamental limitations of Silicon devices, the on-resistance increases and switching speed decreases as the blocking voltage requirement is increased. The switching speeds in low voltage power supplies are as high as several MHz and decrease to several kHz for high power traction. The higher on-resistance and slower switching speed increase losses and limits applicability of PWM for high power and utility applications.

The developments of Silicon IGBTs over the last decade have enabled high frequency power conversion to be used at increasingly higher power levels. Recently SiC power Schottky diode products have also been introduced that increase switching speed capability by reducing diode reverse recovery loss. It is expected that SiC power devices will continue to aid the evolution of increasing PWM frequency and power levels in the **Power Supply** and **Motor Control** areas as SiC Schottky diode and MOSFET products are introduced with higher voltage and current ratings. Because SiC devices have the capability to increase the voltage beyond that of Silicon into the 10 kV through 25 kV range with much higher switching speed for a given blocking voltage, they provide the revolutionary potential to extend high

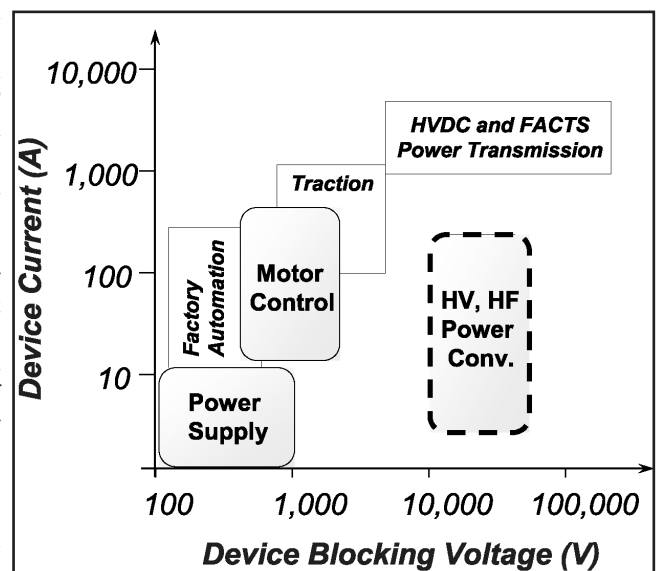


Figure 1. Application ranges for the majority of power semiconductor devices indicating shaded areas where SiC is likely to have an impact in the near future.

frequency PWM switching power conversion into the relatively large volume application area of utility **HV-HF Power Conversion**.

Recent EPRI reports (1001698, 1002159 – see www.epri.com for abstracts) concluded that a solid-state distribution transformer, referred to as the Intelligent Universal Transformer (IUT), would add significant new functional capabilities and power quality enhancements to those available from conventional copper and iron transformers. The IUT is expected to be a cornerstone device in advanced distribution automation (ADA). A more recent EPRI report (1009516) identified SiC power devices as the solution for the HV-HF semiconductor devices needed for the IUT and estimated that **HV-HF Power Conversion** could represent a relatively large segment of the power semiconductor market.

A major driving force spearheading the development of HV-HF power devices is the ongoing DARPA WBST HPE program focused on developing the technology deemed necessary to enable a Solid State Power Substations (SSPS) for future Navy warships. Current distribution approaches being considered for the next generation of aircraft carriers and destroyers employ a 13.8 kV AC power distribution that is stepped down to 450 V AC by using large (6 ton and 10 m³) 2.7 MVA transformers. Substantial benefits in power quality enhancement, advanced functionality, size, and weight are anticipated by replacing this transformer with an all solid state design.

Figure 2 shows an example three level [2] solid state transformer indicating various secondary output options (EPRI reports 1001698). The transformer consists of, from left to right, a high voltage active front end (AFE) rectifier stage, a three level dc link, a high voltage inverter, a high frequency high voltage transformer, low voltage rectifiers, and various output modules such as a DC/DC converter, 400 Hz AC inverter, and various voltage level 60 Hz AC inverter outputs. The AFE rectifier stage provides a flexible utility interface with power factor correction. The high voltage inverter provides high frequency AC required to reduce transformer size and provides power quality voltage regulation functions. Both the AFE rectifier and high voltage inverter require HV-HF semiconductors; for example a single phase 13.8 kV, 15 kVA residential distribution transformer with 8 kV line to neutral requires semiconductors devices to switch at 15 kV, 3 A and the three phase 2.7 MVA SSPS requires devices to switch at 15 kV, 160 A.

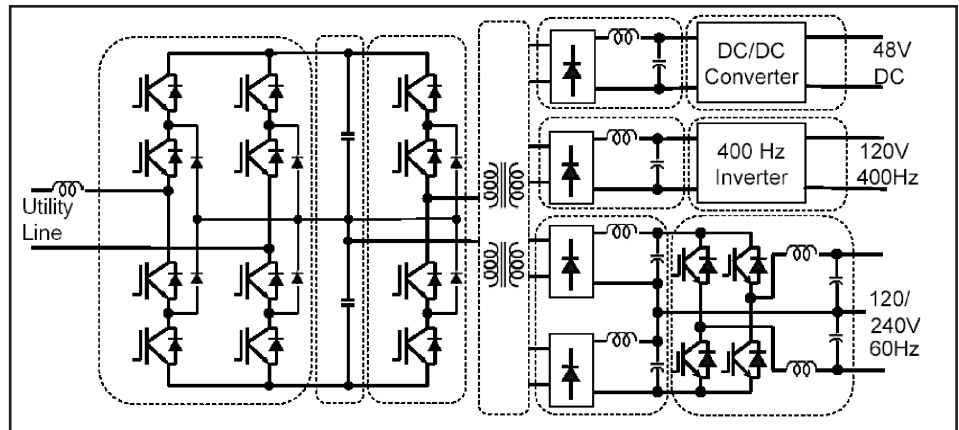


Figure 2. Example three level solid state transformer indicating various secondary output options.

RECENT PROGRESS IN HV-HF POWER DEVICES

Table 1 compares the basic material properties of Si and SiC. The wider bandgap of 4H-SiC results in higher operating temperature capability and better tolerance to heating during fault conditions. The primary advantage of 4H-SiC for power devices is that it has an order of magnitude higher breakdown electric field. For a given blocking voltage requirement, the higher breakdown electric field allows the design of SiC power devices with thinner (0.1 times that of Silicon devices) and more highly doped (more than 10 times higher) voltage-blocking layers. For majority carrier power devices, such as power Schottky diodes or MOSFETs, the combination of 0.1 times the blocking layer thickness with 10 times the doping concentration can result in a factor of 100

advantage in on-resistance. For conductivity modulated devices such as PiN diodes or IGBTs, SiC results in a factor of 100 faster switching speed due to the lower lifetime required to conductivity modulate the thinner blocking layer.

Because the SiC material provides a much lower on-resistance than Silicon, conductivity modulated Silicon devices can also be replaced by majority carrier SiC devices with faster switching speed [3]. For example, new SiC Schottky diode commercial products have recently been introduced [4,5] to replace slower conductivity modulated Silicon PiN diodes. Although these first SiC power device product offerings have been low voltage (300 V to 1200 V) Schottky diodes, the HV-HF devices discussed below break the Silicon voltage capability limit and will be a key enabling technology of the future.

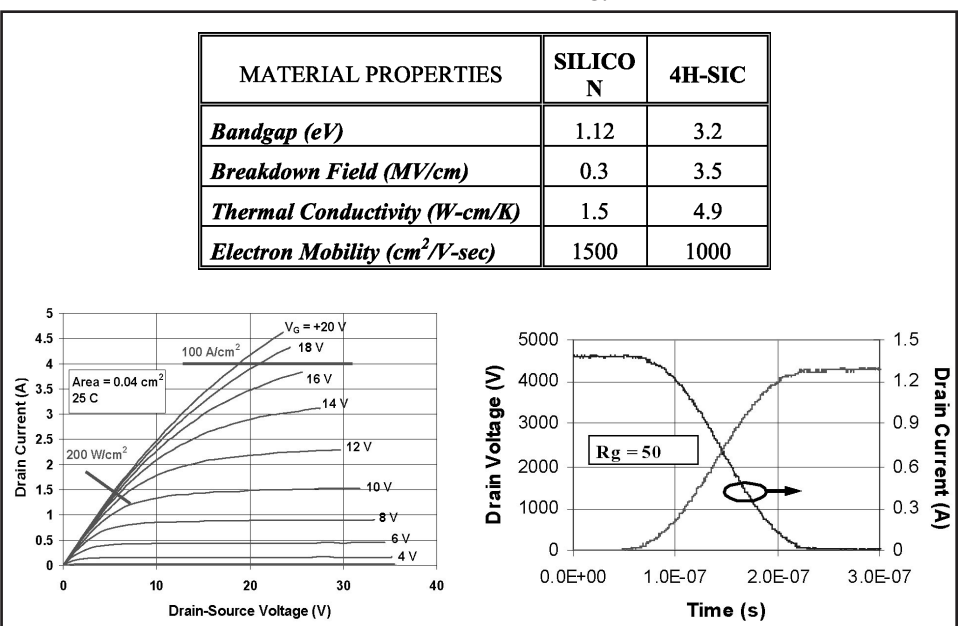


Figure 3. SiC 10 kV power MOSFET: (a) current voltage characteristics and (b) switching waveforms.

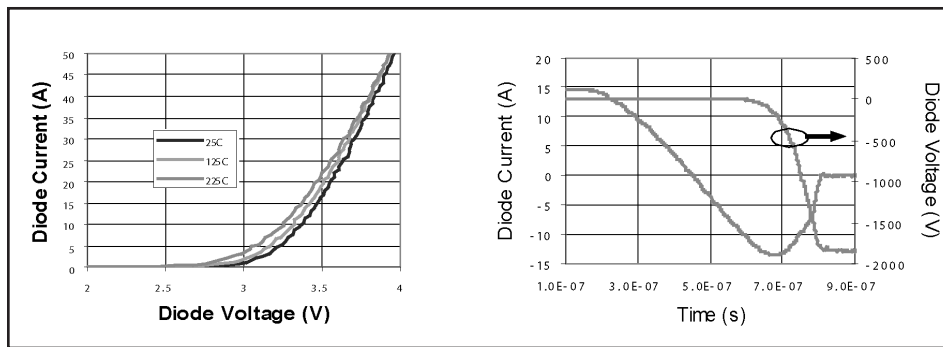


Figure 4. SiC 10 kV PiN diode: (a) current voltage characteristics and (b) reverse recovery characteristics.

Figure 3a shows the output current voltage characteristics of a 0.04 cm² 10 kV 4H-SiC power MOSFET [6]. The continuous current capability of 1.5 A indicated on the figure is determined using the 200 W/cm² power dissipation capability of typical power device packages. The 4.6 kV bus, 1.3 A switching waveforms for this device shown in Figure 3b indicate a 100 ns switching time for the gate resistance of 50 Ohm resulting in a 0.3 A peak gate current. The measured turn-on and turn-off switching energy for this conditions is approximately 0.15mJ resulting in a switching power loss of 112 W/cm² at 15 kHz. The static power loss for 50% duty cycle and the 1.3 A is approximately 75 W/cm². Thus this device can operate with a 4.6 kV bus, 50% duty cycle, and 15 kHz in a typical 200 W/cm² power package. The on-state voltage and switching parameters indicate that the devices are well matched for paralleling or large area die.

Figure 4a shows the forward conduction characteristics at different temperatures for a 0.5 cm², 10 kV SiC PiN diode indicating a continuous current rating of approximately 30 A (60 A/cm²) [7]. The SiC PiN diode forward conduction characteristics only have slight temperature dependence where the current increases with temperature in the lower current range and decreases with temperature in the high current range. Thus the

device should share current well when paralleled in a high current module. Reverse recovery characteristics for the 10 kV, 0.5 cm² SiC PiN diode are shown in Fig. 4b. The reverse recovery time is 200 ns. This 10 kV SiC diode has a better on-state voltage to reverse-recovery time tradeoff than commercial Si 5 kV diodes and there are no Si diodes with 10 kV blocking capability. Thus, these devices represent a revolution in rectifier performance and capability for high voltage, high frequency power conversion applications.

CONCLUSIONS

The emergence of HV-HF devices is expected to revolutionize utility and military power distribution and conversion by extending the use of PWM technology to high voltage applications. SiC power MOSFETs with 10 kV, 1.5 A, 15 kHz switching capability and PiN diodes with 10 kV, 30 A, 200 ns reverse recovery time have already been demonstrated. The DARPA WBST HPE program is expected to develop half-bridge modules with 110 A, 15 kV, 20 kHz capability in the next few years. The emergence of HV-HF power devices presents unique opportunities and challenges to the power electronics industry in specifying the device requirements and establishing PWM converter topologies for high voltage applications.



Allen R. Hefner Jr. (IEEE Fellow) received the B.S., M.S., and Ph.D. degrees in electrical engineering from the University of Maryland in 1983, 1985, and 1987 respectively. He joined the Semiconductor

Electronics division of the National Institute of Standards and Technology in 1983. Currently, he is the Project Leader for Power Devices and Thermal Measurements Project and the Embedded Sensor System-on-a-Chip Project. His research interests include characterization, modeling, and circuit utilization of power semiconductor devices and MEMS-based integrated sensor System-on-a-Chip technologies.



Ranbir Singh (IEEE Member) received the B. Tech degree from Indian Institute of Technology, N. Delhi, India in 1990 and MS & Ph.D. degrees from North Carolina State University in 1992 and 1997 respectively, all in

Electrical Engg. He has been conducting research on SiC power devices first at Cree Inc. in Durham, NC from 1995 to 2003, and since then at the National Institute of Standards and Technology, Gaithersburg, MD. His interests include the development and understanding of a wide range of SiC power devices including MOSFETs, IGBTs, field controlled thyristors, JBS, PiN and Schottky diodes.

ACKNOWLEDGEMENTS

Contribution of the National Institute of Standards and Technology; not subject to copyright. The device results presented here were developed by Cree Inc. with support from Dr. John Zolper at DARPA under ONR contract N00014-02-C-0302 monitored by Dr. Harry Dietrich.

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Jih-Sheng (Jason) Lai (IEEE Senior Member) received the Ph.D. degree in electrical engineering from the University of Tennessee, Knoxville. He joined Virginia Polytechnic Institute and State

University in 1996. Currently, he is a Professor and the Director of the Future Energy Electronics Center. His main research areas are energy related power electronics and utility power electronics interface and application issues.

Fully integrated milliwatt power converters on silicon



By: Patrick L. Chapman

University of Illinois at Urbana-Champaign

1406 W. Green St.

Urbana, IL 61801

(217) 333-4694

In recent years there have been many papers on the subject of integrated or monolithic converters. Typically, these converters involve mixed discrete and IC semiconductors embedded and tightly coupled to achieve very high power density with respectable efficiency. Such converters are ordinarily capable of a few watts or more and have wide application. Less well established of these "integrated" converters are low power converters (< 1 W or even < 100 mW) that are entirely on silicon integrated circuits.

Such low power levels will be unimportant to some power electronics engineers, however, a number of applications can benefit from efficient, embedded conversion at these levels. Analog and digital circuits for portable electronics, for example, continue to show reductions in power consumption compared to functionality. Larger ICs, with higher power drain, can potentially benefit from distributed power management within the chip (as illustrated in Fig. 1). On the left, more conventional external power converters are used to control large subcircuits in the IC load. The converters have feedback that can only react to changes sensed at the load terminals. On the right, the power converters are brought completely on board and are distributed to control a number of subcircuits. The IC core controls the subcircuits and gives the converters information for anticipatory control. These small converters would operate at very high frequency compared to linear regulators and have low value capacitances, meaning they would have very rapid dynamic response. The anticipation of load transients should allow use of even less energy storage, thereby further increasing the speed and reducing the size of the converters. Power management would be taken to a new level as the IC functions can be closely coordinated with converter control. Since these converters would have very low energy storage they could be turned on or off very rapidly, enabling greater control over power management of individual subcircuits [1-2].

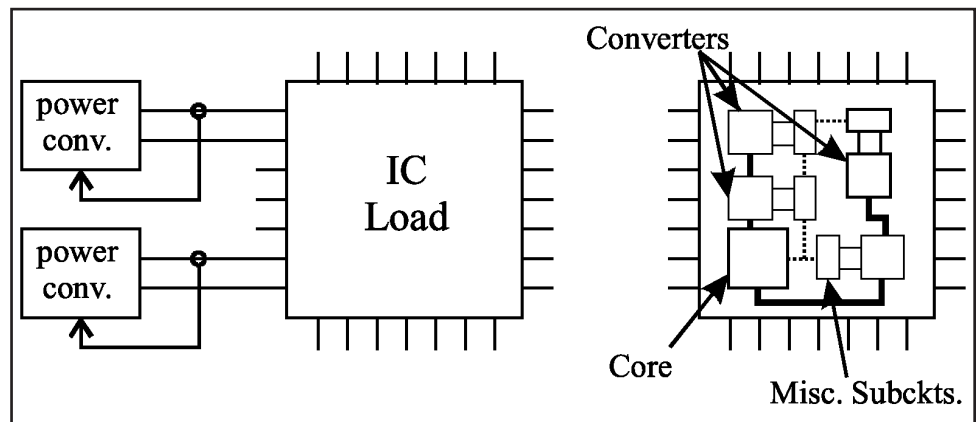


Fig. 1: Comparison between ordinary external power control (left) and integrated, distributed power management (right).

Recent research is showing that monolithic converters in this power range can be completely fabricated on silicon (power switches, control, and passive components) [1-4]. This article briefly discusses some of the challenges, advances, and needs for this area of research and development.

Lateral MOSFETs

The target applications will typically be IC loads, often with battery power, and thus the voltage levels are very low and achieving low power consumption is paramount. As such, there is no need to use vertically integrated MOSFETs. Ordinary lateral enhancement-mode MOSFETs are easier to fabricate and can withstand the low voltage. Better tradeoff is available between on-state resistance and device capacitance (gating and switching loss). Switch design is relatively straightforward yielding an advantage for silicon integrated design. This advantage is mitigated by the difficulty of passive design discussed next.

IC Inductors

Most practical dc-dc converter designs involve inductive and capacitive components. While capacitors on chip do require careful design and consideration, they have well-established CMOS-compatible design techniques and are regularly used in certain analog and RF circuits. Chip inductors have

been investigated extensively for RF circuits and but only recently for power circuits. Due to the relative difficulty of building miniature inductors compared to macroscale inductors, few alternatives exist. The most straightforward designs involve planar spirals, rather than three-dimensional structures.

The key difference in chip inductors for power converters versus RF circuits is the need for low dc resistance. Both applications require high quality (the RF having typically lower inductance but much higher frequency) and adequately high self resonant frequency. This forces a direct trade-off with the self resonant frequency, as when the dc resistance is lowered, the cross sectional area of the inductor increases. The increase in area increases capacitance, and thus lowers the self resonant frequency. Ultimately, excessive chip area is used or efficiency greatly suffers [3].

Given that ordinary, scaled-down versions of macroscopic inductors are not practical to build on chip, and that standard planar designs do not address the simultaneous problem of low dc resistance and high self resonant frequency, a hybrid approach warrants consideration. The idea is to build spiral inductors that have some 3-D properties. They are built as thick as possible to lower the dc-resistance (or decrease planar area) and are removed enough from the substrate to mitigate the worst of the capacitive effects.

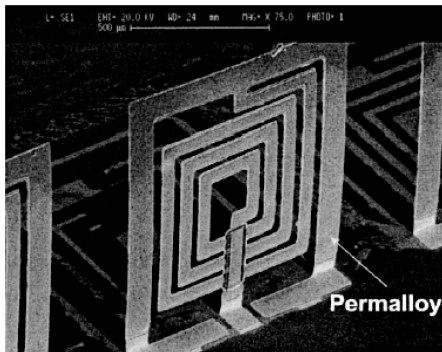


Fig. 2: Example of 3-D inductor on chip using plastic deformation magnetic assembly [5].

One method of accomplishing this is with CMOS-compatible MEMS design. Fig. 2 illustrates a vertically displaced spiral inductor formed by plastic deformation magnetic assembly [4-5]. Notice that the inductor has minimal footprint, is positioned well away from the silicon to reduce eddy current, but would probably require special packaging. Testing revealed that the structure is surprising insensitive to vibration. Fig. 3 shows a horizontal spiral that is lifted far enough off plane to eliminate most of the capacitive coupling to the substrate. If sufficient spacing can be achieved to avoid eddy currents, it is possible to build the inductor in a parallel plane directly over the transistor circuits with minimal footprint and packaging considerations. Both 3-D and planar approaches rely on using deep-etch techniques to achieve a thick metal layer (> 10 microns). Both are compatible with CMOS as back-of-the-line processes. Interesting new CAD tools for CMOS may make at least the latter design appropriate for direct CMOS implementation [6]. Similar process techniques can result in high quality capacitors.

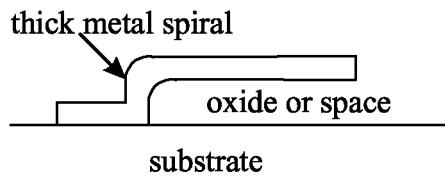


Fig. 3: Illustration of planar inductor on chip using MEMS assembly [].

A different family of inductors will result from interesting combined passive designs [7]. This approach combines the inductor and capacitor into one structure. This takes advantage of the natural capacitive tendency of planar inductors. A drawback is that not every converter can benefit from an integrated L-C circuit due to the connectivity. A challenge is to prove that the structure is not only more space and process efficient, but at least comparatively as high performance as constructing the components separately.

Remaining Challenges

The power-converter-on-silicon concept is interesting from a research point of view, but will require substantially more development to prove its worth to industry. While integration of the passives saves on pin count and board footprint, very inexpensive, high quality, surface-mount inductors and capacitors are readily available for the milliwatt power levels considered here. The external components resolve EMI issues that have not been addressed yet in most work on chip power inductors. Packaging may be problematic for various passives designs, particularly those that involve 3-D structures. CMOS fabrication facilities have substantial barriers to change in process that is likely to be required. Such barriers have obstructed widespread commercialization of MEMS devices. Control of fully integrated converters on silicon has not been studied in much detail. The integration of the converter with the load offers new control possibilities involving anticipation and prioritization previously not widely used.

If converters-on-chips are proven to be viable, many interesting problems remain. The whole issue of control is wide open. Multiple converters integrated on chip with distributed power management pose some challenges in power dispatch and supervisory control, while the low-power nature of the converter poses challenges in efficient circuit techniques to manage dynamics.

I hope you have enjoyed this article, and perhaps it has provoked some

thoughts on these issues. You are encouraged to contact me with questions or observations.

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Patrick L. Chapman (S '94, M '00) is Grainger Associate and Assistant Professor in the Department of Electrical and Computer Engineering at the University of Illinois at Urbana-Champaign. He holds the Ph.D. degree (2000) from Purdue University. He is a Chapter Chair the IEEE Power Engineering Society, an Associate Editor for IEEE Power Electronics Letters, and Associate Director for the Grainger Center for Electric Machines and Electromechanics. chapman@ece.uiuc.edu

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PSPB Approves New Guidelines for Handling Plagiarism Complaints

With so much research now available on the Web, and because the highly searchable nature of electronic content has made it easier to detect unacknowledged copying of original text, the number of reported incidents of alleged plagiarism has been growing. The PSPB Operations Manual now provides helpful and detailed guidelines for identifying and handling instances of plagiarism.

On 18 June 2004, the IEEE Publications Products and Services Board approved new policies and procedures on plagiarism. Specifically, section "8.2 Publication Guidelines" of the PSPB Operations Manual now contains a major new section entitled "Guidelines for Adjudicating Different Levels of Plagiarism." The purpose of this new section is to define 1) plagiarism, 2) five levels or degrees of plagiarism and 3) appropriate corrective actions that correspond to each level of misconduct.

IEEE defines plagiarism as the reuse of someone else's prior ideas, processes, results, or words without explicitly acknowledging the original author and source. It is important for all IEEE authors to recognize that plagiarism in any form, at any level, is unacceptable and is considered a serious breach of professional conduct, with potentially severe ethical and legal consequences.

Equally important to the process of recognizing an act of plagiarism is clarifying who shall be responsible for responding to any complaints of alleged plagiarism. The new guidelines specify that the person responsible for the IEEE publication (referred to generally as "the editor"), shall be responsible for conducting an investigation and determining if plagiarism has in fact taken place. In order to accomplish this critical task, the editor shall also appoint an independent committee of experts in the topic to help make a recommendation on the allegation. Emphasis is placed on the "independence" of the committee, in that the editor cannot be directly involved with the committee's investigation.

Of particular note are the new guidelines for cases involving papers from IEEE conference proceedings. Allegations of misconduct by authors of papers in conference proceedings shall be investigated by the conference publication chair, or by the Publication Officer of the IEEE organizational unit that sponsored the conference if the allegation is made after the publication of the proceedings.

Editors must also bring these efforts to the attention of the Vice President of the Publications Services and Products Board, both at the beginning of an investigation and after findings have been reached for final approval.

In addition, the new guidelines describe procedures for proper referencing of previously published material.

An official, updated version of the PSPB Operations Manual is now available at <http://a957.g.akamai.net/f/957/3680/1h/www.ieee.org/organizations/pubs/pab/opsmanual.pdf>. The new plagiarism guidelines appear in section 8.2 Publication Guidelines. (Editor Comment: Please refer any Comments/Response to Case ID: 0040F325 or Reply To: Pubs-Permissions@ieee.org attention of: William Hagen)

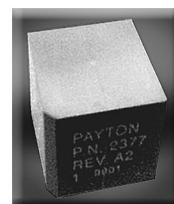
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PELS Awards Update: Nominations Sought for Society Awards

By Randy Frank

Awards Committee Chair



Time to start considering who could be a candidate for PELS' 2005 Awards. The William E. Newell Power Electronics Award, Distinguished Service Award, and the Richard M. Bass Outstanding Young Power Electronics Engineer Award.

The William E. Newell Power Electronics Award has been presented annually since 1977 for outstanding achievement in power electronics. It is presented by the Power Electronics Society and dedicated to the memory of Dr. William E. Newell of the Westinghouse Research and Development Center in Pittsburgh, Pennsylvania. The awardee has been judged to be outstanding in the multidisciplinary field of power electronics, which crosses the technical boundaries of a number of Societies of the IEEE. The recipient receives a suitably inscribed plaque and a cash award of \$5,000.

The Newell Award winner for 2004 announced at PESC 2004 is M Azizur Rahman.

The Distinguished Service Award honors long and distinguished service to the welfare of the Power Electronics Society at an excep-

tional level of dedication and achievement. The prize consists of an engraved plaque and a cash award of \$3,500. All members of the Power Electronics Society are eligible. Achievements by which an individual is judged to have made outstanding contributions to the Power Electronics Society encompass a broad range of activities over a substantial time period including, but not limited to, creative and invigorating leadership of the Society, exceptional administrative and managerial accomplishments on behalf of the Society, identification of new technologies within the scope of the Society and nurturing activities to support these emerging technologies, initiation of innovative programs to encourage wider participation in the full spectrum of Society activities, and the general communication and advocacy of power electronics technology to the technical community as a whole.

The Distinguished Service Award winner for 2004 announced at PESC 2004 is Arthur W. Kelley

The Richard M. Bass Outstanding Young Power Electronics Engineer Award recognizes outstanding achievement in the field of power electronics by an engineer less than 35 years of age. Since 1999, it is dedicated to the memory of Richard M. Bass of the Georgia Institute of Technology in Atlanta, GA, USA. The prize consists of a certificate, a cash award of \$1,500, and reimbursement for transportation expenses up to \$500 to attend the annual PELS Awards Ceremony. All IEEE members of any grade, active in the field of power electronics and less than 35 years of age on January 1 of the year of the award, are eligible. Candidates are judged for outstanding contributions encompassing a broad range of technical activities including research, innovative product design and application, teaching, and project leadership. The technical disciplines in the field of power electronics include the analysis, design, development, simulation and practical application of electronic devices, magnetics, controls and power circuits for inverters, converters and motor drives ranging in power level from fractions of a watt to megawatts.

The Richard M. Bass Outstanding Young Power Electronics Engineer Award winner for 2004 announced at PESC 2004 is Philip Carne Kjaer

The ballots for 2005 and more details about these awards are now on the PELS website. Ballots for next year's candidates must be received by January 15, 2005. The Awards Committee recommends that they be prepared and submitted before the holidays in December and January.

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Tom Jahns awarded 2004 Nikola Tesla Medal



IEEE Power Engineering Society has awarded the 2004 Nikola Tesla Medal to Prof. Tom Jahns of the University of Wisconsin – Madison "For pioneering contributions to the design and application of ac permanent machines." We extend our congratulations to Prof. Jahns and kudo's for his many contributions to a deeper appreciation of the interior permanent magnet machine.

Meetings of Interest

CIEP 2004, the 9th IEEE International Power Electronics Congress, will be held 17 – 20 October, 2004 in Celaya, Mexico. The IEEE Power Electronics Society is a co-sponsor. For additional information visit <http://www.itc.mx/ciep/ciep2004.htm>

ICPE'04, The 6th International Conference on Power Electronics, is scheduled for 18-22 October 2004 in Bexco, Busan, Korea and is sponsored by the Korean Institute of Power Electronics. Visit ICPE'04 web site: <http://www.icpe.or.kr>

WPET 2004, the 8th IEEE Workshop on Power Electronics in Transportation, will be held 21- 22 October, 2004, Cobo Conference and Exposition Center, Detroit, MI. WPET is sponsored by IEEE Power Electronics Society jointly with IEEE Southeast Michigan Section and in collaboration with IEEE Vehicular Technology Society and the Society of Automotive Engineers (SAE). For additional information email: johnshen@mail.ucf.edu.

IICPE 2004, The Second India International Conference on Power Electronics, will be held 21 – 22 December, 2004 in Mumbai, India. The IEEE Power Electronics Society is a technical co-sponsor. Visit <http://www.iicpe2004.com> for further information.

APEC 2005, Applied Power Electronics Conference, will be held 6-10 March, 2005 at the Austin Hilton, Austin, TX. APEC is co-sponsored by IEEE Power Electronics Society, Industrial Applications Society and PSMA the Power Sources Manufacturers Association. Visit the conference website at www.apec-conf.org for the most recent updates.

IEMDC'05, International Electric Machines and Drives Conference, is scheduled to take place 15 – 18 May, 2005 in San Antonio, TX. IEMDC'05 is co-sponsored by the IEEE Power Electronics Society. Submission of abstracts and digests due 29 Oct. 2004. For more information contact Prof. Hamid Toliyat at Texas A&M University, Toliyat@tamu.edu

PESC 2005, the 36th Annual IEEE Power Electronics Specialists Conference, will be held June 12-16, 2005 in Recife, Brazil. PESC is sponsored by the IEEE Power Electronics Society. A Power Electronics Education Workshop, PEEW'05 will be held June 16-17 immediately following PESC in the same venue. Contact Prof. Marcelo Simoes, mgs@mines.edu about PEEW'05

COBEP 2005 The 8th Brazilian Power Electronics Conference, to be held 14-17 June 2005, Recife, PE-Brazil. IEEE Power Electronics Society is a co-sponsor. For additional information visit: <http://www.sobraep.org.br>.

PEED'05 Power Electronics Education Workshop, is scheduled for 16-17 June 2005 and is being organized in conjunction with PESC'05 in Recife, Brazil at the same venue. Plans for tutorials, keynotes and papers should be sent to Prof. Marcelo Godoy Simoes, mgs@mines.edu

IAS2004, 39th Industry Applications Society Annual Meeting, to be held 3-7 October 2004 at the Westin Hotel, Seattle, Washington, USA. Organized by IEEE Industry Applications Society (go to link <http://www.ieee.org/ias2004> for more details).

NORPIE 2005, the Nordic Workshop on Power and Industrial Electronics, takes place 14 – 16 June 2005 in Trondheim, Norway. The IEEE Power Electronics Society is a technical co-sponsor. For additional information visit <http://www.elkraft.ntnu.no/norpie/>

ISPSD2005, IEEE International Symposium on Power Semiconductor Devices, takes place 22-26 May 2005 at the Fess Parker Doubletree Hotel in Santa Barbara, CA. The IEEE Power Electronics Society is a technical co-sponsor. For additional information visit <http://www.ecse.rpi.edu/conf/ISPSD2005/> or contact Dr T. Paul Chow of RPI at: chowt@rpi.edu.

Obituary



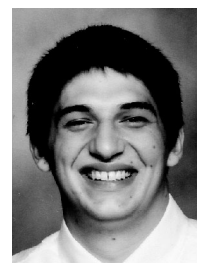
William James (Bill) Hazen

Died June 14 in Framingham, MA after a short illness. Survived by wife Louise, five children, and ten grandchildren. Bill had a long and successful career in power electronics, including employment at Digital Equipment Corporation, Prime Computer, and Best Power Technology, from which he retired in 1996. Bill was one of the founders of APEC, along with John Kassakian, William Burns, and R.D. Middlebrook. Bill was a Life Member of IEEE and an active IEEE volunteer. Bill gave generously of his time and was a mentor for many younger engineers. He is remembered fondly by those who were privileged to know him, and he is missed.



Christine "Chris" Lipo

Christine "Chris" Lipo, wife of UW-Madison professor Thomas A. Lipo, died on Wednesday, August 18th, 2004. Tom and Chris were married for forty memorable years filled with happiness, folk music, travel and fine food. Chris will be remembered by PELS members as Tom's enthusiastic travel companion who loved to accompany him to conferences and anywhere that work led him. She will be sincerely missed by her husband Tom, children Carl (Deb) Lipo of California, Emily (Jay) Pink of Madison, Patrick (Sandi) Lipo of Massachusetts, Anna (Brett) Lindenengel of California, and 8 grandchildren, plus many friends and family.



Quentin "Quen" Patrick Miller

Died July 21 in Huron Township, MI at age 21. The beloved son of John M. and Doreen E. Miller (deceased) was born on July 12, 1983 in Detroit, MI. Quen attended Washtenaw Community College in Ypsilanti, MI and was enrolling at George Mason University in Virginia this fall. He was a quiet and reserved young man who enjoyed life, family and friends, music plus building and programming computers. He is survived by his Father John M., stepmother JoAnn Miller of Cedar, 3 brothers, 2 sisters, 1 stepbrother and 2 stepsisters. Quen is so very missed by all of us.



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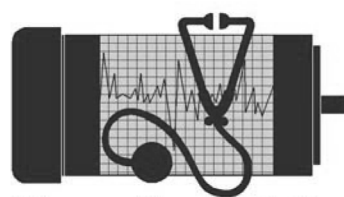
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Special Sessions – There will be special sessions on specific topics. A special session proposal must provide the session name, a list of five potential papers and digests. Special session papers will be reviewed in the normal manner.

Deadlines for submission:

Digests	December 20, 2004
Notification of acceptance	February 18, 2005
Final manuscript due	April 29, 2005

All papers must be submitted in electronic format. Instructions and full information on the conference will be posted in due course on the SDEMPED'05 website:

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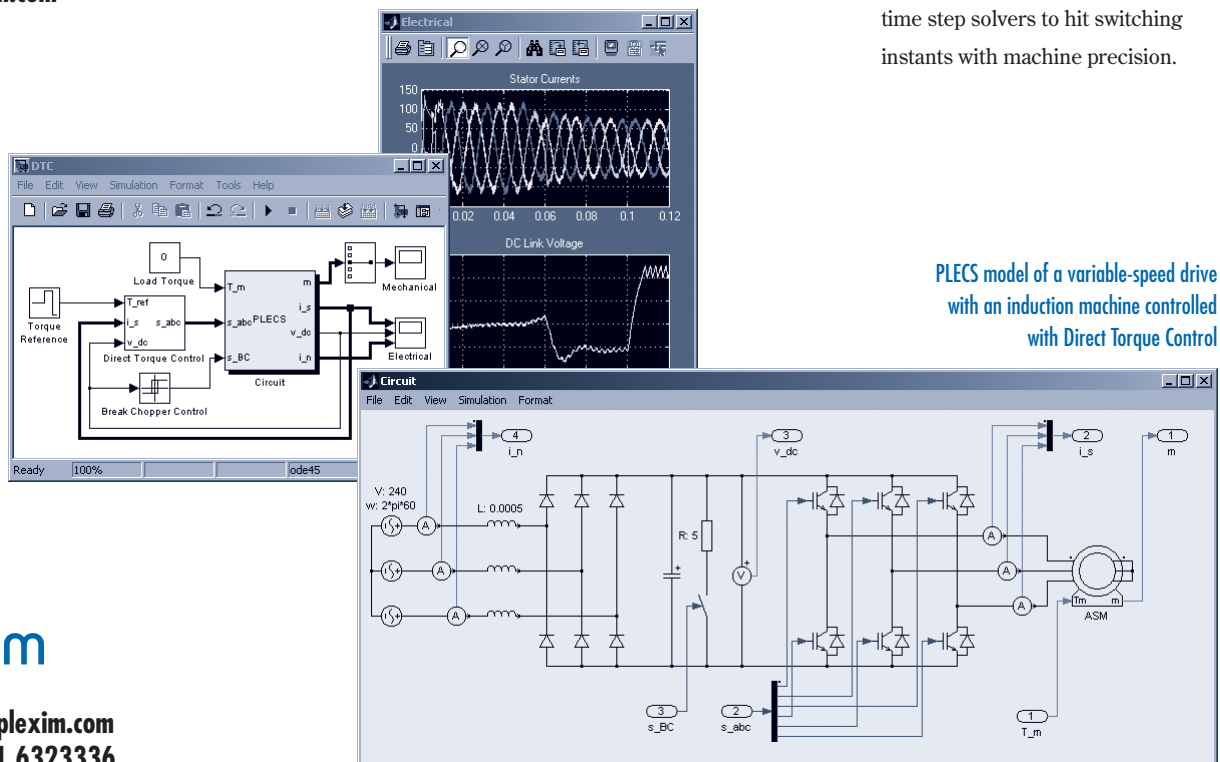
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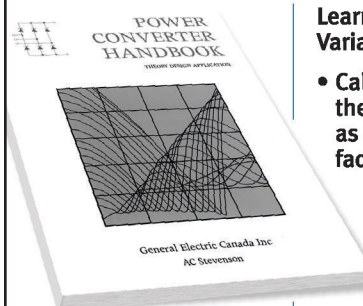
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