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EPE 2011

14th European Conference on Power Electronics and Applications

Birmingham, August 30 - September 1, 2011

Exhibition and Sponsorship

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< TECHED - 19 >

Preliminary Program

Topic 4: Soft switching converters and control

Subtopic Choose

16 **A Design Methodology of Resonant LLC DC-DC Converter**

ABRAMOVITZ Alexander - UNIVERSITY OF CALIFORNIA, IRVINE - UNITED STATES OI AMERICA
BRONSHTEIN Svetlana - SAMI SHAMOON COLLEGE OF ENGINEERING - ISRAEL

182 **Comparison of Resonant LLC and LCC Converters for Low-Profile Applications**

PAWELLEK Alexander - UNIVERSITY ERLANGEN - GERMANY
DUERBAUM Thomas - UNIVERSITY ERLANGEN - GERMANY
OEDER Christian - UNIVERSITY ERLANGEN - GERMANY

304 **A New High Step-Up Voltage Ratio Soft Switching PWM Boost DC-DC Power Converter with Edge Resonant Switched Capacitor Modular**

MISHIMA Tomokazu - KOBE UNIVERSITY - JAPAN
TAKEUCHI Yujiro - KOBE UNIVERSITY - JAPAN
NAKAOKA Mutsuo - YAMAGUCHI UNIVERSITY - JAPAN

307 **Thermal-Electrical Modeling and Simulation of Resonantly Operated DC-DC Converters Based on Extended Describing Function Method**

CAO Zhiyu - PADERBORN UNIVERSITY - GERMANY
LV Jianxun - BEIHANG UNIVERSITY - CHINA
FROEHLEKE Norbert - PADERBORN UNIVERSITY - GERMANY
BOECKER Joachim - PADERBORN UNIVERSITY - GERMANY
YUAN Haiwen - BEIHANG UNIVERSITY - CHINA

311 **A Current Fed Multi-resonant Converter with Extended Voltage Regulation Range**

LI Donghao - XI'AN JIAOTONG UNIVERSITY - CHINA
LIU Bo - XI'AN JIAOTONG UNIVERSITY - CHINA
YUAN Bo - ANALOG DEVICES, INC - CHINA
YANG Xu - XI'AN JIAOTONG UNIVERSITY - CHINA
HUANG Qingyi - ANALOG DEVICES, INC - CHINA
ZHAI Jerry - ANALOG DEVICES, INC - CHINA

318 **Soft Switching Three Level Inverter with Passive Snubber Circuit (S3L Inverter)**

GEKELER Manfred W. - HTWG KONSTANZ UNIVERSITY OF APPLIED SCIENCES - GERMANY

421 **Resonant Inverter with a Variable-Frequency Asymmetrical Voltage-Cancellation Control for Low Q-Factor Loads in Induction Cooking**

YACHIANGKAM Samart - KING MONGKUT'S UNIVERSITY OF TECHNOLOGY THONBURI THAILAND

422 **A Soft Switching Class D Current Source Inverter for Induction Heating with Non-Ferromagnetic Load**

YACHIANGKAM Samart - KING MONGKUT'S UNIVERSITY OF TECHNOLOGY THONBURI THAILAND

534 **New resonant inverter topology with active energy recovery in PDM mode for DBD plasma reactor supply**

JAKUBOWSKI Tomasz - WEST POMERANIAN UNIVERSITY OF TECHNOLOGY, SZCZECI - POLAND
KALISIAK Stanislaw - WEST POMERANIAN UNIVERSITY OF TECHNOLOGY, SZCZECIN - POLAND
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EPE'11 30 August to 1 September 2011, Birmingham, UK
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Preliminary Program

DS3c: Topic 4: Soft Switching Converters and Control

Back to session

Session type: Dialogue

Thursday, September 1st 14:10

Location: Hall 3

Click on the TITLE to download the full paper (It will be available after August 16th if you are registered)

422 - A Soft Switching Class D Current Source Inverter for Induction Heating with Non-Ferromagnetic Load

YACHIANGKAM Samart - KING MONGKUT'S UNIVERSITY OF TECHNOLOGY THONBURI - THAILAND

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Abstract:

A class D current source resonant inverter (CSRI) with interleaved buck converter for induction heating power supplies for non-ferromagnetic load is proposed in this paper. The switching devices of CSRI are connected through the common ground and only a single dc power supply is needed for the gate driver circuitry. The maximum output power transferred to the load for the hardware prototype is 1.26 kW. The resonant inverter operates at a fixed frequency of 108 kHz while the interleaved buck converter operates at 40 kHz for soft-switching operation. The output power is controlled by adjusting the pulse width of the interleaved buck converter. The hardware prototype is capable for melting a 30-gram aluminum workpiece at 700 degree Celsius within 25 minutes.

Back to program

Back to session

A Soft Switching Class D Current Source Inverter for Induction Heating with Non-Ferromagnetic Load

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Keywords

Current Source Inverter (CSI), Interleaved buck converters, Soft switching, Induction heating

Abstract

A class D current source resonant inverter (CSRI) with interleaved buck converter for induction heating power supplies for non-ferromagnetic load is proposed in this paper. The switching devices of CSRI are connected through the common ground and only a single dc power supply is needed for the gate driver circuitry. The maximum output power transferred to the load for the hardware prototype is 1.26 kW. The resonant inverter operates at a fixed frequency of 108 kHz while the interleaved buck converter operates at 40 kHz for soft-switching operation. The output power is controlled by adjusting the pulse width of the interleaved buck converter. The hardware prototype is capable for melting a 30-gram aluminum workpiece at 700 degree Celsius within 25 minutes.

Introduction

Induction heating technology has been widely used in industrial applications [1]. The obvious benefits are high efficiency and compact system size. The advancement of the power electronic technology has made high-frequency operation of an inverter possible. Users can easily choose the operating frequency to suit the applications and size of workpieces. Commonly used inverters in induction heating applications are constant voltage and constant current types [2]. The important advantage of the current source inverter over the voltage source inverter is its inherent short-circuit protection capability [3], [4]. Unlike the voltage source inverter, the current source inverter suffers high current during no-load condition. Therefore, the current limiting capability is essentially required under such a condition. Typical dc sources for the inverter are implemented using thyristors as switching devices. The power control is accomplished by adjusting the phase angle. This means that a large inductor is needed for the purpose of filtering. However, if the inductance is too small and the current contains high ripple, the power control can be difficult and the phase controller can malfunction. This may result in damages on switches due to high voltage across the switches. In general, many variables have effect on the inductance of the induction coil. Specifically, the relative permeability (μ_r) of a ferromagnetic workpiece is very high. When the workpiece is heated to Curie temperature, μ_r varies substantially which results in variation of the resonant frequency. For this type of load, the inverter is relatively complicated since it must be able to track the varied resonant frequency. Unlike the ferromagnetic workpiece, temperature does not have much effect on the μ_r of a non-ferromagnetic workpiece and there is no need for a frequency tracking capability on the hardware. This paper proposes a simple induction heating system for non-ferromagnetic loads using a class D current source inverter with 2 interleaved buck converters for dc bus control. The inverter operates at a fixed frequency while the output power is controlled through the duty cycle of the interleaved buck converters.

Parallel resonant inverter

The current source parallel resonant inverter needs a switch that can block a bipolar voltage. Appropriate switching actions are achieved by connecting a switch and a diode in series. The output voltage of the inverter is nearly sinusoidal, in the case of low damping factor and the operating frequency is near the resonant frequency. The inverter must operate at a frequency slightly higher than the resonant frequency, in order to achieve soft-switching operation which reduces losses at switches and the spike voltage. The voltage across the switch and diode in series has both positive and negative values. The positive voltage is blocked by the switch and the negative voltage is blocked by the diode, as shown in Fig. 1.

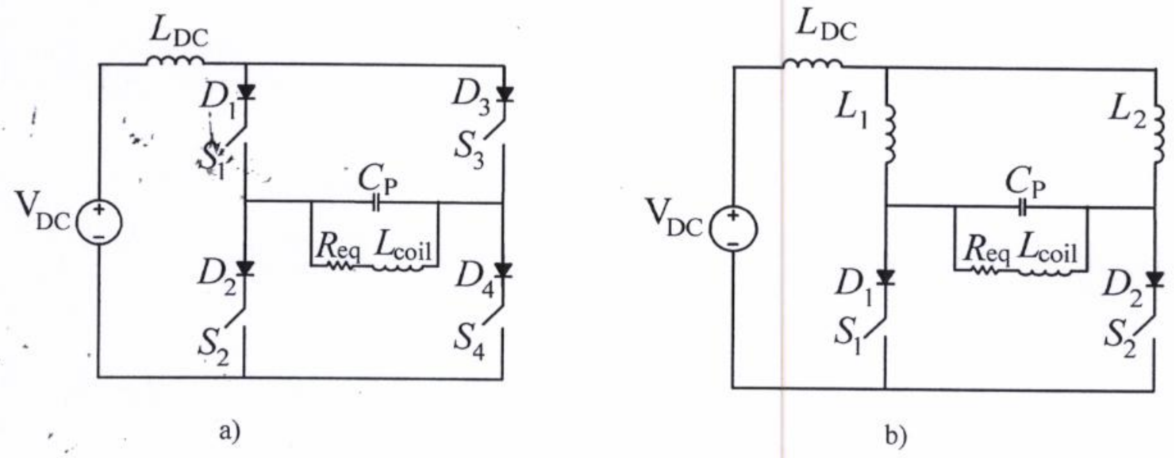


Fig. 1: a) Full-bridge CSI, b) Half-bridge CSI

Parallel Resonant ZCS-PWM inverter

A. Circuit Description

Fig. 2 shows the class D current source resonant inverter (CSRI) with interleaved buck converter for non-ferromagnetic induction heating. The interleaved buck converter consists of two switches (S_{B1}, S_{B2}) and freewheeling diodes (D_{B1}, D_{B2}) and two DC inductors (L_{DC1}, L_{DC2}). The interleaved configuration is introduced with the aims to alleviate the load on the components of each set providing that the current is equally shared among the two sets. With each set operates under 180-degree phase difference, the each switching device operates at only a half of the overall switching frequency. The resonant inverter consists of two switches (S_1, S_2) with blocking diodes (D_1, D_2), a resonant capacitor (C_p), a DC inductor (L_{DC}) and an inductor coil. The inductor coil can be represented as a series combination of resistor (R_{eq}) and inductor (L_{coil}).

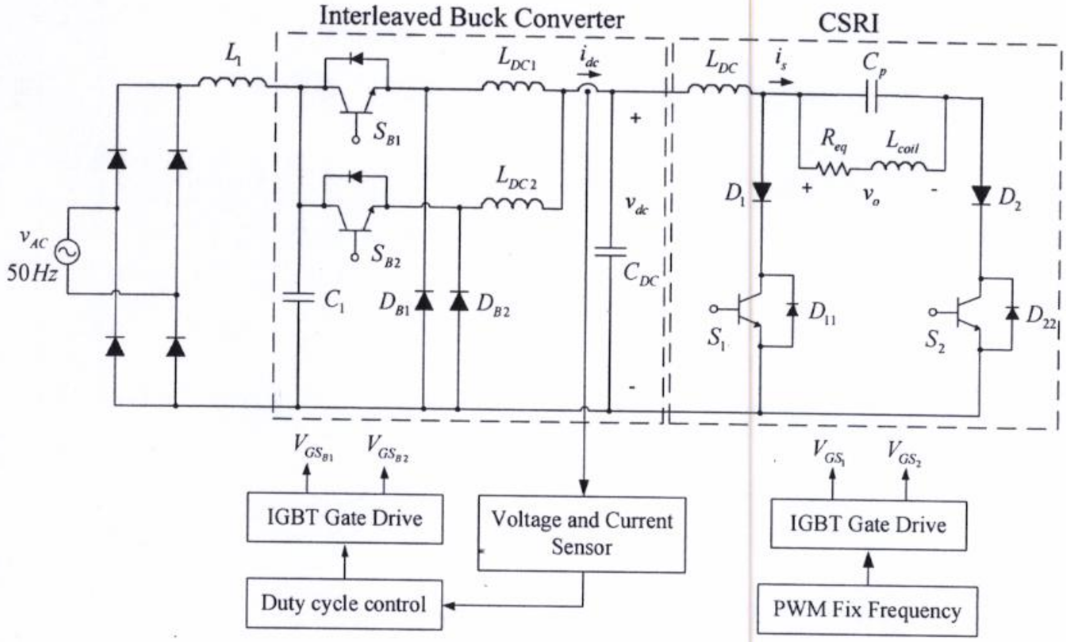


Fig. 2: Class D current source resonant inverter (CSRI) with interleaved buck converter

B. Inverter Modes of Operation

Fig. 3 shows the four modes of operation exist within one switching cycle. The corresponding circuit topology for each mode of operation is illustrated in Fig. 4. The analysis is as follows.

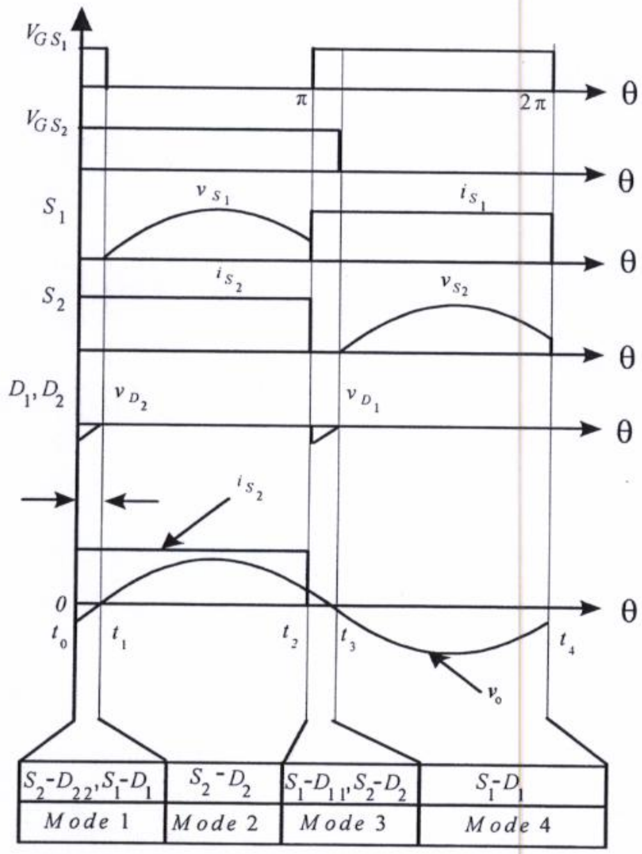


Fig. 3: Typical voltage, current and gate signals

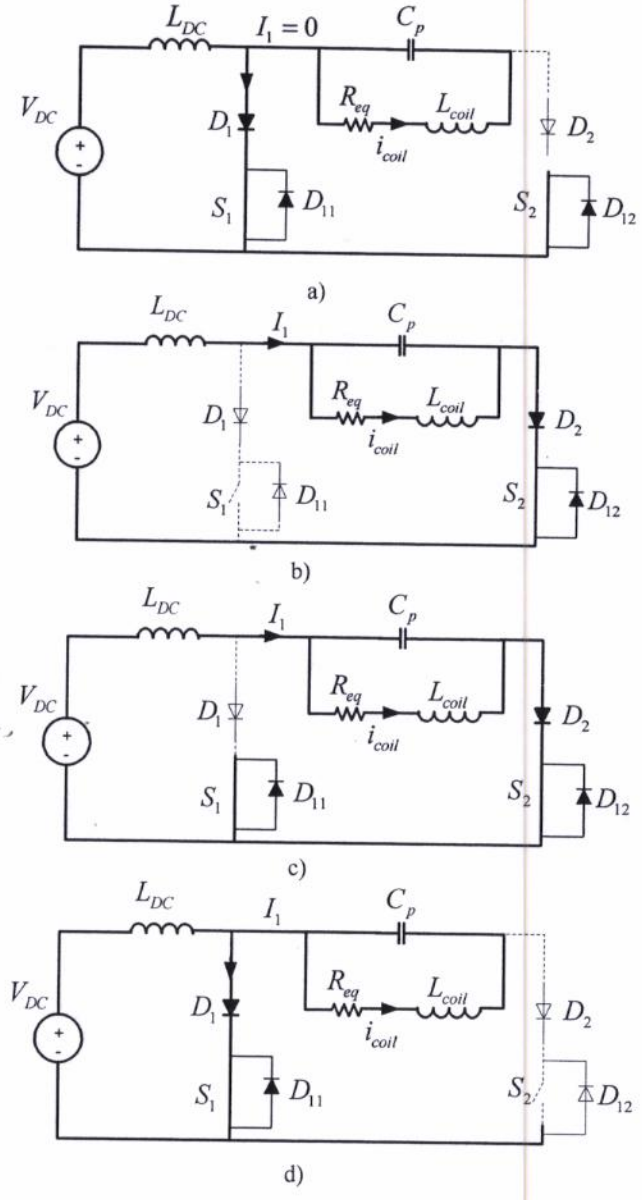


Fig. 4: a) Operation mode 1 $(t_0 - t_1)$, b) Operation mode 2 $(t_1 - t_2)$, c) Operation mode 3 $(t_2 - t_3)$, d) Operation mode 4 $(t_3 - t_4)$

1) Mode 1 (t_0–t_1): While the switch S_1 and diode D_1 are on, at $t = t_0$, the switches S_1 and S_2 receive positive gating signals. The negative voltage appears at the diode D_2.

2) Mode 2 (t_1–t_2): At $t = t_1$, While switch S_2 and diodes D_2 still conducts, switch S_1 and the anti-parallel diode D_{11} are off, the positive output voltage switch appears at S_2. And ZCS operation is achieved. During this mode

3) Mode 3 (t_2–t_3): At $t = t_2$, the switch S_1 is turned off. Similar to that in Mode 1, and the diode D_{11} starts conducting positive. The negative voltage appears at the diode D_1.

4) Mode 4 (t_3–t_4): At $t = t_3$, when the diodes D_{11} and S_1 are off, the switch S_1 and diode D_{11} conduct. During this mode, the output voltage v_o becomes negative. Therefore, the one-cycle operation of the Class D current source inverter is completed. The next operating cycle continues to repeat from modes 1 to 4.

To simplify the calculation of necessary circuit parameters, the series combination of L_{coil} and R_{eq} is transferred to its equivalent parallel configuration of L_{coil} and R_p as shown in Fig. 5. The R_p is given by

$$R_p = \frac{R_{eq}^2 + (\omega L_{coil})^2}{R_{eq}} \quad (1)$$

where ω is the system switching frequency.

The total impedance (Z_{total}) of the resonant circuit in Fig. 5 can be expressed as

$$Z_{Total}(j\omega) = \frac{j\omega R_p L_{coil}}{-\omega^2 C_p L_{coil} R_p + j\omega L_{coil} + R_p} \quad (2)$$

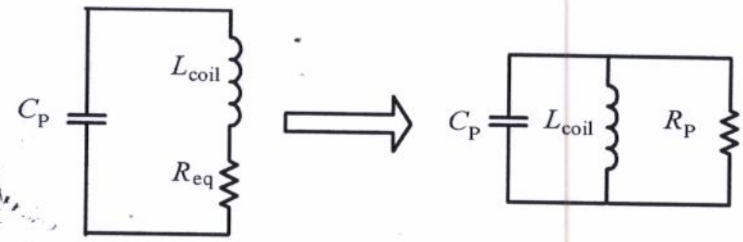


Fig. 5: Changing series circuit to parallel circuit equivalent

and the resonant frequency is given by

$$\omega_o = \frac{1}{\sqrt{L_{coil} \cdot C_p}} \quad (3)$$

Note that the inverter is designed to operate such that the switching frequency is slightly higher than the resonant frequency (i.e. $\omega > \omega_0$) for maximum output power. The parallel impedance at resonant frequency (ω_0) is given by

$$Z_{Total}(j\omega_0) = R_p \quad (4)$$

and the average output power P_D of the CSRI is provided as

$$P_D = \frac{v_{o,rms}^2}{R_p} \quad or \quad P_D = i_{coil,rms}^2 R_{eq} \quad (5)$$

The interleaved buck converter can be control the dc output by adjusting the duty cycle of gate drive signals shown in Fig. 6. So the output power of the CSRI with interleaved buck converter, as in

$$P = 2(P_D D) \quad (6)$$

where D is the switch duty cycle.

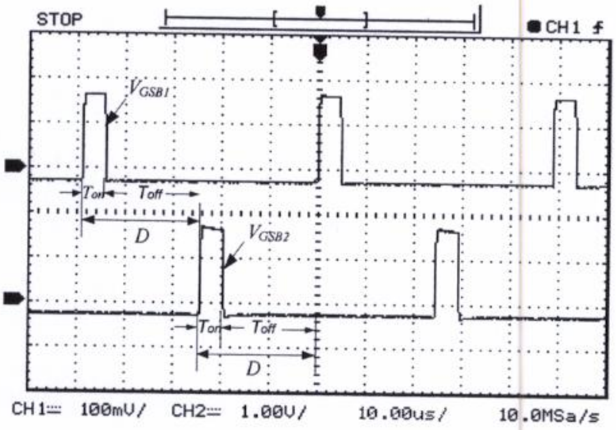


Fig. 6: The gate drive of interleaved buck converter

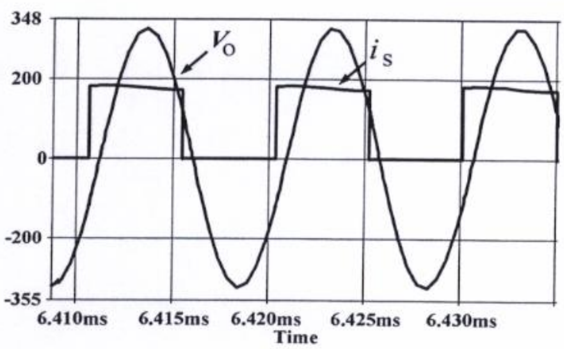
Simulation and the experimental result

A. The current source resonant inverter or CSRI for constant frequency

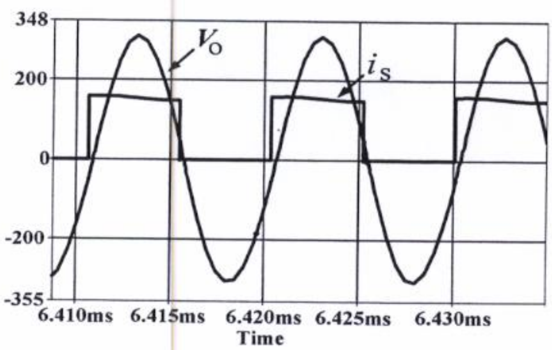
Simulation and experimental results are provided in this section with the parameters given in Table I.

Table I: Parameter and inverter specification for constant frequency

Item	Symbol	Value at 25°C	Value at 625°C
Input Voltage	v_{AC}	70 V_{rms}	70 V_{rms}
Switching Frequency	f	102.5 kHz	102.5 kHz
Resonant Capacitor	C_P	0.88 μF	0.88 μF
Inductor Coil	L_{Coil}	3.18μH	3.12μH
Equivalent Resistor	R_{eq}	138 mΩ	100 mΩ
Switches	S_1, S_2	IRFP460	IRFP460

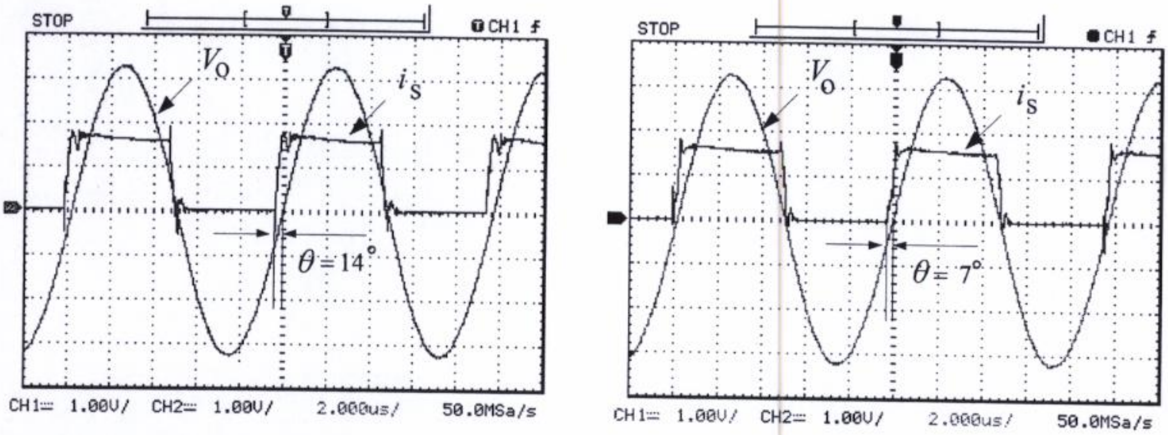


a) v_o and i_s waveforms at 25°C of workpiece



b) v_o and i_s waveforms at 642°C of workpiece

Fig. 7: Simulated results of the class D current source inverter (i_s: 20 A/div, v_o: 200 V/div and Time: 2μs/div.)



a) v_o and i_s waveforms at 25°C of workpiece b) v_o and i_s waveforms at 642°C of workpiece

Fig. 8: Experimental results of the class D current source inverter (i_s: 20 A/div, v_o: 100 V/div and Time: 2μs/div.)

Fig.7 and 8 show the simulation and experimental results of the CSRI with constant switching frequency operation. The resonant frequency is increased when the induction coil parameters (L_{Coil}, R_{eq}) change. Notice that the phase difference between voltage and current becomes smaller when the workpiece is at high temperature. As long as the constant switching frequency is maintained above the resonant frequency, the phase-locked loop is not needed in this setup.

B. The current source resonant inverter or CSRI with interleaved buck converter

The hardware prototype is created using parameters in Table II.

Table II: Parameter and inverter specifications for interleaved buck converter

Item	Symbol	Value
Input voltage	v_{AC}	100 V_{rms}
Switching frequency of CSRI	f_S	104.2 kHz
Resonant capacitor	C_P	0.88 μF
Switching frequency of Interleaved buck converter	f_B	40 kHz
Inductor coil	L_{Coil}	3.78μH
Equivalent resistor	R_{eq}	118 $m\Omega$

The work-piece is a metal with 30 grams in the graphite crucible. The measured signals from Fig. 9 to 14 are taken when the work-piece temperature is at 680°C. The measured results at 50% duty cycle of the interleaved buck converter are illustrated in Fig. 9 to Fig. 11 where the measured results at 10% duty cycle of the interleaved buck converter are illustrated in Fig. 12 to Fig. 14. Different output power level can be achieved through the duty cycle of the interleaved buck converters.

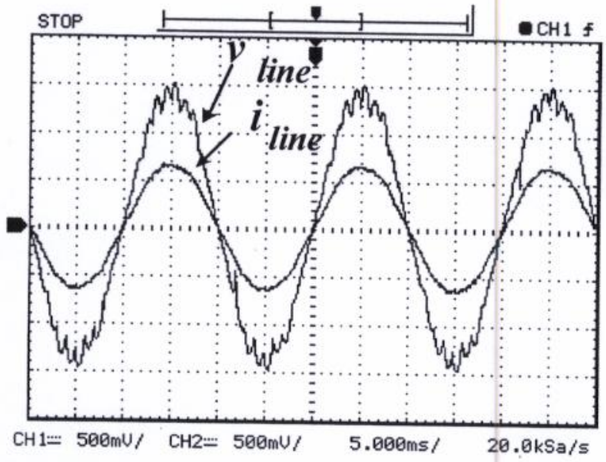


Fig. 9: Experimental results of CSRI with interleaved buck converter at 50% duty cycle. (v_{line}: 50V/div at time 5ms/Div, i_{line}: 5A/div at time 5ms/Div)

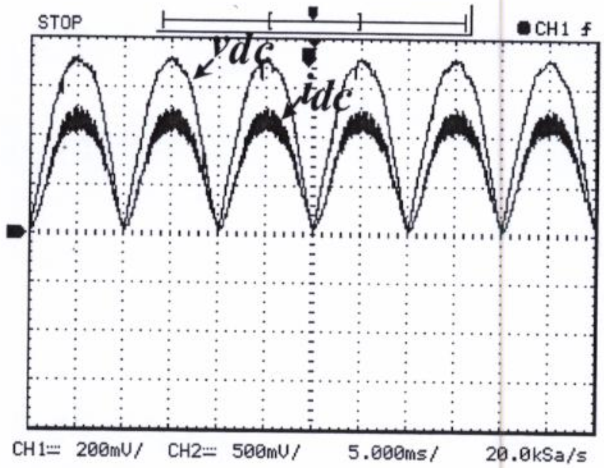


Fig. 10: Experimental results of CSRI with interleaved buck converter at 50% duty cycle. (v_{dc}: 20V/div at time 5ms/Div, i_{dc}:5A/div at time 5ms/Div)

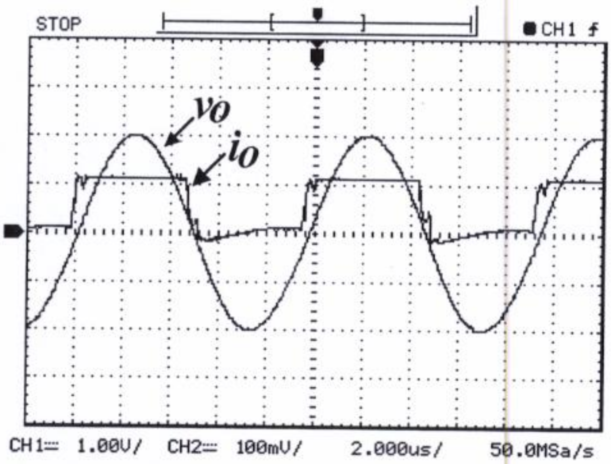


Fig. 11: Experimental results of CSRI with interleaved buck converter at 50% duty cycle (v_o:1V/div at time 2μs/Div, i_o:1A/div at time 2μs/Div)

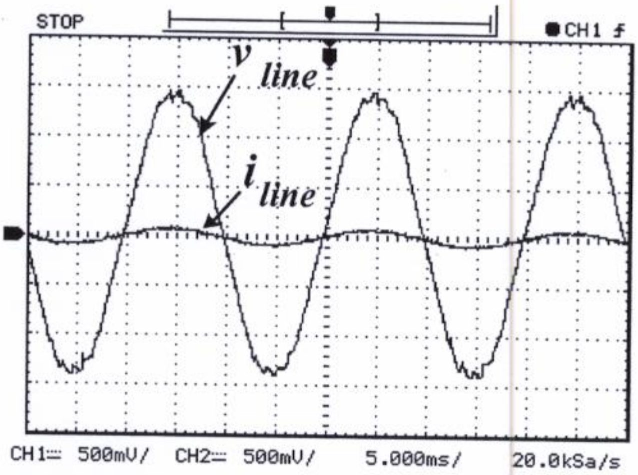


Fig. 12: Experimental results of CSRI with interleaved buck converter at 10% duty cycle (v_{line}:50V/div at time 5ms/Div, i_{line}:5A/div at time 5ms/Div)

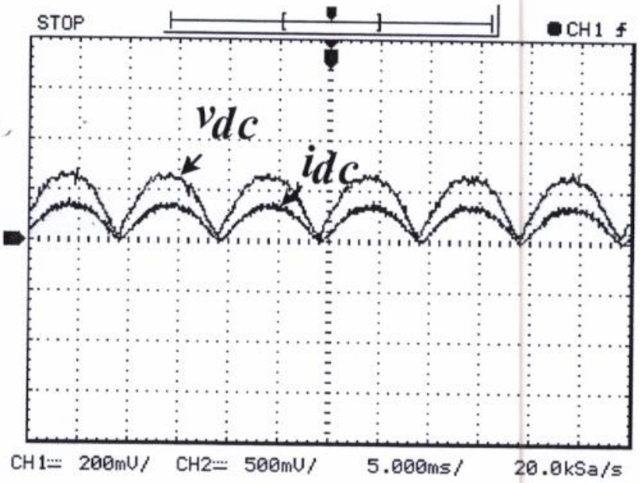


Fig. 13: Experimental results of CSRI with interleaved buck converter at 10% duty cycle. (v_{dc}:20V/div at time 5ms/Div, i_{dc}:5A/div at time 5ms/Div)

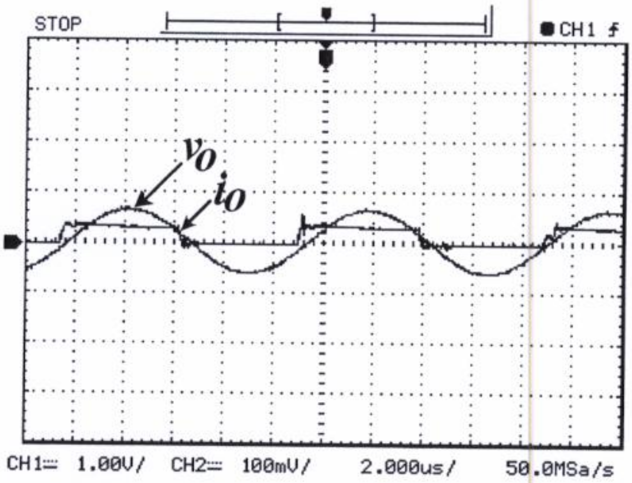


Fig. 14: Experimental results of CSRI with interleaved buck converter at 10% duty cycle (v_o:1V/div at time 2μs/Div, i_o:1A/div at time 2μs/Div)

Conclusion

A simple configuration of a class D current source inverter and a set of interleaved buck converters designed for the induction melting application have been presented in this paper. The constant switching frequency operation of the inverter can be used with non-ferromagnetic workpiece because the effect of the parameter variation under increased temperature is minimal. The use of phase-locked loop control to track the resonant frequency can be omitted and small dc inductors can be used.

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EPE'11
30 August to 1 September 2011, Birmingham, UK
14th European Conference on Power Electronics and Applications
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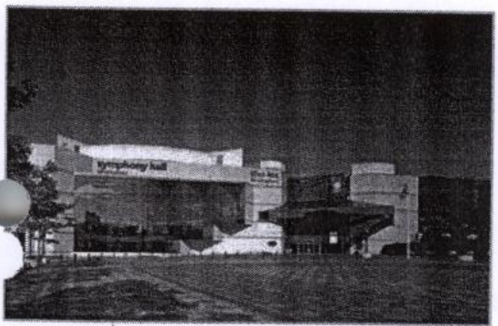
INDEX

WELCOME

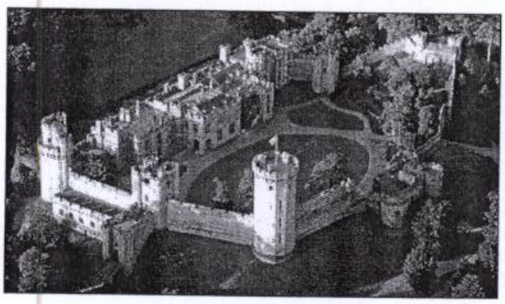


The International Convention Centre

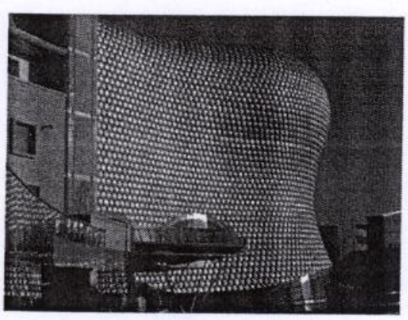
It is our pleasure to invite the whole of the Power Electronics Community to the 14th Conference on Power Electronics and Applications, EPE'11. EPE'11 will be held in Birmingham, UK from the 30th August to the 1st September 2010. This is an exciting and rewarding time to be involved in Power Electronics and we look forward to making this the most successful EPE conference so far.

The EPE conference is held every two years and attracts about 1000 delegates from all European Countries, Asia and America. The delegates represent Industry and the major Academic Institutes involved in research into Power Electronics from across the world. Many major contributions come from industry in the form of Technical Workshops and Keynote presentations covering the major trends in Power Electronics for all its applications.

Birmingham is a colourful and vibrant city in the heart of England which is well known for chocolate, cars, canals and custard! Birmingham is the second largest city in the UK and is only a one hour train journey away from London. The city has a lot to offer conference attendees and their families, from Cadbury World (home of the world famous milk chocolate brand) to the Iron Bridge George (the birthplace of the Industrial Revolution) and from the Science Exploratory to the best shopping in the UK outside of London (so we are told)! There will be a good social programme associated with the conference and tours will be organised to many of the local tourist attractions, including English castles, Stratford-upon-Avon (home of the famous playwright, William Shakespeare), Chatsworth House in the heart of the beautiful Peak District National Park and many more – see the conference web site for details (www.epe2011.com).



Warwick Castle



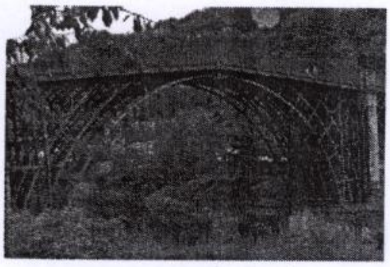
Selfridges

The conference itself will be held at the International Conference Centre (ICC), in Birmingham city centre. The exhibition will be held in the large hall, which will also be used for the provision of coffee and lunch as well as the display of poster presentations. The ICC is very close to restaurants, bars and shops as well as being very convenient for city centre hotels. The ICC provides excellent, high quality conference facilities and we are very fortunate to be able to hold this EPE conference in this prestigious location. The gala dinner will be held at the National Motorcycle Museum where guests will have the opportunity to walk around the historical and contemporary exhibits during pre-dinner drinks as well as sampling the sounds of some traditional English music after the meal.

If anyone would like to book a meeting room at the ICC for side meetings, project meetings, seminars or dissemination events please contact one of us with your requirements. We welcome the hosting of parallel events, seminars and meetings before, during or after the main conference.

The conference will cover a wide range of topics relating to Power Electronics and applications including, but not limited to:

- Devices, packaging and integration
- Power converter topologies and design
- Control and measurement
- Electrical machines and drives
- Power electronics used in the generation, transmission and distribution of electrical energy
- Renewable energy and smart grids
- Power supplies
- Application of power electronics in automotive, aerospace, traction and marine applications
- Education in electrical engineering



Ironbridge Gorge

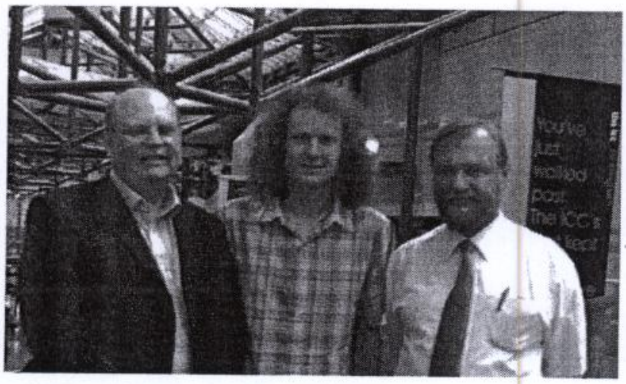
In addition to these wide ranging topics, each day the conference will have a theme for the Keynote presentation and industrial sessions. These themes are based on strong local industrial interests: Power Electronics for Smart Grids/Integration of Renewable Energy; Automotive applications and Aerospace Applications.

Please check out the conference web site for more details of the conference, including paper submission and hotel reservations, as well as discount vouchers for many of the areas tourist attractions and reduced costs tickets with our partner airline group, the Star Alliance.

We look forward to welcoming all our sponsors and exhibitors to Birmingham for this EPE conference. Please let any of the team know if there is anything we can assist you with.

We look forward to welcoming you to Birmingham!

Yours sincerely,



Philip Mawby Patrick Wheeler Colin Oates

OBJECTIVE OF THE COLLABORATION

The following options for collaboration are offered to the companies intending on being acknowledged as sponsors of the **14th European Conference on Power Electronics and Applications**.

The intention of the Organising Committee is to ensure that all Sponsoring Companies receive the highest recognition in return for their generous support to the Congress. EPE is an established and renowned Conference, and will be a useful meeting point for designers, users and engineers of the future, offering the perfect stage for the development of valuable relationships between companies and professionals.

EPE'11 30 August to 1 September 2011, Birmingham, UK
14th European Conference on Power Electronics and Applications

EXHIBITION AND SPONSORSHIP

The EPE conference is held every two years and attracts about 1000 delegates from all European Countries, Asia and America. The delegates represent Industry and the major Academic Institutes involved in research into Power Electronics from across the world. Many major contributions come from industry in the form of Technical Workshops and Keynote presentations covering the major trends in Power Electronics for all its applications.

EXHIBITION

Companies can rent modular booths or spaces of 6 m^2, 12 m^2, 18 m^2 or 24 m^2
Rate per 6m^2: **€2,500 excluding VAT**

- Carpet, table, two chairs and electrical connections included
- Two exhibitors passes (coffee-break and lunch included)
- Four visitor tickets for the exhibition
- Additional furniture will be available for additional cost

SPONSORSHIP

Companies or organisations are welcome to sponsor the conference by sponsoring one of the social events (please ask for details), or based on the following packages:

Diamond: €75,000

- One exhibition space of 24m^2
- Four EPE Conference registrations
- Eight visitor tickets for the exhibition
- Complimentary briefcase insert
- Company logo on sponsors page of Congress website, congress bag and CD Rom
- Advertisement in the final programme- two pages of an A5 booklet
- Company logo on final programme

Gold: €35,000

- One exhibition space of 18m^2
- Three EPE Conference registrations
- Six visitor tickets for the exhibition
- Complimentary briefcase insert
- Company logo on sponsors page of Congress website
- Advertisement in the final programme - a page of an A5 booklet
- Company logo on final programme

Silver: €15,000

- One exhibition space of 12 m^2
- Two EPE Conference registrations
- Four visitor tickets for the exhibition
- Complimentary briefcase insert
- Company logo on sponsors page of Congress website
- Advertisement in the final programme - half a page of an A5 booklet
- Company logo on final programme

Contributor: €6,000

- One exhibition space of 6m^2
- One EPE Conference registration
- Four visitor tickets for the exhibition
- Complimentary briefcase insert
- Company logo on sponsors page of Congress website
- Company logo on final programme

EPE'11 30 August to 1 September 2011, Birmingham, UK
14th European Conference on Power Electronics and Applications

EXHIBITION FLOOR PLAN

See PDF in attachment

EPE'11 30 August to 1 September 2011, Birmingham, UK
14th European Conference on Power Electronics and Applications

APPLICATION AND PAYMENT FOR SPONSORSHIP AND EXHIBITION

Application

Please complete the attached form and return it to the Congress Secretariat as soon as possible, or contact them by email to discuss your requirements further.

Confirmation and Payment

Please fill in the enclosed form. Every effort will be made to assign the requested space. However, the organisation does not guarantee that the booth requested will be available and/or assigned. Assignments will be made only after receipt of the contract form and the appropriate payment (100% of total cost payable application). Confirmation of your sponsorship and stand space will be mailed to you together with an ccompanying invoice for the amount received.

VAT (TAX)

All companies are required to pay VAT at the prevailing rate.

Cancellation

In case of cancellation, the total amount paid will be charged as cancellation fees.

Insurance

Companies participating in the Congress are required to take out appropriate insurance.

If you would like to comment any of the items included in this proposal or any further suggestions, please contact:

E Association
ssica Schmid
c/o VUB – IR – ETEC
Pleinlaan 2
B-1050 Brussels
Phone: 32 2 629 28 19
Fax: 32 2 629 36 20
E-mail: jessica.schmid@vub.ac.be

Local Secretariat
Rebecca Burns
Dept. of Electrical and Electronic Engineering
University of Nottingham
Nottingham
NG7 2RD
UK
E-mail: info@epe2011.com

SPONSORSHIP APPLICATION

We would like to sponsor at the following level

Company: ....
Address: ....
Zip Code:................................. *City:* ....
Country:...
Tel: ....
E-mail:..
VAT N° ....
Contact Person: ....
Position: ....
Name that should appear on the booth front:..
Request For Space:
Number of sqm .... *Preferred Booth[s]:*___________

Order N° (if special from your company, please attach) : ....

An invoice will be sent you.

On behalf of the Company, I consent and undertake to comply with the exhibition rules and my obligations to exhibit from the moment I sign this contract.

Signature & Company Stamp:

This form should be completed and returned as soon as possible to:

EPE Association
Jessica Schmid
c/o VUB – IR – ETEC
Pleinlaan 2
B-1050 Brussels
Phone: 32 2 629 28 19
Fax: 32 2 629 36 20
E-mail: jessica.schmid@vub.ac.be

Local Secretariat
Rebecca Burns
Dept. of Electrical and Electronic Engineering
University of Nottingham
Nottingham
NG7 2RD
UK
E-mail: info@epe2011.com

EXHIBITION APPLICATION

Company: ....

Address: ....

Zip Code:................................. City: ....

Country:..

Tel: ....

E-mail:..

VAT N° ....

Contact Person: ....

Position: ....

Name that should appear on the booth front:..

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Local Secretariat
Rebecca Burns
Dept. of Electrical and Electronic Engineering
University of Nottingham
Nottingham
NG7 2RD
UK
E-mail: info@epe2011.com

COMMITTEES AND ORGANIZATION

Local Conference Chairman:

Prof Patrick Wheeler, University of Nottingham, England
Prof Philip Mawby, University of Warwick, England
Dr Colin Oates, ALSTOM, Stafford

Local Conference Committee:

Name	Affiliation
om Alexander	Emerson
like Barnes	University of Manchester
Roger Bassett	University of Warwick
Angus Bryant	Converteam
Alberto Castellazzi	University of Nottingham
Jon Clare	University of Nottingham
Roger Critchley	AREVA
David Drury	University of Bristol
Shankar Ekkanath	University of Sheffield
Steve Finney	University of Strathclyde
Martin Foster	University of Sheffield
Tim Green	Imperial College London
Nicholas Jenkins	University of Cardiff
Steve Jones	Semelab
mil Levi	Liverpool John Moores University
ean Loddick	Converteam
dam McLoughlin	Rolls Royce
Phil Mellor	University of Bristol
Annette Muetze	University of Warwick
Patrick Palmer	University of Cambridge
Volker Pickert	University of Newcastle
Li Ran	University of Durham
Adrian Shipley	GE Aviation
Danielle Strickland	Aston University
Mark Sumner	University of Nottingham
Paul Taylor	Dynex
Alan Watson	University of Nottingham
Connel Williams	TRW
Ahmed Zobaa	University of Exeter

GENERAL INFORMATION

CONFERENCE VENUE:

The ICC
Broad Street
Birmingham
United Kingdom
B1 2EA

DATES:

From August 30 to September 1, 2011

WEB SITE:

www.epe2011.com

TECHNICAL SECRETARIAT:
Exhibition & Sponsorship

EPE Association
C/o Vrije Universiteit Brussel - IrW – ETEC
1050 Brussels, Belgium
Tel: +32 / (0)2 - 629.28.19. / Fax: +32 / (0)2 - 629.36.20.
E-Mail: jessica.schmid@vub.ac.be

LOCAL SECRETARIAT:

University of Nottingham
Rebecca Burns
Dept. of Electrical and Electronic Engineering
Nottingham
NG7 2RD
Email: info@epe2011.com

Hotel accommodation

Marketing Birmingham
Level 4, Millennium Point,
Curzon Street, Birmingham B4 7XG
Telephone +44 (0) 121 202 5115
Web site link: www.epe2011.com

WELCOME COCKTAIL:

Tuesday August 30, 2011
Exhibition Hall, ICC

GALA DINNER:

Wednesday August 31, 2011
National Motorcycle Museum

OFFICIAL LANGUAGE:

The official language of the Conference is English.
Simultaneous translation will not be provided

ORGANIZATION AND VENUE

The European Power Electronics and Adjustable Speed Drives community will gather in Birmingham, United Kingdom, from 30 August to 1 September 2011 to exchange views on research progresses and technological developments in the various topics described hereunder. The EPE 2011 conference is sponsored by the EPE Association and will be held in the International Convention Centre (ICC). Birmingham has been central to industry and the arts since the start of the industrial revolution, so it is an ideal place to learn more about the latest developments in the power electronics' field.

AIMS OF CONFERENCE

EPE is the place for specialists in power electronics, systems and components to present papers and attend sessions on state-of-the-art technology in this challenging and evolutionary sector. The conference aims to be a meeting forum for researchers, developers and specialists from the industry. Papers are encouraged on all topics described hereunder for interdisciplinary discussions of new ideas, research, development, applications and the latest advances in the field of power electronics and adjustable speed drives.

TOPICS

In accordance with the European Commission's Action plan, the aim of energy policy seeks to enable the European Union to reduce greenhouse gases by at least 20%, to reduce energy consumption by 20%, and increase to 20% the share of renewable energies in energy consumption by 2020 (compared to the respective values in 1990). The demand for electricity is continuously growing and will continue to do so at a much faster rate than other energy sources. Today more than 20% of final energy consumption in the EU is electrical energy, but this is predicted to grow significantly in the next few decades. Efficient energy usage and increased generation of electricity from renewable sources are the main concerns for today's society. Power electronics systems and adjustable speed drives - also referred to as Energy Conversion and Conditioning Technologies (ECCT) - are the enabling and often only possible technologies to help us face these challenges. All fields of the electrical world will be affected by the required changes, starting from the generation of clean, CO_2-neutral electrical energy, up to the most remote applications in industry, households, transport systems and portable applications. To fit this changing environment, the EPE 2011 conference will address a full list of topics, especially highlighting smart grids and the integration of renewable energy, the automotive industry and the aerospace industry. The motto of this year's conference will be "Power Electronics and Adjustable Speed Drives: Towards the 20-20-20 target!"

LIST OF TOPICS EPE 2011

I. COMPONENTS AND SYSTEMS RELATED ISSUES

A. DEVICES, PACKAGING AND SYSTEM INTEGRATION

Topic 1: Active devices

1a. MOS controlled silicon power devices (e.g. IGBT, MOSFET)
1b. Silicon power diode and thyristor devices
1c. Monolithic integration, system on chip
Wide bandgap power semiconductor devices (e.g. SiC, GaN, GaAs)
Simulation, modelling and virtual prototyping
Control and protection of power devices

Topic 2: Passive components, system integration & packaging

2a. Passive components and integrated passive components
2b. Materials and interconnection technologies
2c. Cooling, thermal management and thermal design
2d. Multichip module packaging technologies
2e. Reliability of components and integrated subsystems
2f. Simulation and modelling of integrated components and subsystems

Topic 3: Power system integration

3a. Modularity and standardization of converters
3b. Power electronic system integration methodology
3c. Stability and reliability of cascaded converters
3d. Integrated applied power systems
3e. EMC/EMI issues for integrated power systems, reliability issues

B. POWER CONVERTERS TOPOLOGIES AND DESIGN

Topic 4: Soft switching converters and control

Soft switching converters: resonant, ZVS, ZCS
Soft switching converters: circuits and control

Topic 5: Hard switching converters and control

5a. High power multilevel converters and voltage regulator modules
5b. Matrix converters
5c. Emerging topologies
5d. Failure tolerant systems or converters

C. MEASUREMENT AND CONTROL

Topic 6: Modulation strategies and specific control methods for static converter

6a. Converter control sets and modulation strategies
6b. Converter control, current/voltage control

Topic 7: Application of control methods to electrical systems

7a. Optimal control, robust control, non-linear control
7b. Fuzzy control, neuronal control
7c. Open and closed loop system control, fault handling strategies

Topic 8: Measurements and sensors

8a. Sensors and transducers
8b. Measurement methods and techniques
8c. Software for measurements and virtual instruments
8d. Estimation techniques
8e. System diagnoses

D. ELECTRICAL MACHINES AND DRIVE SYSTEMS

Topic 9: Motion control, robotics, special drives, haptics, communication in drive systems
9a. Servo drives; stepping and linear drives
9b. Electro-active systems
9c. Robotics and haptics
9d. Communications systems for drives, integration of MC, NC and PLC in drive systems
9e. Modelling, simulation and design methods of motion control systems

Topic 10: Electrical Machines
10a. Synchronous, permanent magnet synchronous and brushless d.c. motor
10b. Induction machines
10c. Switched reluctance machines
10d. Linear machines
10e. Integrated electrical machines

Topic 11: Adjustable speed drives
11a. General purpose a.c. and d.c. drives
11b. Converter machine/mains interactions
11c. Adjustable speed drive systems, Reliable and Fault-Tolerant drives
11d. Combined multi-motor drive systems

Topic 12: High performance drives
12a. DTC and other modulation strategies for high performance drives
12b. Advanced Control and other high performance drive systems issues
12c. Sensorless techniques

Topic 13: Energy efficiency; energy saving issues in system components
13a. Energy efficiency; energy saving issues in power electronics components
13b. Energy efficiency; energy saving issues in electrical machines and drives
13c. Special developments to achieve energy efficiency; energy savings

II. APPLICATIONS RELATED ISSUES

E. APPLICATIONS OF POWER ELECTRONICS IN GENERATION OF ELECTRICAL ENERGY, RENEWABLE ENERGY SYSTEMS, WIND, PV, TIDAL, WAVE, ETC...

Topic 14: Converters for rotating and linear generators
14a. Doubly fed generator control
14b. Full power generator converter control
14c. Fault ride through methods
14d. Excitation systems and their control
14e. Simulation and emulation of generator systems
14f. Reliability issues

Topic 15: Non-rotating power generation and storage systems
15a. Fuel cell converters and their control
15b. Photovoltaic converters and their control
15c. Converters for energy storage and their control
15d. Reliability issues

F. APPLICATIONS OF POWER ELECTRONICS IN TRANSMISSION AND DISTRIBUTION OF ELECTRICAL ENERGY

Topic 16: Power electronics in transmission and distribution
16a. Microgrid control
16b. HVDC transmission
16c. FACTS (Incl. STATCOM, SVC) and distribution FACTS
16d. Active filtering and other advanced grid side converter control
16e. Low frequency harmonics and EMC (less than 9 kHz) mitigation

16f. Power electronic protection devices for transmission and distribution
16g. Reliability issues

G. APPLICATIONS OF POWER ELECTRONICS IN USERS DEVICES/PROCESSES

Topic 17: Power supplies

17a. Uninterruptible Power Supplies (UPS)
17b. DC Power Supplies (hard&soft switching)
17c. Distributed Power Supplies
17d. Voltage Regulated Modules (VRM)
17e. EMI & over-voltage protection
17f. Electronic ballasts and solid state lighting
17g. High power density system design
17h. Contactless Power Supply
17i. Power Factor Correction (PFC)

Topic 18: Electrical systems in Road Vehicles

18a. Electric propulsion systems for electrified vehicles
18b. Control strategies in hybrid vehicles
18c. Power converters for electrified vehicles
18d. On-Board energy management: fuel cells, storage, components, systems and control
18e. Communications and data transmission
18f. EMC related phenomena
18g. Modelling, simulation and design methods, reliability issues

Topic 19: Electrical systems in aerospace, space, surface and marine transport (not road)

19a. Power electronics in aerospace and space applications
19b. Rail vehicles
19c. Marine applications (Offshore and ships)
19d. On-Board energy management: generation (f.e. fuel cells), storage, components, systems and control
19e. Communications and data transmission
19f. EMC related phenomena
19g. Modelling, simulation and design methods, reliability issues

Topic 20: Industry specific energy conversion and conditioning technologies

20a. Energy conversion and conditioning technologies in the industry (cement, steel, paper, textile, mining, etc…)
20b. Power electronics and drives in buildings and household applications, including lighting and professional devices
20c. Power electronics and drives for low cost applications
20d. Electroheat and power electronics
20e. Reliability issues, diagnostics

Topic 21: Energy conversion and conditioning technologies in physics research and related applications

21a. Power converters for particle accelerators
21b. Application of power electronics to pulsed power (f.e. nuclear fusion research, microwaves, etc…)
21c. Other related applications

H. EDUCATION IN ELECTRICAL ENGINEERING

Topic 22: Education in electrical engineering

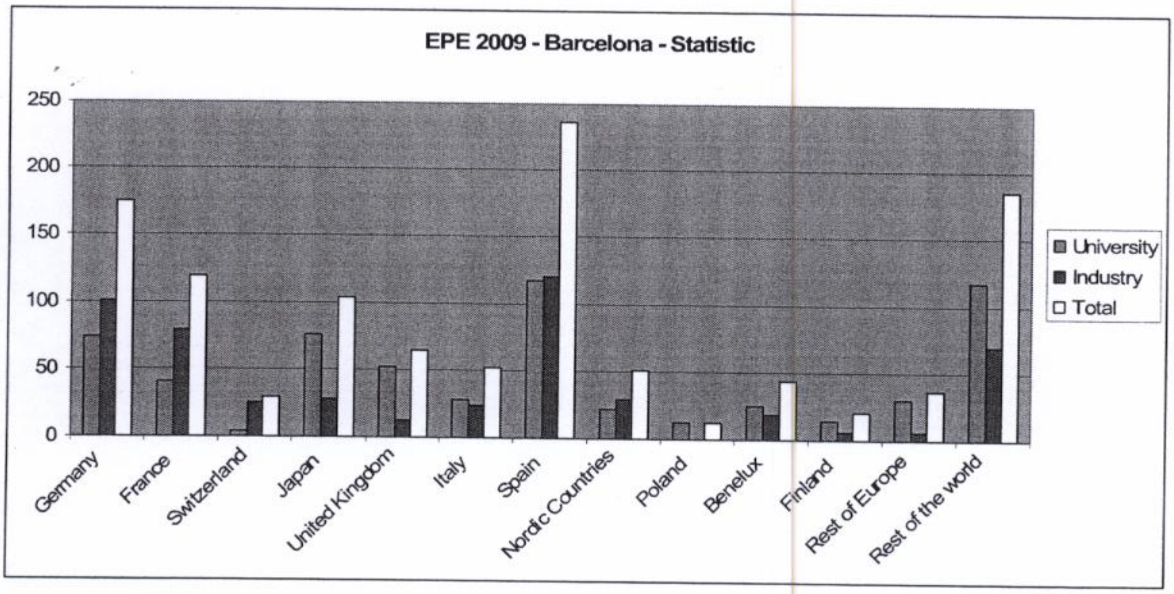
22a. Education methodology
22b. Education tools and e-learning
22c. Simulation software and design tools
22d. Education policy in Europe

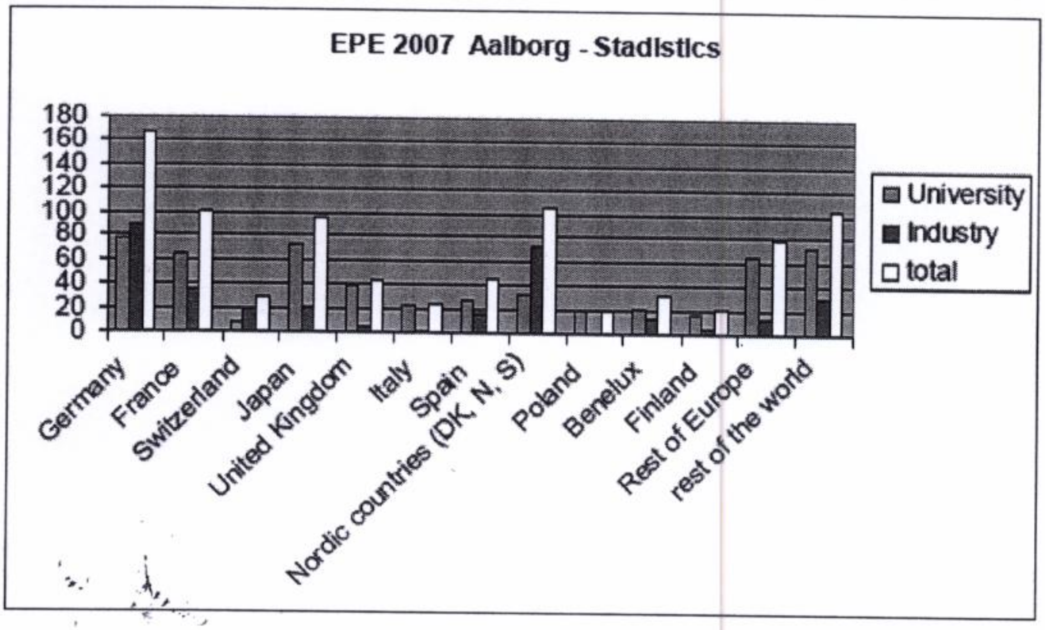
EPE ASSOCIATION CONFERENCES

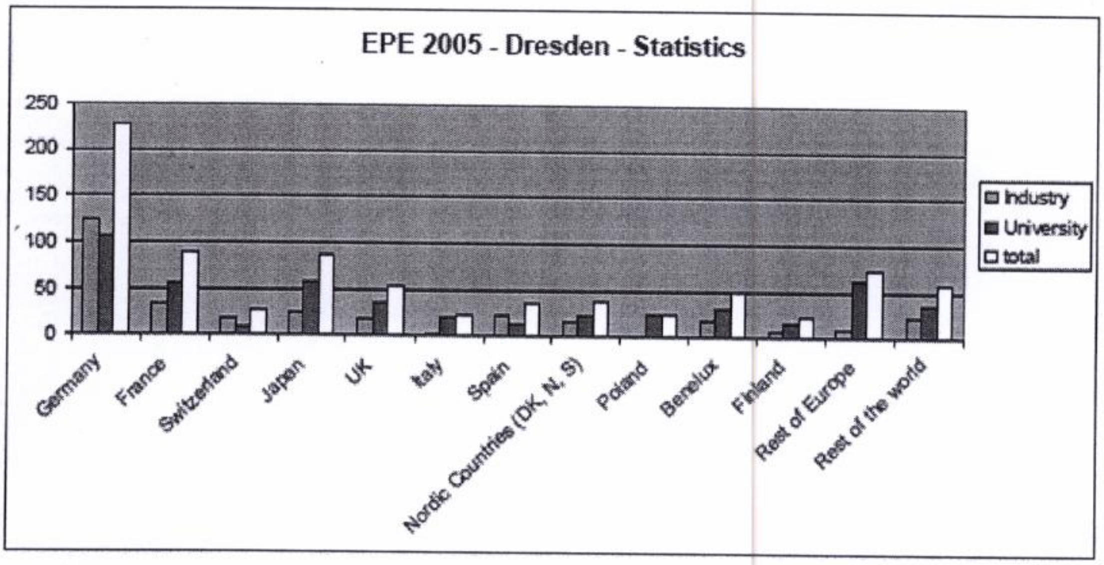
Previous Editions:

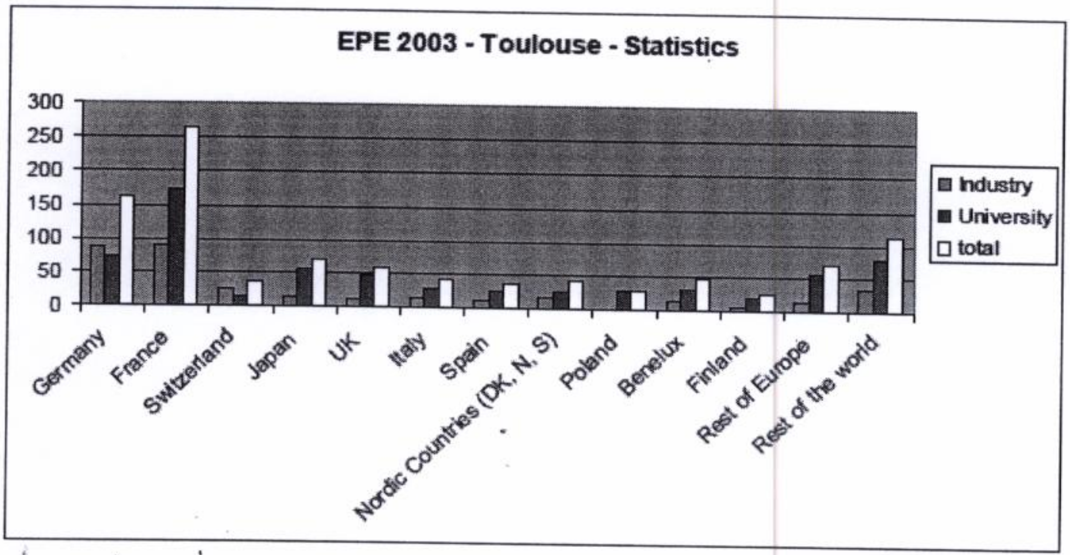
. 1985:	Brussels (Belgium).	Nº of participants:	650
. 1987:	Grenoble (France).	Nº of participants:	750
. 1989:	Aachen (Germany).	Nº of participants:	850
. 1991:	Firenze (Italy).	Nº of participants:	1.000
. 1993:	Brighton (United Kingdom).	Nº of participants:	750
. 1995:	Seville (Spain).	Nº of participants:	800
. 1997:	Trondheim (Norway).	Nº of participants:	975
. 1999:	Lausanne (Switzerland).	Nº of participants:	1040
. 2001:	Graz (Austria).	Nº of participants:	850
. 2003:	Toulouse (France).	Nº of participants:	1.000
. 2005:	Dresden (Germany).	Nº of participants:	805
. 2007:	Aalborg (Denmark).	Nº of participants:	875
. 2009:	Barcelona (Spain).	Nº of participants:	1130

Statistics from previous EPE conferences:




EPE 2007 Aalborg - Stadistics
180
160
140
120
100
80
60
40
20
0
University
Industry
total
Germany
France
Switzerland
Japan
United Kingdom
Italy
Spain
Nordic countries (DK, N, S)
Poland
Benelux
Finland
Rest of Europe
rest of the world


EPE 2005 - Dresden - Statistics
250
200
150
100
50
0
Industry
University
total
Germany
France
Switzerland
Japan
UK
Italy
Spain
Nordic Countries (DK, N, S)
Poland
Benelux
Finland
Rest of Europe
Rest of the world


EPE 2003 - Toulouse - Statistics
300
250
200
150
100
50
0
Industry
University
total
Germany
France
Switzerland
Japan
UK
Italy
Spain
Nordic Countries (DK, N, S)
Poland
Benelux
Finland
Rest of Europe
Rest of the world