Tuesday, May 25, 2004

8:30 Opening Room Paris

8:45 Keynote 1 Room Paris

The Motor Control Technologies for the Hybrid Electric Vehicle – From the State of the Art to Future Trends

Shoichi Sasaki
Project General Manager
Toyota Motor Corporation, JAPAN

Summary
A brief introduction of hybrid systems, and their comparison, especially the system that is implemented in TOYOTA Prius, the first passenger vehicle introduced in the world are presented. And the motor control technologies used in the Prius are also presented. Challenges for further development of hybrid vehicles especially on the motor and inverter are discussed.

9:30 Break

Lecture Sessions 1
9: 45 – 11: 25

Room Paris

S1a
Power Integration 1
Chairman: Alfred Rufer, EPFL, SWITZERLAND

9:45 S1a-1 Investigations of the Influence of PCB Layout Parasitic Inductances in DC/DC-Converters on the Efficiency
J. Ejury, Infineon Technologies, A. Elbanhawy, Fairchild Semiconductor, USA

Summary:
In this paper we will examine the effects of PCB parasitic inductances on the performance of DCDC converters, specifically the source inductance, gate inductance and drain inductance in combination or separately. Furthermore we will investigate the same effects when the switching frequency increases from 200 kHz to 1 MHz. Also we will show the importance of a precise current sharing for highest efficiencies.

10:10 S1a-2 A Method to Determine Parasitic Inductances in Buck Converter Topologies
D. Ahlers, G. Nöbauer, J. Ruiz-Sevillano, Infineon Technologies, AUSTRIA

Summary:
The key parameters determining the switching speed in a buck converter are discussed. A set of equations is derived to determine the stray inductances of the MOSFET packages and the buck converter topology. The results are applied to an example from a real application circuit.

10:35 S1a-3 High Load Currents on FR4-Printed Circuit Boards - Design Considerations and Limits

A. Lese, U. Scheuermann, Semikron Elektronik, GERMANY

Summary:
The paper discusses the design of high current tracks on FR4 PCBs for compact CIB modules. The extrapolation of standard design rules for PCBs is investigated for currents of more than 35A. Different test structures are analysed to evaluate the determining factors of the current capability of high current PCB tracks. The experimental data is a basis for design rules for high current tracks on PCBs.

11:00 S1a-4 Comparative Study of New Emerging Packages for High-Power IGBT Modules

R.-J. Pasterczyk, MGE UPS Systems, J.-L. Schanen,
Laboratoire d'Electrotechnique de Grenoble, France

Summary:
The paper presents detailed electrical analysis of new power electronics 6-packs for high-power 300 / 450A IGBT modules. Generic electrical equivalent scheme of internal package layouts is deduced from PEEC InCA® approach. Analysis of current sharing and voltage surges between all IGBTs and diodes dice has been achieved powered by Saber® as well as interactions among all power and drive circuits were precisely evaluated.

Room Amsterdam

S1b
Low Power Converters
Chairman: Ionel Dan Jitaru, Delta Energy Systems, USA

9:45 S1b-1 The Road to 200Amp at 1 V VRM

A. Elbanhawy, Fairchild Semiconductor, USA

Summary:
This paper describes in details the complete design approach, design trade-offs and MOSFET selection criteria of the first 1 Volt, 200Amp DC-DC converter (VRM) in the industry for the PC market. PCB design approach and size limitations. Cooling requirements are also discussed. Detailed test results and lessons learned will be presented together with a discussion of future improvements

10:05 S1b-2 SiC Single Switch Resonance Reset Forward Converter with ZVS for AC-DC Power Supplies

A. Melkonyan, Infineon Technologies / University of Kassel, GERMANY

Summary:
An overview of the single switch Resonant Reset Forward converter, its limitations and a solution, based on Resonant Reset Forward topology with ZVS, to overcome these limitations are presented. Practical application of the new SiC JFET transistor realising the proposed topology with higher efficiency is shown.

10:25 S1b-3 Changing the Guard - The Next Step in Power MOSFET Packaging for DC/DC Applications

Y. Bulut, A. Smith, Vishay Siliconix, USA

Summary:
As the power density requirements of dc-to-dc converters continue to increase, board real estate is premium increasing demand for power MOSFET packages with a smaller footprint, and improved thermal and electrical efficiency. Advances in silicon technology have helped to reduce on-resistance (rDS(on)) for a given die size to almost negligible levels. This paper will analyse new small package options to reduce conduction losses and switching losses by using the appropriate power MOSFET solution while allowing higher density packaging of the converters.

10:45 S1b-4 Use of Parasitic Power Switch Capacitance for Core Demagnetization Detection in SMPS

F. Lhermite, ON Semiconductor, FRANCE

Summary:
The Quasi Resonant SMPS requires a core-demagnetisation detection. The voltage waveform present on the Power MOSFET Drain creates through its parasitic capacitance Crss a current having a phase lag of 90°. A technique is described that allows the reading of the negative portion of this current and provides a signal coincident with the positive going zero-current-crossing to acknowledge the valley point voltage.

11:05 S1b-5 Hard and Soft Filtering Techniques applied to DC-DC CUK Type Converters Association

C. Pasquier, J.L. Cocquerelle, LEPCEM Polytech Nantes, P. Levron, Scheiber, FRANCE

Summary:
This paper deals with a RF currents harmonics reducing method, based on the application of modular technology to CUK type DC/DC converters. N CUK types converters are parallel connected. Converters have the same duty cycle (a). Commands are displaced (of T/N) or not displaced. For each case we study RF conducted emissions level, which depend on N and a. The line filter reduction is consequently possible. The best one, is obtained using parallel combination, optimal duty cycle and displaced control.

Room London

S1c
Mechatronics

Chairman: Jose Mario Pacas, University Siegen, GERMANY

9:45 S1c-1 The More Electric Aircraft - A Matrix Converter Based Electro-Hydrostatic Actuator

P. Wheeler, J. Clare, L. Empringham, M. Apap, K. Bradley, University of Nottingham, C. Whitley, G. Towers, Smiths Aerospace, UK

Summary:
This paper explores thre reason behind the More Electric Aircraft concept and describes the design, construction and testing of a Matrix Converter Permanent Magnet Motor Drive for an Electro-Hydrostatic Aircraft Actuator (EHA). The converter has been built using a 35Amp IGBT Matrix Converter module and includes closed loop vector control. Practical results from the testing of this converter are presented.

10:10 S1c-2 Design and Realization of Adaptive Control Algorithms for Parallel Kinematic Machines

C. Hamm, Siemens, GERMANY

Summary:
The article to be presented at the PCIM Europe 2004 conference will present methods to model machine tools with a non-linear mechanical structure (like parallel kinematic machines). The significant parameters of the models will be identified using measured frequency responses. The main goal is to design adaptive control algorithms.

10:35 S1c-3 Mechatronic Analysis of Direct Drive Systems
E. Schäfers, J. Hamann, H.-P. Tröndle, Siemens, GERMANY

Summary:
In contrast to common drives, with direct drives the motor is finally generated when it is integrated into the machine. The mechanical and electrical subsystem are merged to the mechatronic system by the velocity and position control loops. Since control parameters have a crucial influence on the behaviour of the complete system, a main goal of this contribution is to get their importance to machine characteristics like stiffness and dynamics across. Furthermore, different approaches for the control of direct drives are discussed.

11:00 S1c-4 Adaptive Reduced Modal Model Identification for Arbitrarily Branched Multi-Inertia Traction Drive-Trains
M. Fleischer, University Erlangen-Nürnberg, GERMANY

Summary:
The traction drive-train of modern locomotives consists of a multi-inertia system. For control purposes an accurate and suitable reduced three-inertia model is required. Therefore a universal modal identification algorithm is proposed taking arbitrarily branched multi-inertia traction drive-trains and adaption due to wheelset wear into consideration.

Room Zürich

S1d
Intelligent Energy Management
Chairman: Hilmar Darrelmann, RWE Piller, GERMANY

9:45 S1d-1 Optimization of Sizing and Tuning Energy Storage Systems and Energy Management
L. Nicod, Alstom, FRANCE

Summary:
The communication focus on the different candidate technologies for Energy System Storage (ESS) : Flywheels, supercapacitors and on the way to use them associated with energy source like fuel cells. Designing such power supply systems is complicate and optimisation design technics will be presented with results.

10:10 S1d-2 Simulation of a Grid connected Hybrid Storage System in ATP/EMTP
M. Bodach, H. Mehlich, S. Völler, Technical University Chemnitz, GERMANY

Summary:
The integration of storage systems in electrical networks, e.g. for renewable energy sources, requires first an exact simulation of such storages. A basic storage model will represented which is able to use combined systems like fuel cell and supercap. The paper shows that such combinations increase the power quality in the connected grid. The storage was simulated in the model of a real existing grid.

10:35 S1d-3 Flywheels as Supplement to Batteries on UPS - Benefits of Redundancy and Battery Life Extension
C.S. Richey, Active Power, USA

Summary:
Flywheel Energy Storage Systems (FESS) can add years to the life of UPS batteries and increase the overall reliability of UPS systems. Flywheels installed in parallel with lead acid batteries isolate the batteries from 96% of all power events at an “average” location in the United States; according to the EPRI PQNA power quality study.

11:00 S1d-4 New Large Variable Speed Drive for Pump-Storage Stations
A. Bocquel, J. Janning, Alstom Power Conversion, GERMANY

Summary:
The topology and control of a new pump-storage station is presented. Two electrical machines (300 MVA each) are designed as converter driven doubly-fed induction machines. Major benefits of this innovative concept are the increase of the efficiency of the turbine and the high dynamic power control for the stabilisation of the grid.

Lecture Sessions 2
11: 40 – 1: 20

Room Paris

S2a
Medium Power Converters I
Chairman: Serge Bontemps, APT Europe ASPM, FRANCE

11:40 S2a-1 Design and Comparative Evaluation of Three-Phase Buck+Boost and Boost+Buck Unity Power Factor PWM Rectifier Concepts for Supplying Variable DC Voltage Link Converters
T. Nussbaumer, K. Mino, J.W. Kolar, ETH Zürich, SWITZERLAND

Summary:
Two topologies fulfilling the same function are presented and evaluated comparatively for a plasma power supply application. Based on switching loss measurements and analytical calculations the overall efficiency and the loss contribution of the power components are given for different operating points. Together with further characteristics like volume, weight and realisation effort a guideline for the selection of the appropriate topology for a specific application is presented.

12:05 S2a-2 Interleaved Operation of Single-Phase Inverter Stages
P. Ide, P. Wallmeier, B. Margaritis, Delta Energy Systems, GERMANY

Summary:
A new control scheme for parallel operation of single phase inverter stages, suitable for decentralised power systems is presented. This control schemes makes sure, that no common mode currents are circulating in case of coupled DC-link voltages. Different arrangements of full-bridge IGBT inverter stages are compared in terms of component stress, ripple cancellation and control efforts

12:30 S2a-3 70W High Efficiency AC Flyback Adaptor with Synchronous Rectification
F. Librizzi, STMicroelectronics, ITALY

Summary:
The design of a 70W AC-DC Converter is presented. The design is intended to achieve good performances in terms of efficiency. These performances are reached using Quasi-resonant topology together with synchronous rectification on the secondary side. Comparisons between theoretical and experimental results are presented. The converter meets no-load power consumption requirements indicated by EU Code of conduct.

12:55 S2a-4 The "Huge" Converter: A One High-Frequency Switch new Single Stage PFC Converter, adapted to operate as a Boost Buck-Boost or Buck Topologies
H. Jorquera, General Electric Medical System, FRANCE

Summary:
This paper presents a new PFC topology, which is able to operate as step-up or step-down converter. One main transistor regulates output-voltage and input-current shape; two low-frequency transistors select between Buck, Boost or Buck-Boost configurations. A prototype was tested sequencing all three configurations and obtaining high PFC and high efficiency.

Room Amsterdam

S2b
Gate Drivers and Low Power Integration
Chairman: Josef Lutz, Technical University Chemnitz, GERMANY

11:40 S2b-1 IGBT/MOSFET Driver Applications Based on Coreless Transformer Driver IC 2ED020I12-F
A. Volke, M. Hornkamp, eupec, GERMANY

Summary:
The CLT technology offers developers a new alternative to implement driver ICs for IGBTs and MOSFETs. Currently almost all driver applications are based on opto-couplers, transformers or level-shifters for function isolation. This paper presents sample applications based on the 2ED020I-F for IGBTs and MOSFETs with respect to low-cost solutions.

12:05 S2b-2 An Isolating IGBT Halfbridge Driver Module with Embedded Magnetics
S. Zeltner, M. März, M. Billmann, Fraunhofer Institute of Integrated Systems and Device Technology, GERMANY

Summary:
A compact IGBT halfbridge driver module is presented. The driver is based on PCB embedded magnetics. A single inductive coupling element is used for galvanic isolation of the gate control and diagnostic feedback signal as well as for the gate drive power supply. The operation of the driver is described in detail, just as the mechanical construction which aims on volume production. Applications oriented data and test results are given.

12:30 S2b-3 New IGBT Driver IC including advanced Control and Protection Functions for 1200V, 3-Phase Inverter Applications
J.-F. Garnier, A. Boimond, STMicroelectronics, FRANCE

Summary:
In this paper, the author presents a new integrated circuit that includes all the functions needed to drive an IGBT in power applications from 1kW to more than 100kW. Advanced features like Active Miller Clamp and Two-Level Turn-off are presented, and benefits in high performance, cost effective applications are highlighted.

12:55 S2b-4 IGBT Drivers – Design for Quality
H. Rüedi, J. Thalheim, CT-Concept Technologie, SWITZERLAND

Summary:
The theoretical advantages of new IGBT technologies can be exploited only with optimal driving capability. The complex demands made on IGBT driver circuits, especially in the higher power and voltage ranges, call for an efficient design methodology to optimize reliability, functionality, scalability, costs and time-to-market. This presentation shows the design methodology of the SCALE driver family. These drivers are used in large item numbers and have proved highly successful within a broad diversity of applications.

Room London

S2c
Variable Speed Drives
Chairman: Gerhard Pfaff, University Erlangen-Nürnberg, GERMANY

11:40 S2c-1 Hybrid Vehicles
J. Laeuffer, PSA Peugeot Citroen, FRANCE

Summary:
Hybrid cars are new combinations of thermal engines and electric drives inside the power train. Including one electric drive makes an additional power. Including two electric drives makes a continuous torque transmission to the wheels. Large fuel economy may be managed with only a small transient energy storage, inside a supercapacitor or a very small fly-wheel. Automotive costs may be reached choosing best combinations of mechanics, electrotechniques and power electronics.

12:05 S2c-2 New Speed Control System for Current-Source Inverter Fed High Speed Induction Machine Drives
S. Rees, University of Stuttgart, GERMANY

Summary:
A new cascaded speed control system for high speed induction machines fed by current-source inverters is presented. The inner stator voltage control loop is fundamentally stable, thus there are no limitations to the filter capacitor dimensioning. The effects of non-linear feedback- and cross-couplings on the stator currents are almost eliminated by means of a novel disturbance observer.

12:30 S2c-3 Sachs Converter - a new Topology for High Speed, Galvanic Isolated Drives
M. Ziegler, D. Domes, W. Hofmann, Chemnitz University of Technology, GERMANY

Summary:
A new AC-AC converter topology is presented. In comparison with the matrix and DC-link converter (active front end) only 9 than 18 and 12 active switches have to be managed, respectively. In addition the proposed topology allows a very simple control mechanism because no interlock algorithm is needed. Therefore high switching frequencies are possible and dead time effects can be neglected.

12:55 S2c-4 Synchronous Reluctance Machine Based Compact Variable Speed Drive System
I.-A. Viorel, L. Szabó, R. C. Ciorba, V. Barz, Technical University of Cluj, ROMANIA, Z. Puklus, Szechenyi Istvan University, HUNGARY

Summary:
Variable speed drives reduce energy costs by saving energy when load requirements are reduced. The synchronous reluctance motor due to its simple construction can be an efficient solution for such drives. Integrating it with a variable frequency power converter existing on the market leads to an efficient compact drive system, which may have several applications.

Room Zürich

S2d
New Energy Storage Solutions
Chairman: Jean-Paul Beaudet, MGE UPS Systems, FRANCE

11:40 S2d-1 Field Performance of a New Flywheel Power System
D. Townley, Pentadyne Power Corporation, USA

Summary:
Pentadyne Power Corporation has recently introduced its new Pentadyne Voltage Support Solution™ (VSS). This presentation will summarise the field performance of the VSS 120 in a variety of installations. The presentation will cover aggregate data reflecting experience on installation, applications and performance.

12:05 S2d-2 Supercapacitors: New Components for High Performance Power Drive Systems
C. Attaianese, V. Nardi, F. Parillo, G. Tomasso, University of Cassino, ITALY

Summary:
Recent developments in the field of supercapacitors allow using these components in a large range of applications. In particular, they can be usefully adopted in all the drive applications where an energy recovery is possible. In the paper experimental and simulated comparison tests of the principal supercapacitors recovery energy scheme are proposed. In particular a new predictive control of step-up converter is proposed.

12:30 S2d-3 Ultracapacitors to Overcome Power and Reliability Requirements of Electronic Products
A. Schneuwly, J. Auer, G. Sartorelli, Maxwell Technologies, SWITZERLAND

Summary:
Ultracapacitors are a viable component for production-intent designs to overcome power and reliability requirements in the power electronics world. In UPS installations ultracapacitor systems provide highly reliable power during the start-up or transfer to e.g. generators, micro-turbines or fuel cells. In wind turbines an ultracapacitor emergency power pack immediately ensures the safe and reliable functioning of fast blade pitch systems.

12:55 S2d-4 Evaluation of Electric Energy Storage: Batteries, Flywheels and Supercaps
T. Montanie, F. Porcher, Alstom Transport, FRANCE

Summary:
Due to the lack of test standard, it is practically impossible to evaluate the performances of the different kinds of energy storage by directly using the data sheets of the suppliers. The ambition of the paper is to give a comparison between the main types of energy storage and the main results of an economic approach. But an absolute classification is unrealistic due to the large range of needs and constraints. The values are the results of tests and design for an utilisation for an urban rail vehicle utilisation.

CCN West, 2nd Floor

Poster/Dialogue Sessions

2 :30 – 3 :50

PP-1 A Simple Position-Encoder Based on a Magnetic Field Sensor
J. Kiel, U. Koch, Lust Antriebstechnik, GERMANY

Summary:
For low cost – medium performance applications (e.g. in combination with an induction machine) a simple position - sensor was developed, based on a magnetic field sensor and a permanent magnet fixed to the rotor shaft. Therefor a contactless measurement is possible, which also allows high speed. Different magnet forms and materials have been investigated, and criteria for accuracy guaranty have been developed.

PP-2 H ∞ Position Control with Robust Non-linear Friction Compensation for a Two-Mass System
K. Peter, B. Orlik, University of Bremen, GERMANY

Summary:
A position control of a two-mass system is a common problem in industrial automation. The control difficulty caused by the compliant coupling is often increased by non-linear friction. Limited cycles and stiction effects are known in this context. This paper describes the design of a robust H ∞ position control with a non-linear friction compensation. Measurements will complete the paper.

PP-3 Innovative Solutions in Power Electronics. A fully Integrated Intelligent Driver for Automotive DC Motors and Application Hints
L. Guarrasi, A. Longhitano, A. Mottese, STMicroelectronics, ITALY

Summary:
Smart power technology is the spell to address new and old applications in automotive environment. A detailed comparison between a traditional approach and an innovative one (smart power) shows the advantages of the second solution. “Mechatronic” approach allows an improvement of thermal performances, reducing wiring and overall costs. The EMI suppression is highlighted as well.

PP-4 Electromagnetic Torque as a Tool for Diagnosis and Condition Monitoring Purposes in Induction Machine Electrical Drives
C. Martis, D. Barna, B. Karoly, Technical University of Cluj-Napoca, ROMANIA,
H. Henao, University of Picardie "Jules Verne", FRANCE

Summary:
This article presents a complete analytical description of the electromagnetic torque of the induction machine, without and under defaults. Electromagnetic torque could be an important element defining the behaviour of the induction machine and can provide a model-based approach of the stator and rotor fault detection in induction machine. An experimental validation of the proposed analytical approach is provided.

PP-5 Reduce Time to Market with Rapid Prototyping of High Power Converters
P. Schugart, American Superconductor, USA

Summary:
The ability to quickly fabricate a power conversion system will be a determining factor for the leaders in the marketplace. The PM1000’s modular approach, library of control algorithms and user friendly interface allow it to be configured to address a wide range of applications (such as AC-AC, AC-DC, DC-DC or DC-AC) and provides a platform for rapid development of high power converters and systems.

PP-6 MOSFET Loss and Junction Temperature Calculation Model in MATLAB

J. Chen, S. Downer, International Rectifier, USA

Summary:
MATLAB is a widely used tool to do high level system analysis. However, evaluation of power electronics is rarely done in the same environment. In this study, a MATLAB subsystem is proposed to calculate MOSFET loss and junction temperature basing on measured device characteristics, and corporate with system simulation. It helps the integration of system analysis with device characterisation. Test results validate this approach with high accuracy.

PP-7 Realistic Benchmarking of IGBT-Modules with the Help of a Fast and Easy to Use Simulation-Tool

R. Schnell, U. Schlapbach, ABB Semiconductors, Switzerland

Summary:
The definition of the nominal current rating of IGBT modules differs significantly between the manufacturers. Therefore that value becomes quite unusable for component selection. This paper describes a simple and fast to use simulation-tool that enables to compare IGBTs in the real application case. The tool performs static and transient calculations of losses and temperature rises together with heatsinks.

PP-8 New 1700V IGBT Modules with CSTBT

S. Iura, E. Suekawa, Mitsubishi Electric, K. Morishita, M. Koga, Fukuryo Semicon Engineering, JAPAN

Summary:
In this paper we deal with a new series of 1700V IGBT modules using our new trench gate technology called – Light Punch Through Carrier Stored Trench gate Bipolar Transistor, LPT-CSTBT – and a new diode technology.

PP-9 World First 3300V / 1200A IEGT Module in Trench-Gate Technology

N. Tsukamoto, K. Nishitani, Toshiba, JAPAN, G. Tchouangue, Toshiba Electronics, GERMANY

Summary:
A new 3,3kV/1,2kA Trench-gate IEGT Module has been developed. This paper is aimed at presenting the remarkable improvements achieved by using the Trench-Gate technology and the benefits for the power designers: switching losses, turn-off capability and short circuit capability. Target applications are large UPS, transportation, Iron-mill motor and so on.

PP-10 Characterisation of Low Voltage IGCTs (3.3KV) by using an Opposition Method Test Bench

S. Alvarez, CIDAE, SPAIN, Ph. Ladoux, ENSEEIHT, FRANCE, E. Carroll, P. Streit, ABB Semicondcutor, SWITZERLAND

Summary:
The opposition method has been employed to characterise the experimental Low Voltage IGCTs (3.3KV) from ABB Semiconductors. The very low conduction losses and reduced switching losses of this component provide a new High Power / Medium Voltage Semiconductor that can be used at high switching frequency (more than 1KHz) and / or at high current rates to improve High Power / Medium Power Converters' performances.

PP-11 Design, Characteristics and Applications of 10kV IGCTs

S. Bernet, S. Tschirley, Technical University Berlin, GERMANY, P. Streit, ABB Semiconductor, SWITZERLAND

Summary:
This paper describes the design, the characteristics and potential applications of 10 kV IGCTs. A detailed description of the device design and measurements of blocking, on-state and switching behaviour of 10 kV IGCTs are the basis for a derivation of potential applications. The application of 10kV IGCTs in industrial medium voltage converters, interties and static breakers is discussed.

PP-12 Recent Advances in Low Voltage MOSFETs are made more effective by new Packaging Concepts: PowerSO-8™ and STripFET™ III Boost DC-DC Converters Efficiency to Higher Levels

M. Melito, F. Di Giovanni, G. Belverde, A. Magri, STMicroelectronics, ITALY

Summary:
The need for improved efficiency in DC-DC conversion is imposing new constraints not only on MOSFETs' silicon, but also on the way it is packaged. At the end it is the combination of advanced silicon and efficient assembly that makes the difference.

PP-13 Dynamical Behaviour of High Voltage Mosfets and IGBTs in Resonant Power Converters Using Piezoelectric Transformers

F.E. Bisogno, M. Radecker, A. Knoll, Fraunhofer-Institut AiS, GERMANY, A.Vazques Carazo, Face Electronics, USA, A. Riedlhammer, G. Deboy, Infineon Technologies, J.M. Pacas, University Siegen, GERMANY

Summary:
Line power supplies with piezoelectric transformers (PT) are becoming interesting for many low power applications due to their advantages in size and costs. In this paper it is shown, how a 1200 V blocking Fieldstop-IGBT guarantees all, extremely low chip size, minimum dynamical losses, and optimum drive and control of a power supply of 1 to 5 Watts, using a PT.

PP-14 High Speed Complementary Gate Drive Utilising a Single Planar Transformer

J.P. Kärst, K.F. Hoffmann, Philips Medical Systems, GERMANY

Summary:
A complementary gate drive utilising a single planar transformer is presented. Both switches are isolated from the control. A planar printed circuit board (PCB) transformer is reliable, reasonably priced and FR4 material has an outstanding isolation capability. A local surface mounted additional PCB is used. The driver operates at switching frequencies up to 200kHz.

PP-15 An Integrated Multi-Functional Control Scheme Based on a Variable Structure Unified Power Flow Controller for Power Quality Control and Energy Saving

T.-T. Ma, S.J. Chiang, National United University, TAIWAN

Summary:
This paper presents an integrated multi-functional control scheme based on a unified power flow controller for power quality control and energy saving. The proposed control scheme can compensate the reactive power, harmonic current and unbalanced power of the load with a capacity-limitation manner. It also can regulate multiple load voltages simultaneously based on the P-V characteristics of distinct loads for energy saving.

PP-16 Optimised Solar Inverter Power Stage

K. Edelmoser, Technical University Vienna, AUSTRIA

Summary:
Conventional power inverters used in mains connected applications fight with the disadvantage of the hard switched PWM power stage. A simple modification in the inverters output section can lead to a significant improvement of the losses in the System. Only two additional components (diodes) are necessary to optimise the power stages for usage in a mains coupled inverters.

Lecture Sessions 3
4:00 – 6:30

Room Paris

S3a
High Power Components
Chairman: Brian Taylor, BrightOne Consultancy, UK

4:00 S3a-1 2.5kV-6.5kV Industry Standard IGBT Modules Setting a New Benchmark in SOA Capability
M. Rahimo, A. Kopta, R. Schnell, U. Schlapbach, R. Zehringer, S. Linder, ABB, SWITZERLAND

Summary:
In this paper, we introduce our new HV-HiPak module line-up with voltage ratings ranging from 2.5kV up to 6.5kV. The HV-HiPak modules employ ABB's newly developed high voltage SPT- IGBTs and diodes showing excellent over all electrical performance while setting new standards in SOA capability.

4:25 S3a-2 Power and Auxiliary Terminals for Modern "Low Profile" Power Modules
M. Freyberg, Semikron International, GERMANY

Summary:
The characteristics of modern IGBT chip generations require a new module package approach. The paper describes the low profile concept of SEMIKRON´s new IGBT module family SEMiX (TM). The internal construction of the power and the auxiliary terminals is presented. The performance of soldered power connections and auxiliary spring contacts is demonstrated and reliability and environmental test results are discussed.

4:50 S3a-3 6.5kV IEGT Module Development for Industrial Applications
N. Yamano, K. Nishitani, Toshiba, JAPAN, G. Tchouangue, Toshiba Electronics, GERMANY

Summary:
6.5kV/600A IEGT Module has been developed. In this 6.5kV IEGT Module, the specific features from 4.5kV Press Pack IEGT and from 3.3kV IEGT Module are combined. The benefits for the power system designers: switching losses, turn-off capability and short circuit capability. Target applications are high power field like transportation and Industrial drives which are operated under 3kVDC and 4.2kVAC.

5:15 S3a-4 New 3300V Trench IGBT Module for Highest Converter Efficiency
J. Biermann, Ch. Lübke, eupec, M. Pfaffenlehner, Infineon Technologies, GERMANY

Summary:
The paper presents the advanced performance of the new 3300V chip generation – IGBT3 and Emcon3 – and shows their benefits for highest inverter efficiency. Measurement results of the characterisation of high power modules with an enlarged current density are shown.

5:40 S3a-5 Large Area IGCTs with Improved SOA
T. Stiasny, P. Streit, M. Frecker, M. Lüscher, ABB, SWITZERLAND

Summary:
In this paper, we present our efforts to extend the SOA of IGCTs. On one hand we improved the local SOA of the device up to switching power density of 1MW/cm2, on the other we compensate effects of lateral turn-off inhomogenites leading to redistribution of current.

6:05 S3a-6 New Hybrid Circuit-Breaker/Current Limiter Topology with Serial and Parallel Commutation Assistance
P. Sellier, Technicatome, R. Besrest, CAPSIM, FRANCE, C. Zimmerman, LEI EPFL, SWITZERLAND

Summary:
The presented work is about a new hybrid circuit breaker topology based on the use of serial and parallel semiconductors that allows to increase the withstand voltage and current with no arc, and to benefit from a current limitation function. All constraints have been spread over the different components in order to optimise the system.

Room Amsterdam

S3b
Sensors and Diagnostics
Chairman: Salvatore Chiama, Consultant, ITALY

4:00 S3b-1 High Precision Current Analysis with Zero-Flux-Technology
H. Bezold, Signaltec, L. Kolb, University of Applied Sciences Ulm, GERMANY

Summary:
Current-, voltage-, power-analysis and loss calculation at modern drives demand highest accuracy from instruments and associated transducers. Zero-flux-transducers offer an accuracy in the ppm-range and a frequency range from DC up to several 100 kHz. The paper describes the working principle of zero-flux transducers and the advantages compared to other technologies.

4:25 S3b-2 PRiME Current Transducers - A Novel Approach for AC current Measurement
E. Favre, LEM Components, Switzerland, Mr. Ebenezer, Mr. Marsh, LEM Heme, UK, Mr. Sorensen, Suparules, IRELAND

Summary:
An innovative solution for AC current measurements will be presented. The design is an air-cored transformer made of printed-circuit-board. Similar technical solutions are already existing but suffer from limited sensitivity / performances. A breakthrough idea in the way of protecting the measurement from external perturbation has allowed to design transducers with significantly enhanced perfomances.

4:50 S3b-3 Low Ohmic Current Sensing Resistors made from Cu-MANGANIN®-Cu Material
U. Hetzler, Isabellenhütte Heusler, GERMANY

Summary:
Ideally suited for the economic manufacture of extremely low ohmic resistors in the µOhm range - longterm stability and precision of only a few ppm - implementation of four terminal technology possible - reduction of resistance value means reduction of power loss.

5:15 S3b-4 Sound Source Location Measuring System for a Systematic Design Modification of Electrical Machines
R.H. Lach, S. Soter, University Dortmund, GERMANY

Summary:
Only with acoustic measurements according to the CE-rules electrical machines are allowed to bring to market. With minor enhancements, given in this paper, a source location and a frequency determination of the source is to be operable with a conventional sound intensity measuring system. So that a design modification of electrical machines for reduction the radiated sound power could be done.

5:40 S3b-5 A FPGA Based Rotor Fault Diagnostic Tool for Squirrel Cage Induction Machines by Means of the Vienna Monitoring Method
H. Oberguggenberger, Ch. Kral, F. Pirker, Arsenal Research, AUSTRIA

Summary:
The Vienna Monitoring Method (VMM), is a model based technique to detect rotor asymmetries (e.g. broken rotor bars) in the squirrel cage of an induction machine. This contribution deals with the implementation of the VMM-Models in a FPGA (Field Programmable Gate Array). Measured results obtained from the FPGA based monitoring system will be presented for a squirrel cage induction motor with one broken rotor bar.

Room London

S3c
System Modelling, Estimation and Optimization of Drive Systems
Chairman: Helmut Knöll, University of Applied Sciences Würzburg-Schweinfurt, GERMANY

4:00 S3c-1 Parameter Identification of a Two-Mass-System in the Frequency Domain
J.M. Pacas, S. Villwock, University Siegen, Th. Eutebach, Lenze, GERMANY

Summary:
The drive shaft of the two-mass-system is modelled by damper-spring-system. The identification of four mechanical parameters is carried out on basis of measured data. Since the data is available in the frequency domain the parameters are identified in the frequency domain, as well. In order to solve this problem the numerical method of Levenberg-Marquardt is implemented.

4:25 S3c-2 Autotuning Compliant Systems with Optimal Bi-Quad Filter
G. Ellis, Danaher Motion, USA

Summary:
The bi-linear quadratic (bi-quad) filter is commonly used to improve the performance problems caused by compliant transmission components. However, the bi-quad filter is difficult to configure manually because four parameters must be set simultaneously. An autotuning method is developed that automatically configures the bi-quad filter with other tuning gains to provide optimal performance in the presence of compliant transmission components. Simulation and laboratory results are provided.

4:50 S3c-3 Bode Plot Based Auto-Tuning - Enhanced Solution for High Performance Servo Drives
J.O. Krah, Danaher Motion, GERMANY

Summary:
Instead of tuning a servo drive system by a high educated servo expert the bode plot based auto-tune can provide reliable results in a short time frame. The result is documented with an open and closed loop bode plot that shows key performance indexes like bandwidth and stability margin.

5:15 S3c-4 Identification of Nonlinear Magnetizing Inductance of Induction Machines using Harmonic Analysis ensuring Torque Optimized Control under consideration of main Flux Saturation
T. Laczynski, Ch. Rudolph, B. Orlik, University of Bremen, M. Tinebor, Lenze Drive Systems, GERMANY

Summary:
Using harmonic analysis the non-linear magnetising inductance of an induction machine is identified. Stator and rotor resistances as well as leakage inductivities have been identified before. Utilizing these machine parameters the analytical calculation of optimised operation points can be performed. The results lead to a torque optimised operation at base speed and in the field weakening range.

5:40 S3c-5 Transfer Function Analysis and Digital Filter Techniques for Motion Control Systems
B. Liu, F. Götz, H. Meis, Baumüller Anlagen-Systemtechnik, GERMANY

Summary:
This transfer function analysis is integrated in the controller software. Based on two channels FFT and a sufficient persistent excitation, the open loop or closed loop transfer function can be identified. The quality of the identification is evaluated by the coherence function. After identification, various digital filters, e.g. the notch filter or the ellipse filter can be used for compensation.

Room Zürich

S3d
Power Quality Improvements
Chairman: Pavol Bauer, Technical University Delft, THE NETHERLANDS

4:00 S3d-1 Hybrid 120MVAR Industrial SVS System for Flicker Mitigation
G. de Préville, D. Michel, Alstom, FRANCE

Summary:
The paper describes a complete EAF installation with different means for flicker mitigation: SVC, D-STATCOM and hybrid solution (SVC+D-STATCOM). Complete EAF installation including Flickermeter and controls of power electronics (TCR and STATCOM) was simulated in Matlab/Simulink. Hybrid solution offer a lot of advantages in front of classical solution and full emergent solution: economical costs, step by step approach and redundancy aspects. Expected performances are similar to full D-STATCOM solutions.

4:25 S3d-2 Harmonic Depollution of a Hypermarket by Active Harmonic Conditioners
S. Vossot, Lycée Louis Couffignal, P. Bois, MGE UPS Systems, FRANCE

Summary:
Proliferation of non-linear loads connected to the electrical network generates disturbances, the effects of which are increasingly obvious. Problems relating to the presence of harmonics do not only affect industry. The following study takes a hypermarket as its context. This type of establishment must possess an emergency supply source should the main network fail, to guarantee safety of people and maintain supply to priority loads. By increasing the power of this source, it its able to supply the entire shop and thus generate major savings on the annual electricity bill. Unfortunately, unpleasant surprises may be in store when the harmonics present in the emergency source are amplified by the shop lighting facilities. Installation of active harmonic conditioners proves to be an ideal solution for this type of problem.

4:50 S3d-3 New Leading Power Factor Loads in Data Centers are a Challenge for UPS
H. Darrelmann, RWE Piller, GERMANY

Summary:
New server generation in Data centers consider correction of lagging power factor and reduction of harmonic input currents. With passive elements added to the input circuit this often results in a leading power factor. The paper shows test results on single servers and entire computer room loads and how UPS can deal with this kind of load.

5:15 S3d-4 Demand-Side Power Quality Monitoring for High-Reliability Applications
A. Kuznietsov, ZES Zimmer Electronic Systems, GERMANY

Summary:
This paper deals with customer-oriented measurements of power quality. Main problems of power quality monitoring as well as drawbacks of existing techniques are described. The significant part of the document is devoted to the measuring techniques and related tools necessary for effective real-time monitoring of the interactions between network and customer. Special attention is paid to the methods of origin investigating to find out the strategy for mitigation of power quality factors.

5:40 S3d-5 Comparative Study on PWM Schemes for Three-Phase Buck PFC Rectifier
Y. Nishida, Nihon University, Y. Okuma, Fuji Electric Advanced Technology, JAPAN

Summary:
The PWM schemes of combinations with different carrier-signals (i.e., triangular and saw-tooth) and different reference-signals (i.e., sinusoidal, sinusoidal with zero-sequence-components and flat-top) have been compared. It is shown in the paper that the combination with the saw-tooth carrier and the reference consisting of a sinusoidal waveform and a 3rd harmonic give the best solution from the viewpoint of switching losses, quality of the filtered line-currents and avoiding oscillation of the filter.

Wednesday, May 26, 2004

8:30 Key Note 2 **Room Paris**

A 40-MW, 60-kV Electric Drive System with a 70-km, sub sea DC Link – From the State of the Art to Future Trends

Tom F. Nestli
Assistant Project Manager
ABB AS, NORWAY

Summary
Recent developments within power electronics and electric machines have enabled a 40-MW, 60-kV transformer-less electric drive system with the inverter and motor located in the North Sea, 70 km away from the rectifier. This paper describes this system and how it, along with other novel power electronic solutions, takes part in forming the future of high power electronics applications.

9:10 Key Note 3 **Room Paris**

Power Industry Restructuring: Challenges on new Technologies – From the State of the Art to Future Trends

Nouredine Hadjsaid
Director of IDEA-GIE and
Professor at INP Grenoble, FRANCE

Summary
Electric power industry is experiencing tremendous changes and restructuring in the way it's operated and planned more rapidly than at any time in its history. Privatization, open market and open-access, competition and customer oriented strategies are the keywords of this upheaval in many areas of the world. As a result, electric power industry in its new environment is facing to a rapid increase. The presentation will deal with three main parts: The event of deregulation, some feedback experiences and potential development in new power electronics based equipment in the context of restructuring of the power industry

9:50 Break

Lecture Sessions 4
10: 00 – 11: 40

Room Paris

S4a
Medium Power Converters II
Chairman: Pierre Aloisi, Consultant, FRANCE

10:00 S4a-1 High Frequency Inverter with Freewheeling SiC Schotty Diodes for Contactless Energy Transmission
R. Mecke, Ch. Rathge, Institut f. Automation u. Kommunikation Magdeburg, GERMANY

Summary:
Transferable electric power and efficiency of contactless transmission systems can be considerably improved by using higher transmission frequencies in the range of several hundred kilohertz. For this special application IGBT with fast freewheeling Si diodes leads to inadmissible operation states. SiC Schottky freewheeling diodes are preferred for this application.

10:20 S4a-2 600V-IGBT3: A Detailed Analysis of outstanding Static and Dynamic Properties
P. Kanschat, eupec, H. Rüthing, F. Umbach, F. Hille, Infineon Technologies, GERMANY

Summary:
With the new 600V IGBT3 and Emcon3 free wheeling diode eupec introduces a maximum junction temperature of 175°C. The paper discusses the chip technology allowing this step as well as robustness, static and dynamic performance with special focus to the temperature behaviour. Finally the guaranteed short circuit withstands time of 5 µs is delivered from a trade-off point of view.

10:40 S4a-3 A Novel Scheme for Current Shaping Circuits Yields Unity Power Factor in Fixed Frequency and Discontinuous Conduction Mode
J. Turchi, ON Semiconductor, FRANCE

Summary:
The paper deals with a novel technique to drive Power Factor Correction stages.

11:00 S4a-4 Optimisation of ZVZCS DC/DC Converter with Tapped Inductor
Z. Krzeminski, K. Kowalewski, A. Lewicki, Gdansk University of Technology, POLAND

Summary:
Zero Voltage and Zero Current Switching (ZVZCS) full bridge DC/DC converter is presented in the paper. Auxiliary circuits for effective reducing the switching losses are used in the proposed DC-DC converter. Simulations were used to optimise inverter parameters and working points. The experimental researches of 10kW DC/DC converter were realized and results are presented in the paper.

11:20 S4a-5 Outstanding 1000W AC/DC Power Supply with Boost PFC and Single Switch DC/DC Converter can Replace Supplies Including Multi-Switch Topologies
A. Müller, Technical University Ilmenau, S. Eisenhut, ISLE, GERMANY

Summary:
As a result of the increasing performance of modern power semiconductors and passive components, the power capability of single switch topologies increases too. It is shown, that it is possible to replace multi-switch topologies by single-switch ones if only the right topology and semiconductors are used. The theoretical analysis is verified by practical measurements using single-switch converters in a power range up to 1000W.

Room Amsterdam

S4b
Thermal Aspects

Chairman: Uwe Scheuermann, Semikron Elektronik, GERMANY

10:00 S4b-1 Blister Liquid Cold Plates - Production Technology; Thermal Performances Analysis and Application Comparisons

C. Capriz, AAVID Thermalloy, ITLAY

Summary:
The Blister Liquid Cold Plates are an innovative approach to the manufacturing of cost effective liquid cooling systems. The paper gives a short description of the technology followed by a detailed analysis of advantages and disadvantages of the application with laboratory tests and economical evaluations

10:20 S4b-2 Development of a High Temperature Package for Avionics Applications

S. Lefebvre, Saitie, S. Bontemps, APT Europe, L. Dupont, Z. Khatir, INRETS, R. Meuret, Hispano-Suiza, FRANCE

Summary:
The paper will present the realisation of an integrated power module dedicated to avionic applications in high temperature applications. The paper will also present electrical characterisation of semiconductor devices in high temperature operations in order to justify the choice of Silicon Carbide Schottky diodes and CoolMOS transistors. The high temperature IPM realised by APT Europe will be presented in detail.

10:40 S4b-3 “Shower Power" New Cooling Concept

K.K. Olesen, R. Eisele, Danfoss Silicon Power, GERMANY

Summary:
Comparing the “Shower Power” principle with state-of-the-art liquid coolers on the market shows that the principle is more effective than most of the coolers available and at a much lower cost. The principle can be implemented easily in almost any liquid cooled application because the basic parts are made of plastic that can be designed to fit into the application, it is very suitable for non-planar applications.

11:00 S4b-4 Thermal Characterization of Double Baseplate Heat Sinks

A. Zaghlol, R-Theta, CANADA

Summary:
An experimental investigation comparing the thermal performance of swaged, glued double baseplate and single baseplate air-cooled heatsinks have been studied for velocity range from 2 m/s to 8 m/s. The experiments were conducted using heaters dissipating 400W covering 10% of the baseplate area. The thermal performance of the swaged double baseplate is 32% better than the single base plate. In average over the measured velocity range, the swaged heat sink thermal performance is 12% better than that of the glued heat sink.

11:20 S4b-5 Copper-Silicon Carbide for IGBT Thermal Management

G. Sundberg, C. Sung, T. Vasilos, P. Paul, University of Massachusetts, USA

Summary:
Copper-Silicon Carbide base plates will enable the next generation of IGBT power modules to achieve significantly greater power density than today’s most advanced designs while maintaining +30 year reliability. Copper-Silicon Carbide offers the promise of a high, thermal conductivity between 250 and 325W/mK combined with an adjustable coefficient of thermal expansion (TCE) between 8.0 to 13.0 ppm/°C.

Room London

S4c
Motors and Actuators I
Chairman: Alfredo Vagati, DIEI Politecnico di Torino, ITALY

10:00 S4c-1 Transverse Flux Machine Design for Manipulating System Applications
N. Parspour, Mr. Babazadeh, University of Bremen, GERMANY

Summary:
This paper deals with the design of a transverse flux machines in the range of 2kW. For a certain type of these machines an analytical model has been developed and verified by a 3D field simulation.

10:25 S4c-2 Permanent Magnet Synchronous Motor Solutions for Automotive Applications Including X-by-Wire Systems
D. Iles-Klumpner, ebm-papst St. Georgen, I. Boldea, Politechnica University of Timisoara, ROMANIA

Summary:
The paper presents an overview of actual high performance electric drives for automotive applications and offers therefor a wide spectrum of solutions based on permanent magnet synchronous motors (PMSM). Detailed aspects regarding performance, motor design and control, materials, technology and costs are shown.

10:50 S4c-3 A Buried Magnet Brushless PM Motor in a Hybrid Electric Vehicle
D. Jones, Incremotion Associates, USA

Summary:
This buried magnet brushless dc motor provides an excellent performance platform for an HEV electric traction drive. The spoke buried magnet design has significant design hurdles to overcome in order to achieve the permanent magnet and reluctance torque components. This paper will describe the general performance trade-offs and the early test results in a Honda CRX automobile.

11:15 S4c-4 The Single Stator-Double -Rotor-Machine-A Comparison between Simulation and Measurement Results
S. Ojak, M. Schrödl, Technical University Vienna, AUSTRIA

Summary:
In its introduction the paper presents the single stator-double rotor-machine, a novel design of electrical machines. The main part describes the mathematical model and the simulation model of this new machine. To demonstrate the quality of the model the simulation results are compared with the results of the measurements, which have been done on existing prototype machines.

Room Zürich

S4d
Power Quality and Renewable Energy
Chairman: Yasuhiro Okuma, Fuji Electric, JAPAN

10:00 S4d-1 Understanding the Power Quality Problems and Compensators
P. Bauer, Delft University of Technology, THE NETHERLANDS, V. Hajek, Brno University of Technology, CZECH REPUBLIC

Summary:
When studying Power Quality problems and compensators the important question is the impact of the compensator on the power grid and at the same time working of the power electronic based compensator. Instead of performing simulations, set of simple animated solutions offering the required better understanding of such a system is often satisfactory. Solved animation give a better understanding about what is going on in the system then a set of equations. In the paper the examples of such a animations for e-learning of different power Quality Problems and Power Electronics based compensators is introduced in the form of a new web based software tool. Addressed and animated are power flow problems and impact of power quality compensators as well as detailed operation of power electronic based compensators such as e.g. Active Filter, SVC, DVR and electronic tap changers. This way both system level and component level (power quality compensator operation) is addressed.

10:25 S4d-2 Compact, Stand-Alone Renewable Energy Systems
T. Petter, H. Raffel, B. Orlik, University of Bremen, GERMANY

Summary:
Quality of supply is a point of growing importance in the electricity networks while deregulation progresses on the European market and electrical power generation becomes more and more distributed. Grid connected storage systems are able to enhance the quality of supply: by hindering blackout periods, by shifting the energy produced in excess for use during high demand periods, or by sustaining the grid for better power quality. In these different applications, diverse storage technologies are claimed to be able to fulfil the technical criteria required for the storage function.

10:50 S4d-3 Photovoltaic Systems: A Co-Operating Architecture to help Batteries
P. Mestre, A. Neusser, D. Lafore, Y. Lausenaz, Ecole Superieure d'Ingénieurs de Marseille, FRANCE

Summary:
Power electronics offer new possibilities in photovoltaïc system design. With them, low loss charging and improved management of storage facilities, in this case of the battery park, are feasible. The new concept of a photovoltaïc system presented in this paper is a modular power supply built out of small autonomous standardised units. Controlled energy exchanges between these units might also be realised. This new concept can be implemented in the presented way thanks to power electronics. After the detailed description of the new concept, its advantages in comparison to classical systems and storage management are pointed out.

11:15 S4d-4 Systematic Evaluation of Harmonic and Interharmonic Measurements of Wind Energy Systems
D. Schulz, R. Hanitsch, Technical University Berlin, GERMANY

Summary:
A systematic comparison of harmonic and interharmonic measurements of wind energy systems with nominal powers of 1.5 and 1.8 MW is presented. Doubly-fed asynchronous machines and synchronous generators in different wind park configurations were measured over the last three years. Different harmonic curves were found depending on the treatment of the star point of the wind turbine transformer.

Lecture Sessions 5
11: 50 – 1: 30

Room Paris

S5a
Control
Chairman: Leo Lorenz, Infineon Technologies Asia Pacific, SINGAPORE

11:50 S5a-1 The Control Algorithm as a High Performance Alternative or Supplement to Linear/Analog Feedback Control
B. Carsten, Bruce Carsten Associates, USA

Summary:
Control algorithms determine the turn-on and turn-off times of switches based only on instantaneous conditions in the power circuit, or on conditions since the last switching cycle; there is no 'averaging' over multiple switching cycles as in conventional feedback methods. The principle advantage is very fast control of output voltage, even with variable frequency converters. The traditional concepts of feedback gain and phase margin become irrelevant.

12:10 S5a-2 Practical Realisation of New Method of Synchronization for Controlled Rectifier
J. Guzinski, Z. Krzeminski, Gdansk University of Technology, POLAND, H. Abu-Rub, Birzeit University, PALESTINE

Summary:
Synchronisation of an inner signal with grid voltage on a basis of zero crossing is not convenient in digital control systems because of disturbances causing multi-crossing of zero and additional hardware needed for detection. A new method of synchronisation to AC network for phase-controlled rectifiers or for front-end rectifiers is presented in the paper. All theoretical dependencies are included in the paper. Results of simulations and experiments in the real system with digital signal processors are presented.

12:30 S5a-3 Optimizing the high Accuracy Measurement Circuit for PMW Power Converters by characterizing the Signal Settling Time of the Operational Amplifier with the Analogue-to-Digital Converter Interface
M. Oljaca, W. Klein, Texas Instruments, USA

Summary:
This paper presents a procedure to measure the settling time of short pulses to 16-bit accuracy. Standard industry practice is to use an oscilloscope. The accuracy in specifying data sheet values is poor and limited by the instrument in use. This new procedure uses the final device to determine real data and performance as in final system.

12:50 S5a-4 A Digital Modulator for Increasing the Performances of Voltage Source Inverter Based Drives
C. Attaianese, G. Tomasso, D. Capraro, V. Nardi, University of Cassino, ITALY

Summary:
An optimised modulation technique for voltage source inverter (VSI) based drives is proposed in this paper. It is based on the imposition of modulation frequencies different for each inverter leg, selected according to the power modules commutation losses. A reduction of the current harmonic content and an improvement of the overall system performances are achieved, as shown by means of an experiment implementation.

1:10 S5a-5 An Economical Digital Voltage Mode Controller Supporting Switching Frequency in the MHz Range
S. Mahadik, M. looney, K. Rinne, University of Limerick, IRELAND

Summary:
This paper introduces a novel economical controller architecture for improving the dynamic response of a PWM DC-DC converter based on voltage mode control. The critical issues in digital controller implementation arising from non-ideal effects are investigated. Controller wordlength determination is done using a reliable sensitivity matrix based method.

Room Amsterdam

S5b
Reliability
Chairman: Enrique Dede, GH Electrotermia, SPAIN

11:50 S5b-1 The Status of Lead-Free and its Impact on Power Electronics
J. Flannery, Artesyn Technologies, IRELAND

Summary:
This paper briefly describes the upcoming WEEE & ROHS legislation & roadmap with respect to implementation. An overview of some of the main technical challenges which the power electronics industry will face is included which will allow the power electronics module manufacturer assess and face the challenges which the proposed legislation will pose.

12:10 S5b-2 Study on IGBT Lifetime under Repetitive Short-Circuits Conditions
F. Saint-Eve, S. Lefebvre, SATIE, Z. Khatir, LTN-INRETS, FRANCE

Summary:
In this paper, we will study the IGBT lifetime under repetitive short-circuits conditions, at different case temperatures (+25°C and +125°C). For given experimental conditions, we will point out that mainly two failure modes are possible, depending on the dissipated energy by the Device Under Test during short-circuit operations, compared with a critical energy (Ec). A simplified 1D thermal model will help us to explain the physical origin of the different failure modes.

12:30 S5b-3 Fault Diagnosis in Switch-Mode Power Supplies Operating in Discontinuous Mode
A.M.R. Amaral, Instituto de Telecomunicações, A.J. Marques Cardoso, University of Coimbra, PORTUGAL

Summary:
This paper addresses the subject of fault diagnosis in switch-mode power supplies operating in discontinuous mode, focusing particularly, in the output filtering electrolytic capacitors. The failure of those capacitors leads to an increase of their equivalent series resistance (ESR), and therefore, the efficiency decreases and the output voltage ripple increases. The method of diagnostics used is based on the relation between the values of the output voltage ripple and the capacitor current ripple. Several simulated and experimental results are presented for a buck-type switch-mode power supply.

12:50 S5b-4 Reliability-Oriented Project Management System
J. Marcos Acevedo, D. Bóveda Losada, University of Vigo, SPAIN, S. Fernández-Gómez, Pixim, USA

Summary:
This work describes a project design and management system that allows incorporating reliability prediction on components, circuits and systems in the design process. The system can process design descriptions in spice format, and it allows full flexibility and scalability in regards to system description, and reliability calculation methodology.

1:10 S5b-5 Evaluation of a DCB Based Transfer Molded Component for Applications with High Temperature Swings
R. Amro, J. Lutz, Chemnitz University of Technology, A. Lindemann, IXYS Semiconductor, GERMANY

Summary:
DCB based transfer molded components show a power cycling capability approximately 10 times higher as expected from the extrapolation of results of standard power modules. They promise to fulfil the demand of the automotive standard AEC-Q101 (5000 power cycles at ΔTj>100°C) at a temperature swing ΔTj>130°C.

Room London

S5c
Design and Simulation Software I
Chairman: Wolfgang Papiernik, Siemens, GERMANY

11:50 S5c-1 Transparency in the Process Chain from the Programming up to the Tool Center Point
J. Bretschneider, Siemens, GERMANY

Summary:
Virtual Production has been developed by Siemens Automation & Drives (A & D) and allows virtual representation and evaluation of a manufacturing process already before real production takes place. In the virtual production the complete process chain starting from the part program, the correct copy of the CNC, the position controlled servodrives up to the characteristic dynamics of the machine tool is represented the very first time.

12:15 S5c-2 Simulating Power Electronics Systems Using Ideal Instantaneous Switches
J. Allmeling, W. Hammer, Plexim, SWITZERLAND

Summary:
PLECS is a new toolbox for the fast simulation for electrical and power electronic circuits under Simulink. It provides the means for simulating large systems containing both electrical circuits and sophisticated controls. The use of ideal instantaneous switches leads to fast and robust simulations.

12:40 S5c-3 Rapid Prototyping of Power Electronics Converter with PSIM and Floating Point DSP
A. Kaminski, K. Wejrzanowski, W. Koczara, Warsaw University of Technology, POLAND

Summary:
The paper describes power electronics research opportunities given by combination of modern power electronics simulator and high performance DSP/FPGA based controller. The features, ideas as well as experimentation methodology are presented - proved by simulation and experiments with sensorless active rectifier as an example system.

1:05 S5c-4 Performance analysis of a linear actuator by means of different simulation models
M. Anders, MACCON, GERMANY

Summary:
Based on the example of a linear actuator different Matlab/Simulink models with different complexity are introduced and the results compared with the results of a direct CoSimulation of Matlab/Simulink and FLUX2D.

Room Zürich

S5d
Wind Energy
Chairman: Frede Blaabjerg, Aalborg University, DENMARK

11:50 S5d-1 Comparative Study of Voltage Recovery behaviour of grid-connected wind turbines

T. Sun, Z. Chen, F. Blaabjerg, Aalborg University, DENMARK

Summary:
The models of two different kinds of variable speed wind turbines, respectively with slip control and with doubly fed induction generator (DFIG), are developed in PSCAD/EMTDC. In both wind power generation systems, control strategies are proposed to re-establish the wind turbine terminal voltage after the clearance of an external short-circuit fault, which helps to maintain the power system stability.

12:15 S5d-2 Influence of Wind Turbines Control Strategies on the Power Quality

X. Guillaud, Ecole Centrale de Lille, V. Rogez, ENSAM de Lille, FRANCE, E. Vandenbrande, J. Deuse, Tractebel Engineering, BELGIUM

Summary:
This paper presents a review of the main type of wind power conversion used in modern wind turbines. These solutions are analysed and compared in term of grid power quality on a distribution network.

12:40 S5d-3 A Tool for Comparison of Wind Turbine Topologies

L. Helle, K.B. Larsen, A.H. Joergensen, Vestas Wind Systems, DENMARK

Summary:
This paper presents a tool for fast prototyping and comparison of different topologies for use in wind turbines. The models are mainly based on standard parameters but may include features such as temperature-, saturation- and skin effects in generators, temperature effects in semiconductors and the effects of applying different modulation and control strategies in the converter control. Although the tool includes several generator- and converter topologies, only the modeling of the doubly-fed induction generator and the two-level back-to-back converter are explained in detail. The effectiveness of the simulation tool is illustrated by some prototyping examples of a wind turbine including a doubly-fed induction generator and a two-level back-to-back converter. The simulated prototyping examples are to some extent validated by measurements on an existing wind turbine.

1:05 S5d-4 Fast Dynamic Modelling of Direct-Drive Wind Turbines

J. Morren, S.W.H. de Haan, Delft University of Technology, J. Pierik, Energy Research Centre, THE NETHERLANDS

Summary:
The Park transformation can be used to derive models of wind turbines and other electrical components. With these models simulation time can be decreased. It will be explained how the Park transformed can be used to obtain the models. This will be illustrated by deriving a model of a direct drive wind turbine. Dynamic simulations to study the impact of wind turbines on the grid will be presented.

CCN West – 2nd Floor

Poster/Dialogue Sessions

2:40 – 3:50

PP-17 Self Tuning Torque Control of Switched Reluctance Motor Considering Nonlinear Analysis

F. Ismael, Cairo University, M. Khater, El Menofia University, H. El Khashab, A. Oshiba, Electronics Research Institute, EGYPT

Summary:
In this paper, a highly nonlinear analysis for the switched reluctance motor is developed. It is used to simulate the drive and to study its performance characteristics with torque control. The paper presents a new method for a simulation accurately calculating the torque and current of a switched reluctance motor from measured or computed flux-linkage/current/rotor position data. The new method is more accurate and uses less input data than previously known procedures, and is computationally efficient. It can be applied to both steady state and transient problems. A new theory is presented to represent characteristic of a SRM and theoretical results of steady state. A self-tuning torque control strategy is carried out. Experimental results are demonstrated to verify the proposed theoretical results.

PP-18 Shoot Through Analysis with Parasitic Inductance

A. Elbanhawy, Fairchild Semicondcutor, USA

Summary:
This paper describes the complete mathematical model for the analysis of the shoot through phenomenon in synchronous buck converters. Equations derived may be used to investigate the susceptibility of a given MOSFET with all its related parameters in a given PCB layout to shoot through. Other equations may be used to calculate the current sinking requirements of the gate driver used in the circuit

PP-19 Simple Control Systems Based on Use of Adjustable Shunt Regulators

T. Suntio, University of Oulu, T. Tepsa, Rovaniemi Polytechnics, FINLAND

Summary:
The shunt regulator based control systems are analysed in detail based on theory and experiments. A voltage-controlled current source with a finite transconductance gain and a capacitor as output impedance is used as its model. The parameters have high manufacturer and operating point variability resulting in high uncertainty of the behaviour of the control system. These deficiencies are not commonly considered in the relevant publications even if the integrity of the control may contain high uncertainties.

PP-20 Temperature Measuring and Control

M. Supák, Trencin University, SLOVAKIA

Summary:
POWER TEMPERATURE CONTROLLERS. They are microcomputer controlled devices which control performance of electric resistive furnace or other effective load so that temperature has the required course. TEMPERATURE CONTROLLERS. They control output of electric heating bodies so that temperature in furnace will correspond to adjusted temperature. Other physical variables can also be controlled by this Controller.

PP-21 An Efficient Nonisolated DC-DC Converter and a Review of the More Common Topologies

Ch.E. Mullett, ON Semiconductor, USA

Summary:
There are several approaches to non-isolated dc-dc conversion for use when the input voltage varies above and below the output. Among these are the SEPIC, buck-boost and others involving a combination of buck and boost circuits. Most accomplish the task, but one is clearly outstanding for its high efficiency.

PP-22 Control of Voltage Source Inverter Without Dead-Time Effects
A. Lewicki, Z. Krzeminski, Gdansk University of Technology, POLAND

Summary:
A new method of generation of inverter output voltage vector is presented in a paper. Necessity of dead-times and their compensation for are eliminated in the proposed PWM strategy. An influence of voltage drops on power elements in the inverter on the inverter output voltage is taken into consideration. A method of compensation for the voltage drops is proposed and investigated by experiment.

PP-23 Advanced Insulated Metal Substrate which has Extremely High Thermal Conductivity
Y. Tsujimura, N. Yonemura, K. Kato, Denki Kagaku Kogyo, JAPAN

Summary:
Heat radiation density generated from CPU has become 5-7 times during this decade. Along with this trend, improvement on characteristics for heat radiation has been strongly required. For replying to these demands, we have developed a new grade IMS (Insulated Metal Substrate) which has very high thermal conductivity (8W/□). In this report, we will explain details of this new grade IMS.

PP-24 300V IGBTs Displace MOSFETs in Power Supplies and Inverters
J. Dodge, J. Morrison, Advanced Power Technology, USA

Summary:
The performance of IGBTs has historically limited them to displacing MOSFETs with a voltage rating of 500V and higher. Characterisation of 200 through 300V MOSFETs and 300V PT IGBTs clearly indicates a cost/performance advantage for 300V IGBTs. Actual performance is verified by retrofitting a popular DC/AC power inverter, and experimental results are presented.

PP-25 Thermal Management and Electrical Characteristics of Advanced Power MOSFET Packages for High Frequency DC-DC Converter
M. Kasem, Vishay Siliconix, USA

Summary:
The paper describes the thermal management and electrical characteristics of an advanced power MOSFET package family called PowerPAKs that has been developed for High Frequency DC-DC Converter applications. The PowerPAKs packages are leadless surface mount packages with novel internal construction and exposed heat sink at the bottom. A summary of extensive experimental and analytical studies over a frequency range of 500 kHz and 2 MHz will be reported.

PP-26 Efficient LED Driving in future Applications
P. Greenland, National Semiconductor, USA

Summary:
Solid state lighting is becoming significant in high power applications as luminous efficacy exceeds that of incandescent. Applications in automobiles and portable electronics are proliferating at breakneck speed. This paper reviews the physics behind the white LED phenomenon and describes three applications, white LED flash, instrument panel backlighting and headlamps in detail.

PP-27 Maximum Power Point Tracking in Photovoltaic Energy Conversion Systems
M. Nikraz, Curtin University of Technology, AUSTRALIA

Summary:
In this paper a DSP-controlled single-phase single-stage grid-connected photovoltaic energy conversion system capable of extracting maximum power from solar photovoltaic arrays is presented. The control of the inverter is provided by a 16-bit fixed-point TI TMS320F240 DSP processor. Preliminary experimental results are included.

PP-28 Band Split PhV Converter Modules hosted inside a HMW THS
M. Checchetti, micrOptronics, ITALY

Summary:
A large inflated Ball tracks the Sun & supports a Mirror, focused on the converter Modules. Each Module includes a Band Splitter, the Photo Voltaic Dices and the PWM power electronics. All the Modules face a curved window, which closes the hosting THS-HMW. Inside, a pressurised gas, He, flows directly over each PhV and power Dice. The flowing He removes large amounts of focused heat, than reaches the HMW thin winglets and exchanges the waste heat with air.

PP-29 Rectifier with Near Sinusoidal Input Currents for Wind Turbine
I.V. Pletea, I. Pletea, T. Goras, E. Lupea, Technical University of Iasi, ROMANIA

Summary:
Several topologies of three-phase low-harmonic diode rectifiers equipped with inductors, capacitors and diodes, based on an original solution, are presented. Inductors and capacitors are used in conjunction with the three-phase diode rectifier bridge to improve the waveform of the currents drawn from the utility grid. Starting from this configuration, the paper proposes an AC/DC converter with small holding current and a four-quadrant frequency converter with possible applications for wind turbine.

PP-30 Optimal Control of Insulated Wind-Diesel Power Systems
N.A. Cutululis, I. Munteanu, E. Ceanga, T. Dumitriu, University of Galati, ROMANIA

Summary:
In the paper is developed an optimal control loop for insulated wind – diesel systems. The main scope is to improve the weight of wind power versus diesel generator in hybrid systems, and this is achieved by improving system dynamic stability to random and non stationary fluctuations of the wind speed. Both numerical simulation and experimental results are presented.

PP-31 A Small Power Autonomous Wind Electric Conversion Plant
L. Modran, L. Popescu, University of Sibiu, ROMANIA

Summary:
This paper presents the simulation of electromagnetic transitory regime of an autonomous conversion equipment compose of permanent magnet synchronous generator, diode bridge, chopper and battery. The (d;q) model of the generator and of the rectifier has been elaborated and coupled each other. The simulation circuits in Simulink are presented and the oscillograms of the electrical values are given. Experimental results validate the performances of the simulation. The modelling and simulation can be made with Power System Blockset and the results will be compared.
In the developing countries the conversion plant price diminishes if using a car alternator, which can have two kinds of excitation: with permanent magnets or coils. In case of SG with electromagnetic excitation the chopper interrupting the excitation current, which is less that 20% of load current, is more convenient. The automation response presents a delay because of the magnetic coupling between the rotor and the stator but the switching frequency can be increase using transistors.

PP-32 Advanced Power Control of Wind Farms
A.D. Hansen, P. Sorensen, RISO National Laboratory, F. Iov, F. Blaabjerg, Aalborg University, DENMARK

Summary:
In recent years the trend has been moved from installations with a few wind turbines to the planning of large wind farms with hundreds of MW capacity. This increased and concentrated penetration makes the power network more dependent on, and vulnerable to, the wind energy production. This situation means that future wind farms must be able to replace conventional power stations, and thus be active controllable elements in the power supply network. In order to meet these requirements, different control strategies can be used for wind farms.

Lecture Sessions 6
4: 00 – 6: 05

Room Paris

S6a
Modern Switches
Chairman: Martin Hierholzer, eupec, GERMANY

4:00 S6a-1 Bi-Directional IGBT Switches for Matrix Converter Applications
D. Chamund, B. Findlay, Dynex Semiconductor, P. Wheeler, J. Clare, M. Bland, University of Nottingham, UK

Summary:
Bi-directional IGBT modules are an efficient means of implementing high-frequency matrix converters. Equations for the calculation of the average losses have been derived by Nottingham University and presented here. The test waveforms for a three phase to single phase configuration using a bi-directional modules illustrate the practical operation of a matrix converter and the level of output current ripple that can be achieved.

4:25 S6a-2 A New Generation of Gallium Arsenide Diodes Optimised for Low Forward Voltage Drop
A. Lindemann, IXYS Semiconductor, S. Steinhoff, IXYS Berlin, GERMANY

Summary:
A new series of Gallium Arsenide diodes has been introduced. This paper explains their main properties being relevant for SMPS applications, referencing technological background. Derivation of a physical model helps to determine dynamic voltage distribution between series connected devices.

4:50 S6a-3 ESBT™ in 3-Phase Auxiliary Power Supply
S. Buonomo, L. DiFalco, F. Saya, G. Vitale, STMicroelectronics, ITALY

Summary:
This paper describes the realization of the single-chip solution achieved through the integration of a Power MOSFET inside the emitter fingers of a Power Bipolar Transistor structure. Application oriented characterization with special emphasis on switching and conduction losses, where dynamic saturation plays an important rule, is hence shown providing useful information to designers for better exploiting of ESBT potentiality: comparative analysis between 1500V rated Power MOSFETs, today widely used in 3-phase auxiliary power supply, and 1700V ESBT is carried out.

5:15 S6a-4 Converter Improvement Using the Schottky Rectifier Avalanche Area
D. Jouve, B. Rivet, STMicroelectronics, FRANCE

Summary:
STMicroelectronics gives useful information for all its Schottky Rectifiers families to define their working limit in the avalanche area. Simple rules concerning the avalanche energy measurement in the converter will be given. From this tool and concrete examples, a methodology will be described in order to optimise the choice of the rectification diode for an improved efficiency of the converter.

Room Amsterdam

S6b
Transformers and Magnetics
Chairman: Jacques Laeuffer, PSA Peugeot Citroen, FRANCE

4:00 S6b-1 Piezoelectric Transformers substitute Conventional Magnetic Elements in Power Converters up to 100 Watts
M. Radecker, F.E. Bisogno, Fraunhofer-Institut AiS, GERMANY, A.V. Carazo, Face Electronics, USA

Summary:
Power supplies of today are becoming smaller and cheaper. Such supplies up to 100 Watts can be found for instance in automotive applications, electronic ballasts, chargers, and off-line power supplies. Piezoelectric and other flat design transformers, as well as new high voltage transistors like the Fieldstop-IGBT and the Cool-Mos, could lead us to improved systems including EMI issues, low flatness and size, and high efficiency, at low costs, as well.

4:25 S6b-2 Integration of Power Transformer Models and Data Acquisition Systems
P. Marino, C. Sigüenza, F. Poza, M. Ubeira, F. Machado, University of Vigo, SPAIN

Summary:
Power transformers' failures carry great costs to electric companies. To avoid this problem in four working 40MVA transformers, the authors have implemented the measurement system of a failure prediction tool, that is the basis of a predictive maintenance infrastructure. Applying Data Warehouse techniques, the models have been provided with an abstraction of sensors called Virtual Cards.

4:50 S6b-3 A New Characterisation Method for Ferrite Polymer Compound
S. Schuh, M. Albach, Friedrich-Alexander-University Erlangen-Nürnberg, E. Waffenschmidt, Philips GmbH Forschungslaboratorien, GERMANY

Summary:
This paper describes a method for characterising the material parameters of Ferrite Polymer Compounds (FPC). Instead of using small toroids as in case of conventional ferrite grades, FPC layers are used in combination with spiral windings. To determine the permeability of the new materials, the measured influence either on the impedance of the winding or on the coupling between two windings is used. This is possible, because the influence of the foils on the measured results can be accurately predicted by calculations.

Room London

S6c
Artifical Intelligence, Sensorless Drives and Communication
Chairman: George Ellis, Danaher Motion, USA

4:00 S6c-1 Design Optimization of External Rotor Permanent Magent Synchronous Machines with Respect to Enhanced INFORM-Capability for Sensorless Control
U.-H. Rieder, M. Schrödl, Vienna University of Technology, AUSTRIA

Summary:
In many applications like traction, starter generators and direct drives the need for high torque is a basic issue. This paper presents the combination of advantages of external rotor PMSMs and sensorless control algorithms, especially for low speed using the INFORM-method. Therefore saliency and saturation effects have to be taken into account and have been enforced for improved INFORM performance.

4:25 S6c-2 Sensorless Field Oriented Control of Induction Motors Using Test Signals and Considering Main Flux Saturation
Ch. Rudolph, B. Orlik, University of Bremen, GERMANY

Summary:
The field oriented control of induction motors without speed sensor requires the calculation of the flux angle and the speed by a model from stator voltages and currents. A new method is proposed considering main flux saturation in order to identify the flux angle even down to zero hertz stator frequency. Thus stable operation in the entire torque-speed-plane is ensured.

4:50 S6c-3 Genetic Algorithms Used for Geometrical Structure Design of Transverse Flux Permanent Magnet Motors to Optimize the Torque Wave Form
M. Vinogradski, U. Werner, B. Orlik, University of Bremen, GERMANY

Summary:
It is possible to determine the wave form and maximum value of the torque before the TFPM motor will be built. The geometrical parameters of the TFPM motor will be varied in the way that the maximum torque can be achieved. In order to achieve a desired torque wave form in every single pole pitch, an optimisation method based on artificial intelligence can be used. This work explains how a genetic algorithm can be applied in order to optimise the geometry of a TFPM. This algorithm can be applied to every other motor structure.

5:15 S6c-4 FireWire and 1394AP - A High Speed Real-Time Network for Automation Industry
U. Koch, C. Korb, Lust Antriebstechnik, U. Schumacher, Lust DriveTronics, GERMANY

Summary:
The need for a high speed real time bus solution leads to FireWire as an appropriate standard bus. Its characteristics make it well suited to create a 16Bit embedded solution, avoiding several drawbacks of proposed real time Ethernet realisations. A practical implementation of the new 1394Automation Protocol is presented, which demonstrates the superiority of this solution

5:40 S6c-5 Profiles for Motion Control Sub-Systems
H. Zeltwanger, CAN in Automation, GERMANY

Summary:
The IEC is developing a bus-independent interface for motion control applications. This generic interface will be described in detail. In addition, the paper will discuss the mapping to the CANopen device profile for drives and motion controllers as well as machine module specific profiles such as for x-ray collimators and extruder downstream devices.

Room Zürich

S6d
Active Filtering
Chairman: Johann W. Kolar, ETH Zürich, SWITZERLAND

4:00 S6d-1 Harmonic Current Sources Based on PWM Voltage Source Inverter
U. Großmann, G. Berger, J. Petzoldt, Ilmenau Technical University, H.-G. Mall, Frako Kondensatoren- und Anlagenbau, GERMANY

Summary:
Two solutions for generating harmonic currents based on IGBT- voltage source inverters are presented. The first set-up comprises an inverter connected via transformer to the grid. The second set-up uses a passive shunt filter in combination with the same inverter to achieve a higher output current. The control of the inverters is accomplished in the stationary reference frame by means of transformed PI-controllers.

4:25 S6d-2 New Application for Active Filter: Filtering of the Low Voltage Network of a Scientific Vessel

D. Moreau, MGE UPS Systems, F. Jeuland, Alstom-Chantiers de L'Atlantique, P. Guerin, Large, FRANCE

Summary:
The scientific equipment of the vessel needs a high quality supply network. At the opposite the network supplies several highly polluting equipments (propulsion converters, frequency converters for motors , …)

4:50 S6d-3 A New Transformerless Series Hybrid Active Power Filter (TL-Shapf) Topology

N. Raghavan, K. Vasudevan, Indian Institute of Technology Madras, INDIA, T. Ellinger, ISLE, J. Petzoldt, Ilmenau Technical University, GERMANY

Summary:
In this paper, a new transformerless Series Hybrid Active Power Filter Topology (TL-SHAPF) is presented. The active filter is in series with the capacitor in the parallel branch and is connected to the line without transformer. The control structure is derived in the stationary reference frame through low pass to band pass transformation. The modelling and simulation results are presented.

5:15 S6d-4 Modelling and Implementation of Space Vector PWM Techniques in Three Phase Four-Wire Shunt Active Filter and Filter Size Optimization

M. Rahimi, H. Mokhtari, Sharif University, IRAN

Summary:
The pulse width modulation technique is effective factor on system power circuit size and system performance. In this paper the space vector modulation (SVM) is developed for four wire active filter that is novel. Also is shown that active filter with SVM technique requires smaller power circuit than active filter with triangular carrier modulation and in the former, dc link voltage as well as ac link inductor size is reduced.

Thursday, May 27, 2004

8:30 Key Note 4 **Room Paris**

Storage Technologies for enhanced Quality of Supply in Configurations with Grid Connected Renewable Energy Sources - From the State of the Art to Future Trends

Marion Perrin
Manager European Projects
CEA Cadarache, FRANCE

Summary
Quality of supply is a point of growing importance in the electricity networks while deregulation progresses on the European market and electrical power generation becomes more and more distributed. Grid connected storage systems are able to enhance the quality of supply: by hindering blackout periods, by shifting the energy produced in excess for use during high demand periods, or by sustaining the grid for better power quality. In these different applications, diverse storage technologies are claimed to be able to fulfil the technical criteria required

9:15 Break

Lecture Sessions 7
9:30 – 11:10

Room Paris

S7a
Medium Power Converters III
Chairman: Eric Carroll, ABB Semiconductors Ltd., SWITZERLAND

09:30 S7a-1 Control and Performance of a New UPS Technology
N. Blacha, AEG SVS Power Supply Systems, Mr. Losansky, Dresden University of Technology, GERMANY

Summary:
Firstly it will be pointed out theoretically how the high performance full digital control algorithms for the new AEG UPS technology work. Secondly practical measurement results and construction of real UPS systems will be shown. Finally it will be given the description of an very powerful flexible decentralised control concept based on 32 bit processors and FPGAs to handle complex UPS control requirements .

09:50 S7a-2 Technology Renewal for Power Auxiliary Railway Converters by Using 3 Phases Integrated Inverter
G. Coquery, R. Lallemand, INRETS, A. Jeunesse, SNCF CIM, G. Terzulli, AVX, FRANCE

Summary:
Railways transportation systems need auxiliary power functions. Then, auxiliary power converters are used to control a lot of critical functions required for a reliable working of the traction chain. The paper is focused on the latest technology of power semiconductor module which allow to design auxiliary power converters for locomotive of high speed train (TGV) by using only one triphase integrated inverter module in the range 30-50kVA.

10:10 S7a-3 Novel Single-Phase UPS for IA Server System based on Series Parallel Processing

Y. Okuma, H. Tokuda, Fuji Electric Advanced Technology, H. Matsuo, H. Naito, Fuji Electric FA Components and Systems, JAPAN

Summary:
We developed the single phase UPS of small capacity (0.5 to 3kVA). This UPS has applied series parallel circuit topology. Consequently, this UPS attained high conversion efficiency, maintaining a performance equivalent to UPS of a double converter system. For example, it is 95% of the efficiency with the equipment of 700VA/450W.

10:30 S7a-4 Inverter with Hard- and Soft-Switched Transistors for Usage in Uninterruptible Power Supplies

F. Renken, Siemens VDO Automotive, GERMANY

Summary:
One main aspect in the development of Uninterruptible Power Supply (UPS) is the reduction of the losses. This paper shows the effects of reducing the losses by hard and soft switched MOSFET Inverters with different dc-link voltage levels. The efficiency-curves of the inverters will be presented and the losses are divided up in switching and forward power losses. All results were measured in practical circuits.

10:50 S7a-5 Design and Implementation of a Fast HV Solid State Switch

H. Farzaneh-fard, S. Yusefi, A. Jeyhani, Isfahan University of Technology, IRAN

Summary:
Construction of serial structure of switches with medium voltage ratings for fast high voltage switching is developed. In this paper different types of solid-state power switches for fast switching are investigated and IGBT switch are selected for switching cells. A macro behavioural model for IGBT is developed for simulation purposes. Finally a prototype of implemented switch unit that consists of eight IGBTs in series is tested at 7KV, and 150ns turn on time is achieved.

Room Amsterdam

S7b
Motors and Actuators II

Chairman: Daniel B. Jones, Incremotion Associates, USA

9:30 S7b-1 New Industrial Process to make Squirrel Cage Copper Rotors and optimise Induction Machine Performances

L. Doffe, O. Walti, FAVISA, FRANCE

Summary:
There are two main technologies to make rotors for squirrel cage induction machines: the first one is to die-cast aluminium cages, and for the other one, conductive material is copper with shaped bars assembled into the magnetic circuit and welded at the extremities of both end rings. This second method is really expensive.
The method described is specialized in copper alloys pressure die casting and has focused for some years on a new industrial process to die-cast copper rotors. This new technology points out real gain for copper rotors as regards simplicity and very large possibilities for filling the slots, compared to the welding-assembling method.

9:55 S7b-2 Asymptotically Exact Linearization and Robust Control of an Electromagnetic Actuator
A. Forrai, T. Ueda, T. Yumura, Mitsubishi Electric, JAPAN

Summary:
The paper deals with system identification and robust control of an electromagnetic actuator, which is used in many practical applications. The investigated system is open loop unstable, non-linear, and it has a restricted equilibrium region. The experimental results demonstrate that the controller design problem can be handled successfully within the framework of robust control.

10:20 S7b-3 Magnetic Field and its Application of a Single-Phase Induction Motor without a Rotor
O. Sugiura, Yamanashi University, JAPAN

Summary:
This paper discusses the magnetic field characteristics of a single-phase induction motor without a rotor and its application to an electromagnetic barrel finishing machine. The magnetic flux density in the stator core was obtained by the calculations and the experiments. The finishing experiments are carried out with the finishing machine built as a trial. And the proper finishing conditions and finishing characteristics were investigated. Particularly, the effect of the magnetic flux density was investigated under the various finishing experiments.

10:45 S7b-4 Magnetic Field in Bearingless Electromechanical Actuator
D. Maga, W. Juraj, S. Jan, U. Peter, University of Alexander Dubcek, SLOVAKIA

Summary:
This paper deals with a bearingless rotary machine which is capable of stable controlling the levitated position of a rotor of an induction motor with a squirrel-cage type rotor under loaded conditions. This bearingless induction machine is capable to serve as an electric motor and also as a magnetic bearing for magnetically levitating and supporting the rotor of the machine.

Room London

S7c
Advances in Battery Monitoring and Technology
Chairman: Florence Mattera, CEA-GENEC, FRANCE

9:30 S7c-1 The Need of Battery Monitoring and how todays Technologies fulfil the Requirement for a fixed Battery Monitoring System
H. Tribick, P. Taberham, NDSL, UK

Summary:
The document gives a general outline of the uses and locations of lead acid UPS batteries, followed by the causes and effects of battery failures on static UPS. The document then focuses on the design of battery monitoring and what parameters should be monitored. Examples are given to show how historical trending can help safeguard the installation in a proactive manner.

9:55 S7c-2 Development of Battery Management Strategies for Lead Acid Batteries used in Photovoltaic Systems
D. Benchetrite, F. Mattera, O. Bach, M. Le Gall, CEA-GENEC, FRANCE

Summary:
Various strategies for managing lead-acid batteries are proposed in the literature depending on the battery technology. Most of them are based on the application of a voltage threshold, which limits the range of utilization of the battery during the period of charge and discharge. With the development of electrical vehicles, new strategies of recharge for lead-acid batteries went to light like the use of pulsed current at the end of the charge. These managements are more and more explored for other applications, such as photovoltaic systems. In this paper, we present results concerning parameters optimization of a pulsed current strategy for lead acid batteries used in photovoltaic applications, in order to extend battery lifetime.

10:20 S7c-3 Lithium-Ion Technology and High Power Batteries
P. Desprez, G. Sarre, SAFT, FRANCE

Summary:
Lithium-Ion batteries are a leading technology for consumer market and portable devices. Since some years major developments are in progress for larger batteries in particular in the field of high power batteries. Achievements provided by Li-Ion Technology, characteristics and performances of this kind of batteries are shown here.

10:45 S7c-4 Electrolyte Density Measurement in Lead-Acid Batteries
A.M. Cao y Paz, J.M. Acevedo, J.D. Gandoy, University de Vigo, SPAIN

Summary:
Lead-acid batteries are a energy storage system very used in a lot of applications. For a good management of this batteries is interesting to measure the electrolyte density. In this work, some sensors based in electronic devices are exposed for the measurement of this variable

Room Zürich

S7d
Disturbances, Measurement and Reduction
Chairman: Yasuyuki Nishida, Nihon University, JAPAN

9:30 S7d-1 Power Quality at Supply Input of a small Industrial Plant with Resistance Spot Welding Machines, a Case Study
D. Dujic, V. Katic, D. Reljic, Faculty of Technical Sciences Novi-Sad, YUGOSLAVIA

Summary:
In this paper, results of power quality investigations in small industrial plant with resistance spot welding machines will be presented. On the basis of results of measurement and Matlab simulation it can be seen that the level of high harmonics and flicker is not in accordance with the recommended IEEE standards.

9:55 S7d-2 EMI Filter Design Issues in Switched-Mode Converter Applications
T. Suntio, University of Oulu, T. Tepsa, Rovaniemi Polytechnics, K. Kostov, J. Kyyrä, Helsinki University of Technology, FINLAND

Summary:
EMI filter design in power converters for EMC, stability and performance has been a hot topic since 1970's. The filter design may be divided into three different issues having not much overlap in frequency and may be, therefore, discussed in separated topics. Even if this is obvious, it is not well understood in academy and practice. The paper would clarify the situation and present the important matters for consideration in each of the topic areas.

10:20 S7d-3 Power Quality in Adjustable Elevator AC Drives - A Case Study
D. Reljic, V. Katic, V. Vasic, University Novi Sad, Yugoslavia

Summary:
In this paper, results of research and investigations of power harmonics of elevator AC drives will be presented. On the basis of results of measurement and Matlab simulation it can be seen that the level of current harmonics is much above the recommended IEEE-519 standard. The level of voltage harmonics is below IEEE-519 standard but could be much higher depend on elevators action.

10:45 S7d-4 Modelling the Effect of Control Signal Variation on the Generation of Harmonics in PWM Converters
Ch. Saniter, R. Hanitsch, Technical University Berlin, GERMANY

Summary:
The effects of control signal variation on the generation of harmonics in PWM converters are described. Results from measurements and a novel modelling approach in the frequency domain using FCMs are presented. This approach is based on a full analytical solution of the converter and aids the understanding and prediction of the generation and propagation of harmonics in PWM converters.

Lecture Sessions 8
11: 25 – 1: 05

Room Paris

S8a
Power Integration and Application
Chairman: Bruce Carsten, Bruce Carsten Associates, USA

11:25 S8a-1 Integral Manufacturing of Embedded Passive Integrated Circuits for Power Electronics
E. Waffenschmidt, B. Ackermann, Philips Research, E. Langkabel, Isola, M. Wille, Ruwel, H. Marczinske, Straschu Leiterplatten, S. Schuh, University Erlangen-Nürnberg, GERMANY

Summary:
A new concept for highly integrated passive components named emPIC (embedded passives integrated circuit) is developed. All components will be integrated in the printed circuit board (PCB) using structured layers of different materials. This publication shows the concept, the materials, which are available or are developed, and a switched mode power supply as a demonstrator.

11:50 S8a-2 Control and Power in the Same Package: An Integrated Programmable Three-Phase Power Module for Moter Drive Applications
D. Giacomini, E. Bianconi, M. Palma, F. Pagani, M.T. Bombardieri, International Rectifier, ITALY

Summary:
International Rectifier strategy of integrating control and power on the same package, to achieve a better power quality, is going on with this new intelligent power module belonging to the iNTERO family. In this paper a new Programmable Isolated Intelligent Power Module, implementing a complete AC-to-AC conversion for induction or brush-less motor driver applications, is presented.

12:15 S8a-3 Improvement of Circuit Functionality and Power Density in Power Electronic Hybrid Circuits
F. Brucchi, P. Salvati, Semikron, ITALY

Summary:
Development of a new method to increase circuit functionality and power density per unit area improving the current SEMIKRON technology on ceramic substrates. This was done implementing DBC “partial multi-layer” structures on-purpose designed. It improves circuit design allowing a significant cost reduction and good layout complexity increasing. A new coefficient to identify the “layout complexity” has been proposed in the paper.

12:40 S8a-4 Modular Technology Concepts for 14V/42V Automotive Converters
J. Popovic, J.A. Ferreira, Delft University of Technology, THE NETHERLANDS

Summary:
Three concepts, based on different technology bases, are proposed to construct a 42V/14V DC-DC converter. These concepts have been chosen for their suitability for large volume production but they have a common limitation namely that the power level is limited. Therefore a number of them have to be connected in parallel in order to achieve the desired power rating. Virtual designs will be presented and evaluated.

Room Amsterdam

S8b
Design and Simulation Software II
Chairman: Ted Hopper, Maccon, GERMANY

11:25 S8b-1 Thermal Simulation of Power Electronics
P.J. Van Duijsen, Simulation Research, P. Bauer, Delft University of Technology, THE NETHERLANDS, U. Killat, Cadfem, GERMANY

Summary:
In many electronic appliances, Power Electronics based power supply is used. Due to miniaturisation of the appliances, such as mobile telephones, small drives in automotive industry, etc., thermal management becomes serious challenge for the Power Electronics Engineer. He can not only design his system for the worst case scenario but it is required to optimise the design for both efficiency as well as transient response. Existing engineering thermal design methods are not suitable for the distributed designs containing more than one semiconductor. Therefore a coupled modelling/identification/simulation method is developed where 3D thermal designs can be taken into consideration in the total Power Electronics design optimisation.

11:50 S8b-2 Current Transducers - Thermal Modelling by Finite Elements
B. Richard, LEM Components, Switzerland

Summary:
The paper will present the results of finite elements thermal simulations, used to determine the thermal behaviour of a given current transducer. The main focus will not be on the "finite element methodology and use“, but on the assumptions behind which makes a thermal simulation correct or wrong (special thermal resistance, air-cooling, tests issues). Presented matters will be corroborated by several theoretic & practical comparisons.

12:15 S8b-3 Extendable Library Support for rapid and verified Simulation of Dynamic Drive Systems

D. Fischer, University of Applied Sciences Rosenheim, M. Podehl, MACCON, GERMANY

Summary:
This paper summarises our experience in the simulation of dynamic servo-systems. Our modular and extendable Matlab / Simulink library contains different types of drives, controllers and sensors which can be combined to represent a complete drive system. This design approach offers advantages in providing both rapid and verified simulation data and good development documentation.

12:40 S8b-4 Design of a 1kA Pulsed Current Source with 60ns Rise Time for the Analysis of Current Probes

A. Nagel, T. Kerwer, Siemens, GERMANY

Summary:
The current slope common in today's power electronics applications can reach values up to 10kA/µs and more. To check the usability of current probes like shunts, current transformers or Rogowski transducers a current source has been designed, which generates a flat top 1kA pulse with a rise time of 60ns.

Room London

S8c
Fuel Cells Applications and Generators
Chairman: Alfred Rufer, EPFL, SWITZERLAND

11:25 S8c-1 Economic and Environmental Considerations of Fuel Cells as a Primary Power Source in UPS (Uninterruptible Power Supply) extended Run Time Application

J.H. Pouchet, MGE UPS Systems, USA, S. Bernard, MGE UPS Systems, FRANCE, B. Graham, Ballard Power Systems, CANADA

Summary:
This paper covers the economic and environmental aspects of fuel cell technology for power systems in the 1 – 30 kVA range and with typical run times of 2 – 72 hours and contrasts to batteries and Diesel generators.

11:50 S8c-2 Uninterruptible Power Supply based on Fuel Cells

G. Siegmund, H. Klos, P 21 Power for the 21st Century, GERMANY

Summary:
Presenting an application example in the field of the telecommunication market with an uninterruptible power supply based on PEM-fuel cell technology.

12:15 S8c-3 Development of a Fuel Cell Power Train for Vehicle Application

H. Hinz, Adam Opel, GERMANY

Summary:
Fuel cell vehicle technology success relies on customer acceptance both from a performance and economic standpoint. To take the next step to commercialisation a new generation of fuel cell vehicles has been developed. This paper describes the design of the power train and its power conversion modules. Experimental results during driving cycles show the improved performance of the vehicle.

12:40 S8c-4 Configuration for Mobile Power Sources

J. Leuchter, O. Kurka, Military Academy Brno, CZECH REPUBLIC, P. Bauer, Delft University of Technology, THE NETHERLAND

Summary:
The paper brings some practical results of research devoted to the optimum configuration for mobile power source, based on the Variable Speed Constant Frequency technology. In this Electrical Generator Sets (EGS) the driving motor and generator speed is optimally controlled in accordance with the load power thus decreasing the fuel consumption. The output voltage and frequency are stabilised by means of power electronics. The paper gives short outline of some problems in research and development of the new generation of EGS.

CCN West – 2nd Floor

Poster/Dialogue Sessions

2 :20 – 3 :30

PP-33 Optimization of Electrical Drives

P.J. Van Duijsen, Simulation Research, P. Bauer, Delft University of Technology, THE NETHERLANDS, D. Gospodaric, Trimerics, GERMANY

Summary:
Optimisation of the entire drive system demands multi-physics simulation of the electrical machine, power converter, mechanical load and the applied control. The model of the entire drive used for optimisation integrates the parameters from the Rapid Application Development tool.

PP-34 Performances Improvement of a PWM AC - To - DC Converter with the Help of Hysteresis Control

R. Marschalko, Technical University of Cluj, ROMANIA, C. Elöd, Konkoly es Kis Kft, HUNGARY

Summary:
The paper deals with some new investigations concerning the performances improvement of a single-phase PWM AC-to-DC converter, based on a current source voltage inverter, provided with dc voltage level control on the output and power factor control on the input. As compared to the switched-mode power supplies, this kind of converters operates in two quadrants and are recommended for inverter fed low power drive systems. The object of the researches is here focused on the bi-level current controller, which is provided with hysteresis control, and, as a result, the commutation losses and the high frequency harmonics of the input current are reduced, with special advantages concerning the line-conditioning capabilities of the converter and the appropriate EMI filter design.

PP-35 A DC/DC Converters with Energy Dosing

N.D. Madzharov, Technical University of Gabrovo, BULGARIA

Summary:
The scientific and applied problems treated in the present paper are related to the development of new DC/DC converters. They are, in their nature, a hybrid between the achievements in modern microelectronic components - frequency capabilities and low commutational losses, and the latest trends in the development of power conversion circuit engineering manifested in the use of adaptive energy dosing circuits which always maintain the power constant and independent from the load changes.

PP-36 The Optimisation of a Magnetic Circuit of a Magnetic Separator

L. Popescu, L. Mondran, University of Sibiu, ROMANIA

Summary:
The constructive optimisation method of a magnetic circuit of a magnetic separator, when we know the magnetisation curve of the material, and predimensionalised through the classical method, permits its constructive finalisation, with the condition to fulfil some imposed gauge or efficiency criteria. The calculation program is a component part of an integral medium of computer aided design of magnetic circuits, which permits the design time reduction simultaneously with the obtaining of some optimal variants from the energetical point of view or the kinematic parameters concomitantly with costs reduction.

PP-37 Superior MOSFET Performance Achieved With The Combination Of Advanced Technologies

J. Brown, Vishay Siliconix, UK

Summary:
This paper shows that by combining the best parameters from both the high cell densities and improved gate structures, results in unparalleled MOSFET performance. Efficiencies are presented for all the different technologies and the benefits of the new technologies are proven in typical application circuits. It is also shown that these new devices can succeed in applications where in the past they had not been viable.

PP-38 Frequency Response of Parallel Current Source Inverters

N.P. Gradinarov, N.L. Hinov, Technical University of Sofia, D.D. Arnaudov, Higher Collage of Telecommunications and Posts, BULGARIA

Summary:
The precise expressions are found in this article for the fundamental characteristics of the current converter with the change driving frequency. These characteristics are built for the cases, of a load compensated in parallel. They are built for infinitely high-power of direct current power supply (DCPS) as well as for limited power of DCPS (presence of a regulator of a current). These characteristics allow evaluating the behaviour of the converter during real changes of the load.

PP-39 Switching Losses Reduction in High Voltage Flyback Converter

L. Filipic, M. Martinjak, Iskraemeco, SLOVENIA

Summary:
Three phase Power Meters are designed to work at wide input voltage range. If flyback converter is used, the duty cycle at upper voltage limit is approximately 3%. So ratio between turn off time and conduction time is up to 50% and power losses on transistor are too high. One possible approach is to reduce number of switching cycles when power consumption on secondary side is low enough.

PP-40 Comparison between Resonant and Conventional Gate Drivers in ZVS Applications

T. Lopez, T. Duerbaum, T. Tolle, G. Sauerländer, Philips Research, GERMANY

Summary:
Gate drivers generate significant losses, especially at high frequencies. While conventional solutions dissipate all the energy, resonant gate drivers partly recover it. A resonant gate driver is studied in detail with the emphasis on ZVS applications. Compared to other resonant drivers, the investigated driver combines simplicity, soft switching and loss reduction. Advantages and limits are discussed using a mathematical model and a prototype.

PP-41 EMC Problems Due to Transit-Time Oscillations in Bipolar Power Devices

R. Siemieniec, Technical University of Ilmenau, R. Mourick, Consulting Engineer, J. Lutz, Technical University of Chemnitz, GERMANY

Summary:
Transit time oscillations may occur in the turn-off phase of power devices and cause high-frequency oscillations. This paper investigates the deterioration of the EMC behaviour due to two mechanisms, which lead to this type of oscillations: the dynamic impact ionisation transit time oscillation and the plasma extraction transit time oscillation. These oscillations should be avoided since they lead to an increase of electromagnetic emission.

PP-42 PWM P-Channel MOSFETs for Computer Applications

D. Koonce, Vishay Siliconix, USA

Summary:
This paper will present a new type of P- channel MOSFET that was developed for high-speed switching for applications such as power supplies. It will outline the various DC-DC topologies that use P- channel MOSFETs. And it will present test results showing how the switching optimised process can improve efficiency.

PP-43 Variable Sampling Time Serial-Resonant Current Converter Control for a High-Voltage X-ray Tube Application

G. Soto Guillermo, G.-W. Baptiste, J. Gaysse, General Electric Medical System, FRANCE

Summary:
This paper presents a variable sampling time fuzzy logic based control on a serial-resonant current DC/DC converter used in X-ray medical imaging power supply. The proposed control manages large load and deals with non-linear system. The control was successfully implemented on a 16 bits fixed-point ST10F269 and FPGA circuit and ensure fast rise time without voltage overshoot.

PP-44 Mechanics and Electronics as Instrument for Minimized Drive Applications

M. Frisch, Tyco Electroncis Power Systems, GERMANY, R. Ehler, Tyco Electronics Power Systems, HUNGARY

Summary:
The goal of this report is to show the electrical and mechanical requirements for power modules, such as compact outline, low inductance, thermal connection to heatsink and stress relief of the electrical interconnection. The special focus is the mechanical interaction between PCB, module and heatsink.

PP-45 Optimal Design of a Boost Converter Using Analytical Models and a Dedicated Optimisation Tool

C. Larouci, D. Brunel, A. Prost, A. Saint John de Crevecoeur, J. Vauchel, ESTACA, FRANCE

Summary:
The current 14V DC system is not able to supply the increasing new electrical options in vehicles and a 42V DC system will be introduced. So, a special DC/DC converter is therefore needed to interconnect theses two voltage networks. In this context, the paper develops an analytical optimisation methodology under constraints of a boost converter using a developed optimisation tool. The aim is to optimise the passive element volume of this converter by respecting EMC standards, by constraining the efficiency, the semiconductor junction, the winding and the magnetic circuit temperatures.

PP-46 Analysis of Dynamic Current Balancing in Parallel Commutation Cells

K.F. Hoffmann, J.P. Kärst, Philips Medical Systems, GERMANY

Summary:
Differences in both the device delay-times and the commutation inductances can cause overcurrents in semiconductors connected in parallel especially during the commutation. These can be avoided by an inductive decoupling of the different commutation cells by small inductances. Hereby a step-by-step commutation will be achieved and the load current is balanced shared. The additional balance-inductances are calculated and their influence is presented by experimental results/measurements

PP-47 Experimental Analysis of the Line Side Behaviour of an Uncontrolled 12-Pulse Rectifier with Capacitive DC-Smoothing Compared to Analytical Analysis

T. Rechberger, Graz University of Technology, AUSTRIA

Summary:
Supply authorities restrict the injection of harmonics from rectifier loads. The designer must therefore be able to quantify the effect on the line current of different values of line reactances to obtain a practical design compromise.

PP-48 The Evaluation Method of Economy Based on Measured Data regarding the Application of Cold Thermal Storage System to Industry

Y.S. Kwon, Korea Electric Power, KOREA

Summary:
To decrease the gap of electric power load between day and night mainly during summer season, the supply of cold thermal storage system to industry is very efficient. To verify the suitability and economy in application of cold thermal storage system to industry, the acquired data from industry and developing evaluation algorithm is needed. This study, shows that the degree of economy can be determined by this new method, and the prediction of levelling effect is possible.