

ISSN 0352-9045

# Informacije MIDEM

*Journal of Microelectronics,  
Electronic Components and Materials  
Vol. 43, No. 4 (2013), December 2013*

*Revija za mikroelektroniko,  
elektronske sestavne dele in materiale  
letnik 43, številka 4 (2013), December 2013*



# *Informacije MDEM 4/2013*

Journal of Microelectronics, Electronic Components and Materials

VOLUME 43, NO. 4(148), LJUBLJANA, DECEMBER 2013 | LETNIK 43, NO. 4(148), LJUBLJANA, DECEMBER 2013

Published quarterly (March, June, September, December) by Society for Microelectronics, Electronic Components and Materials - MDEM.  
 Copyright © 2013. All rights reserved. | Revija izhaja trimesečno (marec, junij, september, december). Izdaja Strokovno društvo za mikroelektroniko, elektronske sestavne dele in materiale – Društvo MDEM. Copyright © 2013. Vse pravice pridržane.

**Editor in Chief | Glavni in odgovorni urednik**

Marko Topič, University of Ljubljana (UL), Faculty of Electrical Engineering, Slovenia

**Editor of Electronic Edition | Urednik elektronske izdaje**

Kristijan Brecl, UL, Faculty of Electrical Engineering, Slovenia

**Associate Editors | Odgovorni področni uredniki**

Vanja Ambrožič, UL, Faculty of Electrical Engineering, Slovenia

Slavko Amon, UL, Faculty of Electrical Engineering, Slovenia

Danjela Kučer Hrovatin, Jožef Stefan Institute, Slovenia

Matjaž Vidmar, UL, Faculty of Electrical Engineering, Slovenia

Andrej Žemva, UL, Faculty of Electrical Engineering, Slovenia

**Editorial Board | Uredniški odbor**

Mohamed Akil, ESIEE PARIS, France

Giuseppe Buja, University of Padova, Italy

Gian-Franco Dalla Betta, University of Trento, Italy

Martyn Fice, University College London, United Kingdom

Ciprian Iliescu, Institute of Bioengineering and Nanotechnology, A\*STAR, Singapore

Małgorzata Jakubowska, Warsaw University of Technology, Poland

Marc Lethiecq, University of Tours, France

Teresa Orlowska-Kowalska, Wrocław University of Technology, Poland

Luca Palmieri, University of Padova, Italy

**International Advisory Board | Časopisni svet**

Janez Trontelj, UL, Faculty of Electrical Engineering, Slovenia - Chairman

Cor Claeys, IMEC, Leuven, Belgium

Denis Đonlagić, University of Maribor, Faculty of Elec. Eng. and Computer Science, Slovenia

Zvonko Fazarinc, CIS, Stanford University, Stanford, USA

Leszek J. Golenka, Technical University Wrocław, Wrocław, Poland

Jean-Marie Haussonne, EIC-LUSAC, Octeville, France

Barbara Malič, Jožef Stefan Institute, Slovenia

Miran Mozetič, Jožef Stefan Institute, Slovenia

Stane Pejovnik, UL, Faculty of Chemistry and Chemical Technology, Slovenia

Giorgio Pignatelli, University of Perugia, Italy

Giovanni Soncini, University of Trento, Trento, Italy

Iztok Šorli, MIKROIKS d.o.o., Ljubljana, Slovenia

Hong Wang, Xi'an Jiaotong University, China

**Headquarters | Naslov uredništva**

Uredništvo Informacije MDEM

MDEM pri MIKROIKS

Stegne 11, 1521 Ljubljana, Slovenia

T. +386 (0)1 513 37 68

F. + 386 (0)1 513 37 71

E. info@midem-drustvo.si

www.midem-drustvo.si

Annual subscription rate is 100 EUR, separate issue is 25 EUR. MDEM members and Society sponsors receive current issues for free. Scientific Council for Technical Sciences of Slovenian Research Agency has recognized Informacije MDEM as scientific Journal for micro-electronics, electronic components and materials. Publishing of the Journal is cofinanced by Slovenian Book Agency and by Society sponsors. Scientific and professional papers published in the journal are indexed and abstracted in COBISS and INSPEC databases. The Journal is indexed by ISI® for Sci Search®, Research Alert® and Material Science Citation Index™. | Letna naročnina je 100 EUR, cena posamezne številke pa 25 EUR. Člani in sponzorji MDEM prejemajo posamezne številke brezplačno. Znanstveni svet za tehnične vede je podal pozitivno mnenje o reviji kot znanstveno-strokovni reviji za mikroelektroniko, elektronske sestavne dele in materiale. Izdajo revije sofinancirajo JAKRS in sponzorji društva. Znanstveno-strokovne prispevke objavljene v Informacijah MDEM zajemamo v podatkovne baze COBISS in INSPEC. Prispevke iz revije zajema ISI® v naslednje svoje produkte: Sci Search®, Research Alert® in Materials Science Citation Index™.

Po mnenju Ministrstva za informiranje št.23/300-92 se šteje glasilo Informacije MDEM med proizvode informativnega značaja.

# Content | Vsebina

## Review scientific paper

- P. Bulić:  
 Fixed-point Multiplication and Division in the Logarithmic Number System: a Way to Low-Power Design

203

## Pregledni znanstveni članek

- P. Bulić:  
 Zmanjševanje porabe v vezjih z uporabo celoštevilskega množenja in deljenja v logaritemskem številskem sistemu

## Original scientific papers

- C. Roncero-Clemente, O. Husev, V. Miñambres-Marcos, E. Romero-Cadaval, S. Stepenko, D. Vinnikov: Tracking of MPP for Three-level Neutral-point-clamped qZ-source off-grid inverter in Solar Applications

212

## Izvirni znanstveni članki

- C. Roncero-Clemente, O. Husev, V. Miñambres-Marcos, E. Romero-Cadaval, S. Stepenko, D. Vinnikov: Sledenje točke največje moči s trinivojskim NPC quasi-Z-source neomrežnim razsmernikom v solarnih aplikacijah

- H. Ercan: A Linear Current-controlled Floating Negative Resistor

222

- H. Ercan: Linearen tokovno kontroliran plavajoči negativni upor

- M. Petkovšek, A. Leban, M. Nemeč, D. Vončina, P. Zajec: Series Active Power Filter for High-Voltage Synchronous Generators

228

- M. Petkovšek, A. Leban, M. Nemeč, D. Vončina, P. Zajec: Serijski aktivni močnostni filter za visokonapetostne sinhronske generatorje

- Z. Brezočnik, B. Vlaovič, A. Vrež: Model Checking using Spin and SpinRCP

235

- Z. Brezočnik, B. Vlaovič, A. Vrež: Preverjanje modelov z uporabo orodij Spin in SpinRCP

- D. Strle, J. Trontelj: Signal Processing for Integrated, High Performance, Low Noise Chemical/Biological Sensor Interface

251

- D. Strle, J. Trontelj: Signalno procesiranje za integriran, visoko-zmogljiv nizkošumni vmesnik za kemijske/biološke senzorje

- A. Biasizzo: On-line Testing and Recovery of Systems with Dynamic Partial Reconfiguration

259

- A. Biasizzo: Sprotno preiskovanje in popravljanje sistemov z dinamično delno rekonfiguracijo

## Professional papers

## Strokovni članki

- M. Terörde, T. Do Thanh, D. Schulz: Different Switchover-strategies for Load Balancing in Future Aircraft

267

- M. Terörde, T. Do Thanh, D. Schulz: Različne preklopne strategije uravnovešenja bremena v letalih prihodnosti

- A. Stadler: The Copper Losses of Gapped Inductors with Litz-Wire Windings

277

- A. Stadler: Bakrove izgube na tuljavah z režo pri uporabi navitij s pletenico

- Announcement and Call for Papers:  
 50<sup>th</sup> International Conference on Microelectronics, Devices and Materials

284

- Napoved in vabilo k udeležbi:  
 50. Mednarodna konferenca o mikroelektroniki, napravah in materialih

## Front page:

## Naslovnica:

Chairmen and invited speakers at MIDEM 2013 - 49<sup>th</sup> International Conference on Microelectronics, Devices and Material MIDEM 2013s

Predsedujoči in vabljeni predavatelji na 49. Mednarodni konferenci o mikroelektroniki, napravah in materialih MIDEM 2013

# *Editorial | Uvodnik*

Dear Reader,

This issue brings 8 selected papers based on the presentations at the two international conferences that took place in Slovenia in 2013.

The first four papers are contributed from the invited speakers at the MDEM 2013 Conference (49th International Conference on Microelectronics, Devices and Materials with the Workshop on Digital Electronic Systems, Kranjska Gora, Slovenia, 25-27 Sep 2013) and selected by co-chairpersons Prof. Andrej Žemva and Assoc. Prof. Andrej Trost to reflect the state-of-the-art achievements from the broad field of Digital Electronic Systems.

The last four papers are a selection from the CPE 2013 (8th International Conference-Workshop Compatibility and Power Electronics, Ljubljana, Slovenia, 5-7 June 2013) by Prof. Vanja Ambrožič and Prof. Ryszard Strzelecki as General Chairmen of CPE 2013.

Since this is the last issue of the volume 43, let me reveal some statistics of the submitted manuscripts. In 2013 we have received more than 75 manuscripts, out of which 32 were accepted for publication (3 review scientific papers, 23 original scientific papers and 6 Professional Articles), whereas a dozen are still under review. Despite a well defined title of our journal and on-line instructions for authors we receive each year few manuscripts that are out of our journal's scope. The success rate of 50% in 2013 is a good foundation for the long-term quality growth of the journal. I would like to sincerely thank all reviewers for their valuable contribution to the journal quality and growing reputation. Editorial Board's commitment to high quality in the review process paths a way toward a better profiling of our journal.

Year 2013 is silently fading out. Let the last December days bring festive atmosphere, joy and peace in each home, office or research laboratory. It is the time to look back, but also to look ahead ambitiously and make plans for the coming year. This brings me to editorial wishes for 2014 that as a part of your success we have the privilege of seeing your next manuscript(s) in our inbox (editor@midem-drustvo.si).

Merry Christmas and a Happy and Prosperous New Year!

Prof. Marko Topič  
Editor-in-Chief

P.S.

All papers published in Informacije MDEM –Journal of Microelectronics, Electronics Components and Materials (since 1986) can be access electronically for free at <http://midem-drustvo.si/journal/home.aspx>. A search engine is provided to use it as a valuable resource for referencing previous published work and to give credit to the results achieved from other groups.

# MDEM 2014

## 50<sup>th</sup> INTERNATIONAL CONFERENCE ON MICROELECTRONICS, DEVICES AND MATERIALS



### Announcement and Call for Papers

October 8<sup>th</sup> – 10<sup>th</sup>, 2014  
Cankarjev dom, Ljubljana, Slovenia

**ORGANIZER:** MDEM Society - Society for Microelectronics, Electronic Components and Materials, Ljubljana, Slovenia

**CONFERENCE SPONSORS:** Slovenian Research Agency, Republic of Slovenia; IMAPS, Slovenia Chapter; IEEE, Slovenia Section; Zavod TC SEMTO, Ljubljana.

### GENERAL INFORMATION

The 50<sup>th</sup> International Conference on Microelectronics, Electronic Components and Devices continues a successful tradition of the annual international conferences organised by the MDEM Society, the Society for Microelectronics, Electronic Components and Materials. The conference will be held in **Cankarjev dom, Ljubljana**, Slovenia, well-known cultural and conference centre, from **OCTOBER 8<sup>th</sup> – 10<sup>th</sup>, 2014**.

### Topics of interest include but are not limited to:

- Novel monolithic and hybrid circuit processing techniques,
- New device and circuit design,
- Process and device modelling,
- Semiconductor physics,
- Sensors and actuators,
- Electromechanical devices, Microsystems and nanosystems,
- Nanoelectronics

- Optoelectronics,
- Photonics,
- Photovoltaic devices,
- New electronic materials and applications,
- Electronic materials science and technology,
- Materials characterization techniques,
- Reliability and failure analysis,
- Education in microelectronics, devices and materials.

### ABSTRACT AND PAPER SUBMISSION:

Prospective authors are cordially invited to submit up to 1 page abstract before **May 1<sup>st</sup>, 2014**. Please, identify the contact author with complete mailing address, phone and fax numbers and e-mail address.

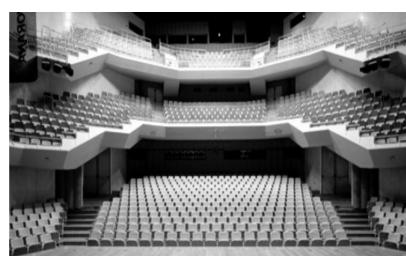
After notification of acceptance (**June 15<sup>th</sup>, 2014**), the authors are asked to prepare a full paper version of six pages maximum. Papers should be in black and white. Full paper deadline in PDF and DOC electronic format is: **August 31<sup>st</sup>, 2014**.

### IMPORTANT DATES:

- Abstract deadline: **May 1<sup>st</sup>, 2014** (1 page abstract or full paper)
- Notification of acceptance: **June 15<sup>th</sup>, 2014**
- Deadline for final version of manuscript: **August 31<sup>st</sup>, 2014**

Invited and accepted papers will be published in the conference proceedings.

Detailed and updated information about the MDEM Conferences is available at  
<http://www.mdem-drustvo.si/> under Conferences.



# *Boards of MDEM Society | Organi društva MDEM*

## *MDEM Executive Board | Izvršilni odbor MDEM*

### **President of the MDEM Society | Predsednik društva MDEM**

Prof. Dr. Marko Topič, University of Ljubljana, Faculty of Electrical Engineering, Slovenia

### **Vice-presidents | Podpredsednika**

Prof. Dr. Barbara Malič, Jožef Stefan Institute, Ljubljana, Slovenia

Dr. Iztok Šorli, MIKROIKS, d. o. o., Ljubljana, Slovenija

### **Secretary | Tajnik**

Olga Zakrajšek, UL, Faculty of Electrical Engineering, Ljubljana, Slovenija

### **MDEM Executive Board Members | Člani izvršilnega odbora MDEM**

Prof. Dr. Slavko Amon, UL, Faculty of Electrical Engineering, Ljubljana, Slovenia

Darko Belavič, In.Medica, d.o.o., Šentjernej, Slovenia

Prof. Dr. Bruno Cvikel, UM, Faculty of Civil Engineering, Maribor, Slovenia

Prof. DDr. Denis Đonlagić, UM, Faculty of Electrical Engineering and Computer Science, Maribor, Slovenia

Prof. Dr. Leszek J. Golenka, Technical University Wroclaw, Poland

Leopold Knež, Iskra TELA d.d., Ljubljana, Slovenia

Dr. Miloš Komac, UL, Faculty of Chemistry and Chemical Technology, Ljubljana, Slovenia

Prof. Dr. Miran Mozetič, Jožef Stefan Institute, Ljubljana, Slovenia

Jožef Perne, Zavod TC SEMTO, Ljubljana, Slovenia

Prof. Dr. Giorgio Pignatelli, University of Perugia, Italia

Prof. Dr. Janez Trontelj, UL, Faculty of Electrical Engineering, Ljubljana, Slovenia

## *Supervisory Board | Nadzorni odbor*

Prof. Dr. Franc Smole, UL, Faculty of Electrical Engineering, Ljubljana, Slovenia

Mag. Andrej Pirih, Iskra-Zaščite, d. o. o., Ljubljana, Slovenia

Dr. Slavko Bernik, Jožef Stefan Institute, Ljubljana, Slovenia

## *Court of honour | Častno razsodišče*

Emer. Prof. Dr. Jože Furlan, UL, Faculty of Electrical Engineering, Slovenia

Prof. Dr. Radko Osredkar, UL, Faculty of Computer and Information Science, Slovenia

Franc Jan, Kranj, Slovenia

**Informacije MDEM**

*Journal of Microelectronics, Electronic Components and Materials*

ISSN 0352-9045

Publisher / Založnik:

MDEM Society / Društvo MDEM

*Society for Microelectronics, Electronic Components and Materials, Ljubljana, Slovenia*

Strokovno društvo za mikroelektroniko, elektronske sestavne dele in materiale, Ljubljana, Slovenija

[www.midem-drustvo.si](http://www.midem-drustvo.si)