The 3rd IEEE ICDCM 2019

International Conference on DC Microgrids

May 20 – 23, 2019

KUNIBIKI Messe

Matsue, Shimane, Japan

Program

The 3rd IEEE ICDCM
International Conference on DC Microgrids

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Welcome message from the Chairs of the ICDCM 2019

It is my great pleasure to welcome you to the IEEE International Conference on DC Microgrids 2019 sponsored by the IEEE Power Electronics Society (PELS). On behalf of the ICDCM 2019 committee, I would like to express my deepest thanks to you all for coming from all over the world to participate in the conference. Today, we are holding the third IEEE conference here in Matsue, Japan, following the first one held in Atlanta, USA in 2015 and the second one held in Nuremberg, Germany in 2017.

Expectations for DC power technology are growing year by year along with the increasing adoption of renewable energy and storage batteries, which at the same time boosts expectations for the development of more efficient and reliable DC power distribution systems and equipment. Since ICDCM is joined by numerous experts and researchers across the globe, it will expand your academic network and offer you a great opportunity for learning and sharing the state-of-the-art technologies through the high-quality research papers presented to the conference and in-depth discussions during the session.

Standing by the Sea of Japan where Lake Shinji and Nakaumi meet, Matsue is known as the “City of Water”. I also would like you all to have a wonderful stay in Matsue, enjoining the beauty of the city and trying Japanese food.

Before concluding my remarks, please let me extend my heartfelt appreciation for all the work the committee members have done for us. Thanks to their dedication, I believe we will have a successful ICDCM 2019. Without their dedication, we could not have such a successful ICDCM 2019. In addition, the committee members and I feel truly glad and honored to welcome the officers of the IEEE PELS, technical supporters, sponsors, exhibitors and stakeholders to the conference. Once again, thank you for joining us today.

Keiichi Hirose, General Chair

Masanobu Matsui, Technical Program Chair

Kazuto Yukita, General Vice Chair

Welcome message from the President of IEEE Power Electronics Society

On behalf of the IEEE Power Electronics Society I warmly welcome you to the third ICDCM conference, which is held in Matsue, Japan here in 2019. DC micro-grids are evolving very fast and the level of attendance, submitted papers and also companies who sponsor this conference clearly indicate this. Our modern society becomes more and more electrified - we have already many examples of DC based grid structure - but as the power electronics technology continuous its progress, we will see even more - in many autonomous systems, in the transportation electrification but also as grid structure in rural areas just to mention a few. The tracks at this conference clearly indicate the areas under development.

The conference has all aspects of a classical conference structure including an interesting social programme to - which can be used for professional networking - A special thanks to all volunteers for this conference and sponsors - without such support - ICDCM would hardly be possible. And thanks to the general chairman Keiichi Hirose - congratulations for this event.

I wish you all an inspiring and enjoyable ICDCM.

Frede Blaabjerg
President of IEEE Power Electronics Society 2019-2020

Prof. Dr. Frede Blaabjerg (S'86–M'88–SM'97–F'03) was with ABB-Scandia, Randers, Denmark, from 1987 to 1988. From 1988 to 1992, he got the PhD degree in Electrical Engineering at Aalborg University in 1995. He became an Assistant Professor in 1992, an Associate Professor in 1996, and a Full Professor of power electronics and drives in 1998. From 2017 he became a Villum Investigator. He is honoris causa at University Politehnica Timisoara (UPT), Romania and Tallinn Technical University (TTU) in Estonia.

His current research interests include power electronics and its applications such as in wind turbines, PV systems, reliability, harmonics and adjustable speed drives. He has published more than 600 journal papers in the fields of power electronics and its applications. He is the co-author of four monographs and editor of ten books in power electronics and its applications.

He has received 30 IEEE Prize Paper Awards, the IEEE PELS Distinguished Service Award in 2009, the EPE-PEMC Council Award in 2010, the IEEE William E. Newell Power Electronics Award 2014 and the Villum Kann Rasmussen Research Award 2014. He was the Editor-in-Chief of the IEEE TRANSACTIONS ON POWER ELECTRONICS from 2006 to 2012. He has been Distinguished Lecturer for the IEEE Power Electronics Society from 2005 to 2007 and for the IEEE Industry Applications Society from 2010 to 2011 as well as 2017 to 2018. In 2019-2020 he serves a President of IEEE Power Electronics Society. He is Vice-President of the Danish Academy of Technical Sciences too. He is nominated in 2014-2018 by Thomson Reuters to be between the most 250 cited researchers in Engineering in the world.

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PROGRAM AT A GLANCE

Venue: Kunibiki Messe, Matsue, Japan

The 3rd IEEE ICDCM
(International Conference on DC Microgrids)

	Monday 20-May-2019	Tuesday 21-May-2019	Wednesday 22-May-2019	Thursday 23-May-2019
9:00	Registration Open	Opening Session	Special Sessions [9:00 - 10:30]	Key note Sessions [9:00 - 10:30]
9:30	Tutorial 1 [9:30-10:15]	Plenary session [9:30 - 10:30]		
10:00				
10:30	Tutorial 2 [10:15-11:00]	Coffee Break [10:30 - 11:00]	Coffee Break [10:30 - 11:00]	Coffee Break [10:30 - 11:00]
11:00		Parallel Sessions	Parallel Sessions	Parallel Sessions
11:30	Tutorial 3 [11:15-12:00]	[11:00 - 12:30]	[11:00 - 12:30]	[11:00 - 12:30]
12:00	Lunch Break	1-A, 1-B	4-A, 4-B	5-A, 5-B
12:30	[12:00 - 13:00]	Lunch Break	Lunch Break	Lunch Break
13:00	Tutorial 4 [13:00-13:45]	[12:30 - 13:15]	[12:30 - 13:15]	[12:30 - 13:15]
13:30		Poster 1 [13:15-14:35]	Social event	Poster 2 [13:15-14:35]
14:00	Tutorial 5 [13:45-14:30]		[13:15 - 18:00]	
14:30	Coffee Break [14:30 - 15:00]	Parallel Sessions		Parallel Sessions
15:00	Woskshop	[14:40 - 16:10]	- Matsue Castle	[14:40 - 16:10]
15:30	[15:00 - 16:00]	2-A, 2-B	- Sightseeing Boat	6-A, 6-B
16:00		Coffee Break [16:10 - 16:30]	- Adachi Museum	Coffee Break [16:10 - 16:30]
16:30	Panel discussion	Parallel Sessions		Parallel Sessions
17:00	[16:15 - 17:45]	[16:30 - 18:00]		[16:30 - 18:00]
17:30		3-A, 3-B		7-A, 7-B
18:00				Closing Session
18:30	Welcome reception			
19:00	[18:00 - 20:00]		Banquet	
19:30			@YUSHI-EN	
20:00			[18:00 - 21:00]	
20:30				
21:00				

Technical Program

Plenary and keynote speeches

Tutorials

- **(**1) DC Microgrids: Architectures, Control and DC/DC Converter Topologies
- (2) Energy Storage Techniques for DC power Applications

Workshop: Introduction to Hardware in the loop (HIL) simulation

Panel discussion: DC power applications by Block chain

Oral session (13 sessions)

- Power Electronics for grids (1), (2)
- DC Breaker and Arc Detection
- Protection and Safety
- Control, Simulation, Emulation and Analysis of Microgrids
- Controls Strategy of DC Microgrids
- Stability and Performance Analysis, Management
- Technology and demonstration of DC Microgrids
- DC Microgrids in Buildings
- DC applications for transportation
- DC Applications (1), (2), (3)

Organized session (1 session)

- Recent trends in DC power supply for electric railway and stations

Special session (2 sessions)

- Data Center-centered DC Micro-grid
- A Snapshot of DC Activity in North America

Poster session (2 sessions)

Social Program

1. Welcome Reception
Date & Time: Monday, May 20, 18:00 – 20:00
Venue: Exhibition area, KUNIBIKI Messe

2. Site tour & Banquet
Date & Time: Wednesday, May 22, 13:15 - 22:00
The banquet will be held following the sightseeing tour. All the participants of this event will go on the boats or buses and travel as group.

Note:
- ✓ The following times are for reference only and may change due to traffic jam or weather conditions.
- ✓ The details of the event will be announced on the bulletin board on the day of the event.

13:15 Start of boat boarding, towards Matsue Castle
14:00 Matsue Castle sightseeing
15:00 Bus transfer from Matsue Castle parking lot
16:00 Adachi Museum of Art, Japanese garden & fine arts appreciation
17:30 Departure from Adachi Museum of Art
18:00 Arrival at Yushien, watching Japanese Garden and Peony garden, & welcome drink
19:00 Banquet start
21:00 Banquet end, & Bus transfer
22:00 Arrival in Matsue city

About Matsue Castle

Matsue Castle is a feudal castle in Matsue in Shimane prefecture, Japan. Nicknamed the "black castle" or "plover castle", it is one of the few remaining medieval castles in Japan – at least of the few remaining in their original wooden form, and not a modern reconstruction in concrete. The construction of Matsue Castle began in 1607 and finished in 1611, under the local lord Horio Yoshiharu.

Most Japanese castles have been damaged or destroyed by war, earthquakes, or other causes. Since a large part of their construction was wooden, fire was a major hazard. Matsue castle was built after the last great war of feudal Japan, so it never saw a battle. Yet only some of the walls and the keep exist today.

Matsue Castle, standing on the shores of Shinji Lake, is one of Japan's Three Great Lake Castles. It is also known as a riverside district.

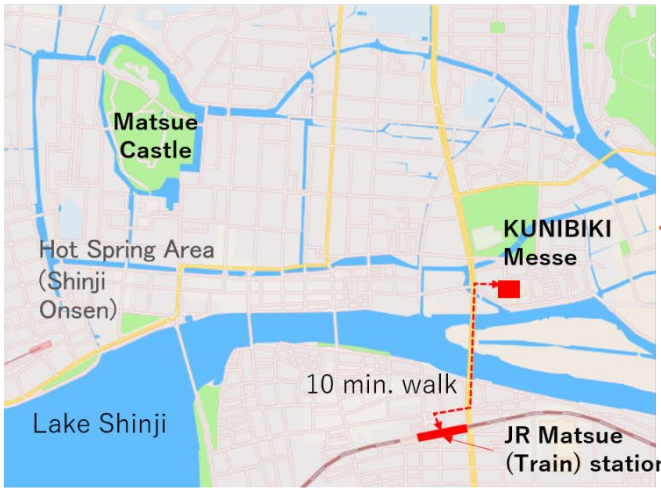
About Adachi Museum of Art

The Adachi Museum of Art was founded by Adachi Zenko in 1980 as a way of combining his passions for Japanese art and garden design. He hoped that viewing the gardens and artwork together would expand peoples' appreciation and interest in Japanese art.

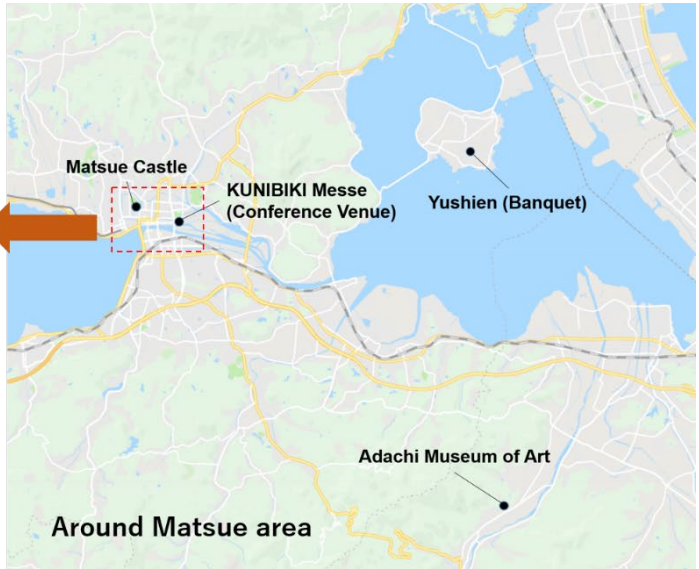
The Adachi Museum of Art is best known for its award winning garden. It has been named the best garden in Japan annually since 2003 by the "Journal of Japanese Gardening". The garden can be enjoyed at any time of the year and shows a different character depending on the season. It can only be viewed from the museum building. In addition to the gardens, the Adachi Museum of Art also houses a collection of nearly 1300 twentieth century paintings and artworks which are rotated seasonally. There is also a permanent exhibit of paintings by Yokoyama Taikan, as well as a ceramics exhibit.

About Yushien (Banquet venue)

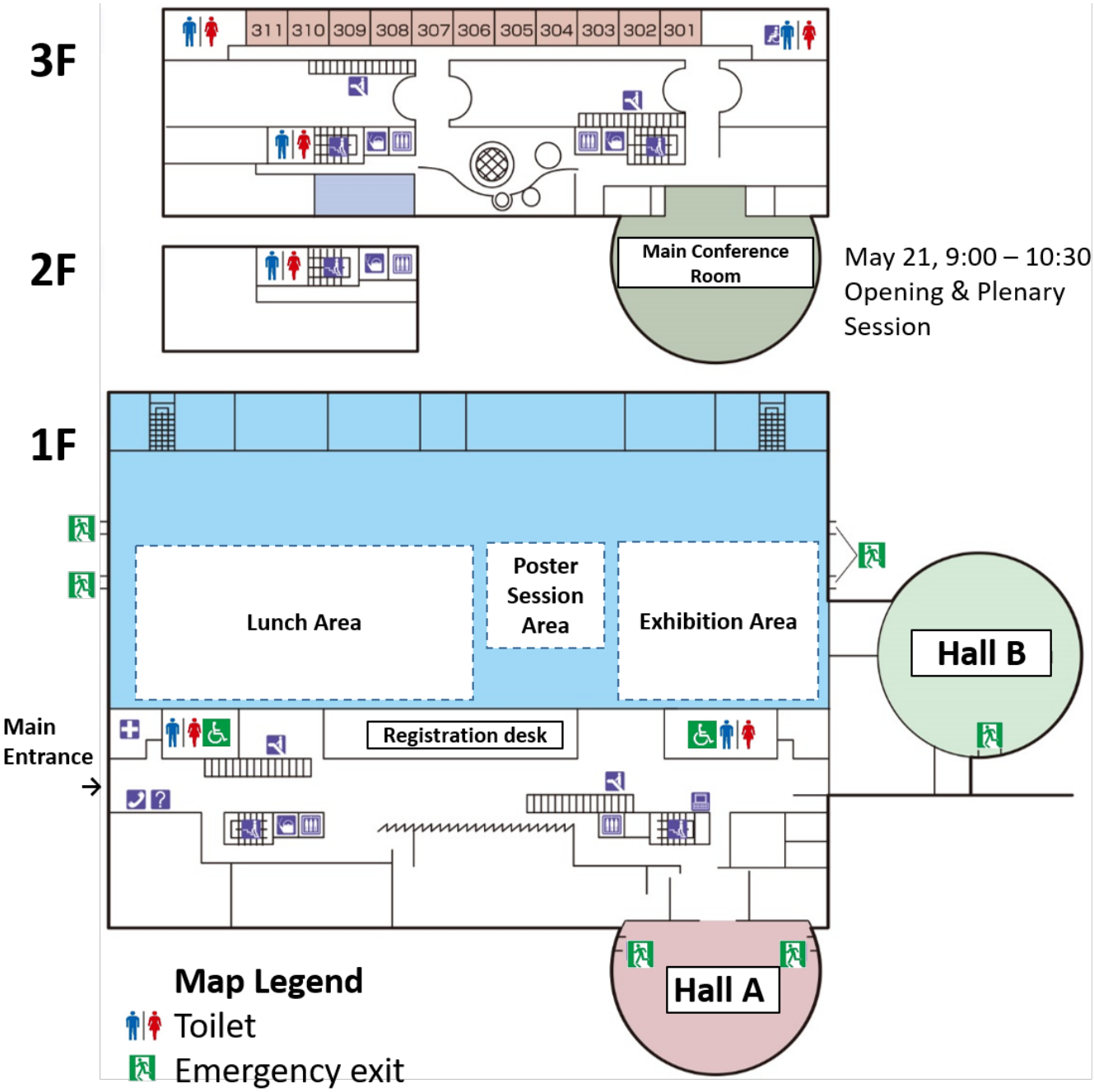
Yushien is located on Daikonjima, a small 12 km island that was formed by a volcanic eruption. Up until the 1950s, Daikonjima enjoyed prosperity through their silkworm industry, but the island eventually fell into decline and the women of the island resorted to traveling around outside the island selling young peony trees in order to make a living. Seeing the women like this touched the heart of Kadowaki Sakae, the creator and first generation owner of Yushien. He decided to create Yushien so that the women of Daikonjima did not have to leave the island and could attract visitors from all over Japan to see the beauty of the island's peonies. 5 years later, Yushien was opened to the public and ever since the garden has become a highly popular tourist spot, attracting around 300,000 visitors per year.



Map of Matsue down town



KUNIBIKI Messe Floor Layout



No smoking on the premises

Free WIFI:
SSID:

Conference Information

Official Language
The working language of the ICDCM conference is English.
All presentation including discussions shall be made in English.

Date and Venue
Date: May 20 - 23, 2019
Venue: KUNIBIKI Messe
1-2-1 Gakuenminami, Matsue City, Shimane Prefecture 690-0826, Japan
TEL: +81-852-24-1111 FAX: +81-852-22-9219

Registration
The registration desk is the 1st floor and opens during the following hours:
May 20 (Mon) 9:00 – 18:00
May 21 (Tue) 8:45 – 17:00
May 22 (Wed) 8:45 – 12:30
May 23 (Thu) 8:45 – 12:30

Badges
All the participants including accompanying persons are asked to wear their name badges to enter the session rooms and take part in social programs. Please wear your name badge at all the time during the conference period.

Coffee Break
Refreshments are available at the exhibition area of the conference venue.

Internet Connections
Wi-Fi access is available at the conference venue.
SSID:

Message Board
Any program changes or urgent announcements from the secretariat and person to person messages will be posted on the message board located near the registration desk. Please check the board occasionally.

Photography and Recording
Except authorized media staffs, photography/recording in the session halls is strictly prohibited. Taking photos of posters without any approval from authors is also prohibited.

Plenary/Keynote Speech

Plenary – 1
Date: May 21, Tuesday 9:30 – 10:10, International Conference Hall
Name: Mr. Kunihiro Tanaka, Founder, President, CEO of SAKURA Internet, Inc., Japan
Title: The DC Powered Data Center-Perfect performance during Hokkaido Blackout and its expansion to DC smart community-

Summary: Some data center operators have facilities around Sapporo urban area. The power supply from these data centers was cut off by a power outage whole Hokkaido island due to the Central Eastern Earthquake that occurred on September 6, 2018. Ishikari Data Centers, operated by Sakura Internet Inc., are not the exception but could minimize the adverse influences.

Sakura Internet Inc., had already introduced a DC power system with 380 VDC distributions and server racks. This DC power system is connected to a 200kW solar panel, which not only works on CO2 reduction, but also contributes to reducing power consumption and improving reliability.

In this plenary speech, Mr. Kunihiro Tanaka, founder and president of Sakura Internet Inc., talks about the results of DC power supply systems that were completely worked during the Hokkaido blackout, and proves to be the most reliable and stable. The DC power system for data center will be expanded to not only the ICT sectors but also the smart grid and the community as an essential power supply infrastructure.

Note: *This speech is offered by Japanese-English translation*.

Kunihiro Tanaka was born in 1978. He founded “Sakura Internet” for hosting service with start-up services in 1996, while studying at National Institute of Technologies, Maizuru College at the age of 18. After limited company, “Inforest” founded in 1998, he became a president and established a “Sakura Internet Inc.” the following year. In 2005, it listed on the Tokyo Stock Exchange Mothers, became listed on the Tokyo Stock Exchange in 2015.

On November 15, 2011, Ishikari Data Center in Hokkaido launched for cloud services with top-level eco technologies including DC power distribution. DC power system in Ishikari worked perfectly without any trouble since its launch.

Plenary – 2
Date: May 21, Tuesday 10:10 – 10:40, International Conference Hall
Name: Mr. Vimal Mahendru, the President of Legrand-India, Chair of the IEC Systems Committee for Low Voltage Direct Current and Low Voltage Direct Current for Electricity Access (SyC LVDC), India
Title: Trend in international standards on LVDC power

Summary: The world is changing, and changing rapidly. There is an unprecedented advent of electronics, digitalization, software, AI, e-mobility, which is all creating a huge demand for electricity. At the same time, we are saddled with challenges of making our world a better place, of reducing poverty, enhancing sustainable practices and bringing opportunities to all. These mega trends are pointing toward a new electrical system based on direct current. The keynote address will explain the megatrends, their impact and implications, and how electricity itself will evolve in the next two decades.

Vimal Mahendru is the President of Legrand-India, a subsidiary of the French multi-national Legrand. In his present role, he continues to guide the strategic initiatives of the company, especially new and emerging technologies and markets. Vimal is the elected board member of the IEC Standardization Management Board (SMB) Since January 1, 2015, and would continue to shoulder the same responsibilities till December 31, 2020. Simultaneously, he is the Chair of the IEC Systems Committee for Low Voltage Direct Current and Low Voltage Direct Current for Electricity Access (SyC LVDC). Furthermore, he is also the Chairman of the Committee of Bureau of Indian Standards responsible for standards for LT and HT Fuses and member of the Bureau of Standards' Electrotechnical Divisional Council (BIS ETDC).

Keynote – 1
Date: May 23, Thursday 9:00 – 9:30, Hall A
Name: Josep M. Guerrero, Professor in Microgrid, Department of Energy Technology, IEEE Fellow, AALBORG UNIVERSITY, Denmark
Title: Maritime DC Microgrids for Greener Seas

Summary: This keynote will present different maritime applications in which the use of DC microgrids can help on make them more sustainable and efficient, including: electric/hybrid yachts, ships, ferries and vessels, seaport connections and cranes. Shipboard DC microgrids will be presented in connection to the last trends in the industry, including topologies, control and management, and in contrast to AC and AC/DC hybrid ones. Onboard DC grids with multidrive power system schemes from different companies such as ABB or Siemens will be presented and contrasted. Integration of energy storage like fuel cells, batteries and flywheels will be presented in real examples to improve the effect of Dynamic Positioning (DP) systems, which will be as well introduced, in drilling offshore platforms and offshore/platform support vessels (OSV/PSV). Retrofitting projects of old ships to hybrid/full electrical propelled ones will be illustrated from different parts of the world, including Norway, Denmark, and Taiwan, among others. Finally shipboard microgrid standards will be reviewed and connection schemes to the onshore seaport power supply will be shown in real applications, like that in the port of Rotterdam.

Keynote – 2
Date: May 23, Thursday 9:30 – 10:00, Hall A
Name: Sudip K. Mazumder, Prof. IEEE Fellow, University of Illinois at Chicago, USA
Title: EV Battery Supercharger: Confluence of Advanced Power Electronics and Next-Generation SiC Devices

Summary: Electric vehicles (EVs) are one of the major technological advancements that help in reducing the dependence on the fossil-fuel-based energy sources. EVs are typically charged using Level-1 chargers, which are slow and need to be plugged in overnight. Level-1 chargers operate using 120 V (RMS) single-phase AC available at homes. Level-2 chargers need 240 V (RMS) single-phase input and offer relatively faster charging capabilities but still take relatively long time to charge the batteries. A long battery charging time limit the operating range of EV and serving time. Recently, the focus has been on DC Level-3 quick charger (DCQC), which typically operates using 480/679 (RMS/peak) V three-phase AC input. Power levels are normally up to about 60 kW. This results in rapid charging of the EV batteries. Typical time taken to charge to 80% is just 15-30 minutes. However, the current silicon-based power-electronic charger solutions, which are typically transformer and multiple-conversion-stage based, are relatively low on power density, specific power, peak efficiency, and thermal sustenance. Rapid technological advancements, using integration of SiC technologies and novel EV charger circuit innovations that reduce architectural and operational complexities, are needed for reduced volume, reduced weight, lower cost, enhanced reliability, and wide (and hence universal) voltage applicability thereby yielding greater market penetration and accelerated deployment of EV charging infrastructure aside from providing a pathway to on-board vehicular integration of the charger at higher power. This keynote will provide a broad outline on the newly-emerging DC battery supercharger and how it benefits by the confluence of advanced power electronics and SiC devices.

Sudip K. Mazumder received his Ph.D. degree from Virginia Tech in 2001. He is a Professor and the Director of Laboratory for Energy and Switching-Electronics Systems in the Department of Electrical and Computer Engineering at the University of Illinois at Chicago. He also serves as the President of the small business NextWatt LLC.

He is the recipient of University of Illinois at Chicago's Inventor of the Year Award (2014), University of Illinois' University Scholar Award – university's highest award (2013), IEEE International Future Energy Challenge Award (2005), ONR Young Investigator Award (2005), NSF CAREER Award (2003), and IEEE PELS Transaction Prize Paper Award (2002). In 2016, he was elevated to the rank of an IEEE Fellow and he was elected to serve as a Distinguished Lecturer for IEEE PELS beginning in 2016. Since 2019, he is also the Editor-at-Large for IEEE Transactions on Power Electronics. Currently, he also serves as the Chair for IEEE PELS Technical Committee on Sustainable Energy Systems. He is the Chair for IEEE PEDG'21, the TPC Chair for IEEE DEAS'19, and the Tutorial Chair for ECCE'19. He is an AdCom Member for IEEE Power Electronics Society.

Keynote – 3
Date: May 23, Thursday 10:00 – 10:30, Hall A
Name: Mr. Harry stockman, IEC SyC LVDC, rep. of the Netherlands NC, CEO of DC Systems, The Netherlands
Title: DC power distributions in the Netherlands

Summary: High level DC systems and examples of use cases to test the system. To show there can be an DC world after all.

Harry Stokman is a DC entrepreneur for more than 30 years. In 2009 he started the company Direct Current Ltd with a mission to DCify the world by developing a DC System that ends the chicken-egg discussion. With his team, he develops the missing items, such as DC protection and DC devices. He is active in the LVDC SyC System Committee and multiple commissions. He is the drive behind the DC projects in the Netherlands, such as DC offices, DC streetlights and DC greenhouses. It is important to define a system and not an application. And thus, to test the application within the system.

Tutorial Part-1: DC Microgrids: Architectures, Control and DC/DC Converter Topologies

Tutorial 1-1

Date: May 20, Monday 9:30 – 10:15, Hall A
Name: Tomislav Dragičević, Associate Professor, Aalborg University, Denmark
Title: DC Microgrids: Applications, Architectures and Control

This part of tutorial aims firstly to shed light on practical design aspects of DC distribution technology concerning typical power hardware topologies and their suitability for different existing and emerging applications. Moreover, several industrial projects in the area of DC microgrids, from remote telecom systems to commercial and military shipboards and to DC homes will be introduced. Following this overview, a systematical control structure for DC microgrids will be presented and classified into local and coordinated control levels according to the respective functionalities in each level. As opposed to local control which relies only on local measurements, communication channels between units needs to be made available in order to achieve coordinated control. In this view, the overall control in DC microgrids, depending on the communication topology, can be divided into three basic coordinated control strategies, i.e. decentralized, centralized and distributed control. These strategies are briefly overviewed, and a separate application example is presented to clarify each one of them. While, all presented examples rely on non-isolated DC/DC converter topologies, in many practical DC microgrid applications, it is worthwhile to have isolated topologies. For this reason, the following two parts of the tutorial explore modeling and control of dual-active bridge (DAB), as one of the most prominent members of the family of isolated DC/DC converters.

Tomislav Dragičević (S'09-M'13-SM'17) received the M.Sc. and the industrial Ph.D. degrees in Electrical Engineering from the Faculty of Electrical Engineering, Zagreb, Croatia, in 2009 and 2013, respectively. From 2013 until 2016 he has been a Postdoctoral research associate at Aalborg University, Denmark. From March 2016 he is an Associate Professor at Aalborg University, Denmark. He made a guest professor stay at Nottingham University, UK during spring/summer of 2018. His principal field of interest is overall system design of autonomous and grid connected DC and AC microgrids, and application of advanced modeling and control concepts to power electronic systems. He has authored and co-authored more than 170 technical papers (more than 65 of them are published in international journals, mostly IEEE Transactions) in his domain of interest and 8 book chapters and an IET book in the field of DC microgrids. He serves as an Associate Editor in the IEEE Transactions on Industrial Electronics, in the IEEE Emerging and Selected Topics in Power Electronics and in the Industrial Electronic Magazine. Dr. Dragičević is a recipient of a Končar prize for the best industrial PhD thesis in Croatia, and a Robert Mayer Energy Conservation award.

Tutorial 1-2
Date: May 20, Monday 10:15 – 11:00, Hall A
Name: Shuai Shao, Assistant Professor, Zhejiang University, China
Title: Modeling, Modulation, Circulating Current and ZVS-on of a Dual Active Bridge DC/DC Converter

The second part of the tutorial goes more in detail with regard to Dual active bridge (DAB) dc-dc converter which is a promising technology for smart grids, energy storage systems and bidirectional electric vehicle on-board chargers due to its attractive features including auto-adjust bidirectional power flow, wide voltage gain range and ZVS-on capability. In this tutorial, modeling of a DAB is firstly introduced. The inductor current of a DAB is purely ac and its modeling is different from conventional dc converters. Various methods including reduced order model, improved reduced order model, generalized average model and discrete-time model are introduced and compared with simulation results. Based on the derived DAB model, the control of a DAB converter is presented. Feedback control, feedback plus feedforward control and feedback control based on observer are introduced. Simulation results are given to compare the performance of these control methods. Some practical issues such as dead time effect, phase drift and transformer dc offset suppression are also explained. Circulating current and loss of ZVS-on can decrease DAB conversion efficiency significantly. For the circulating current problem, this tutorial explains the cause of the circulating current based on the fundamental component analysis (FCA). Hardware methods to suppress the circulating current are firstly presented. Then the PWM plus phase shift control based on FCA and time domain analysis are introduced, and the optimal phase shift ratios are given to achieve the minimum circulating current. These methods to suppress circulating current are summarized and compared. Next, the ZVS-on of DAB is discussed. The ZVS-on range of a DAB is firstly derived using fundamental component analysis. Control methods including PWM plus phase shift and frequency modulation are introduced. Hardware methods including current-fed DAB, variation of inductance are also explained. Finally examples of applications of bidirectional DAB are introduced such as V2G on-board EV charger, and DC solid state transformer.

Shuai Shao (M'17) was born in Hunan Province, China, in 1987. He received the B.S. degree in2010 from Zhejiang University, China, and the PhD degree in Electrical Engineering from the University of Nottingham, UK, in 2015. In December 2015, he joined the College of Electrical Engineering, Zhejiang University as a lecturer. His research interests include solid state transformers, bidirectional dc-dc converters and fault detection in power converters.

Tutorial 1-3

Date: May 20, Monday 11:15 – 12:00, Hall A

Name: Linglin Chen, Research assistant, University of Nottingham, UK

Title: A Model predictive control of a DAB converter in DC microgrids on naval vessels and more electric aircraft

The third part of the tutorial will focus on the control for isolated dc-dc converters which are the enabling technology for the integration of energy storage systems in microgrids on naval vessels and more electric aircrafts. They present a common feature of galvanic isolation with high frequency transformer. The existence of the high frequency transformer causes issues in converter modelling and control. In this tutorial, a Moving Discretized Control Set Model Predictive Control (MDCS-MPC) tailored for isolated dc-dc converters is presented. This tutorial kicks off by introducing the concept of the MDCS-MPC. Fixed switching frequency is maintained, enabling easy passive components design. The proposed MDCS-MPC has a reduced prediction horizon, which allows low computational burden. The operating principle of the MDCS-MPC is introduced in development of a cost function that provides stiff voltage regulation. Resonance damping and sampling noise resistance can also be achieved with the cost function. An adaptive step is introduced to enable fast transition. Assessments on the performance of the proposed MDCS-MPC are conducted. Comparisons with other control methods are also provided. Based on the MDCS-MPC, online optimization is carried out by exploiting the extra degree of freedom in Dual Phase Shift. The conceptual process of the 2-D optimization is introduced in development of a cost function that on one hand regulates the output voltage, on the other hand, minimizes the transformer peak current. Further extension of the MDCS-MPC to Triple Phase Shift (TPS) is explained. Due to the limitation on the computational power in standard commercial control platforms, the optimization is carried out offline aided by artificial neutral network. Conventional linear control shows limitation under TPS as several operation modes coexist. In contrast, control parameters in MDCS-MPC are expected to work for all operating modes with salient performance. Finally, MDCS-MPC is applied for the isolated DC/DC converters for fast system stabilization. The impedance of the converter is presented by describing function. The mechanism of the instability is analyzed based on the impedance. A damping term is derived in the cost function for MDCS-MPC which drastically increases the phase margin.

Linglin Chen received his MSc degree in Electrical Engineering from Zhejiang University, Hangzhou, China, in 2016 on construction of a 100kW demonstrative high surety DC microgrid. He is currently a Ph. D candidate and research assistant in the University of Nottingham, U.K.

His current research interests include isolated DC/DC power converters, advanced modulation schemes, nonlinear power converter controls and stability of microgrids in more electric aircraft.

Tutorial Part-2: Energy Storage Techniques for DC power Applications

Tutorial 2-1
Date: May 20, Monday 13:00 – 13:45, Hall A
Name: Nihal Kularatna, Associate Professor, School of Engineering, the University of Waikato, Hamilton, New Zealand
Title: Supercapacitor Techniques for DC Microgrid Applications

Outline: During the last two decades, electronics industry has seen many commercial versions of electrical double layer capacitors (EDLC), which are also known as ultra-capacitors and supercapacitors, with the aim of complementing or replacing electrochemical batteries. EDLCs come in capacitance values from 0.2 to 7500 farads, with the limitation of very low DC voltage ratings from 0.7 V to 4 V. An EDLC gives an approximately one million times larger capacitance compared to an electrolytic. Recently some SC manufacturers have introduced a novel family of 'supercap-batteries' where capacitance has gone up to 70,000 F. Compared to conventional capacitors with large DC voltage ratings, EDLCs offer one to two order greater energy density and approximately twice the power density.

Supercapacitors can be the basis for non-traditional and novel circuit topologies to achieve: significantly high energy efficiency in DC-DC converters; surge protection; rapid energy transfer; high density inverters and renewable energy converters with DC-UPS capability. Seminar will present a discussion on how to develop unique solutions to well-known issues in power electronics, with the examples of developing many patented or patent pending SC assisted (SCA) techniques such as SCA low dropout regulator (SCALDO), SCA surge absorber (SCASA), SCA temperature modification apparatus (SCATMA), SCA high density inverter (SCAHDI) and SCA light emitting diodes (SCALED). Industrial applications of these SCA techniques will be discussed including their application in DC Microgrid area.

Nihal Kularatna is an Associate Professor in the School of Engineering at the University of Waikato, New Zealand. He won the New Zealand Innovator of the year award (2013). His electronic engineering career spans 43 years and he is active in research in supercapacitor applications, power supply topologies, and power conditioning. He has contributed to over 150 papers and nine reference books. His important contributions include two IET Electrical Measurement Series books titled Modern electronic test & measuring instruments (1996) and Digital and analogue instrumentation- testing and measurement (2003/2008) and three Elsevier (USA) titles. His recent research monograph on surge protection systems, titled Design of Transient Protection Systems, was published by Elsevier in 2018, summarizing his commercially oriented research on his SCASA technique. Multiple patents were granted for his supercapacitor assisted (SCA) circuit topologies. Before migrating to New Zealand in 2002, he was the CEO of the Arthur C Clarke Institute in Sri Lanka.

Tutorial 2-2
Date: May 20, Monday 13:45 – 14:30, Hall A
Name: Shinichi Uesaka, Murata Manufacturing Co., Ltd.
Koji Sekai, Ph.D., Murata Manufacturing Co., Ltd.
Title: Extremely High Safety and Long Cycle life Energy Storage System (ESS)

Abstract: In the ESS market, long cycle life is required during 15 years, and then, safety characteristics of ESS has to be remaining at the temperature range of 0~60 ˚C. Long cycle life can be obtained by employing electrochemically stable cathode such as olivine LiFePO4. Even by extracting Li from LiFePO4, olivine structure remains stable at fully charged state even at high temperature range of 40~60 ˚C.

Furthermore, fire propagation of battery module can be controlled by using LiFePO4 cell. If one cell would explode and fire in the battery module, battery module does not explode and fire. This high safety character is significant in order to illuminate ESS fire incident completely. On the contrary, in case that battery module propagates, ESS is burnt out completely if one cell explode and fire. As ESS is using many cells, and operates at -20~60 ˚C, it is very difficult to control ESS safety issue during 15 years.

Murata have developed high quality LiFePO4 cell, battery module, and extremely high safety and long cycle life ESS. In this session, we will present on key technologies regarding cycle performance and safety characteristics, which shall be needed concerning with ESS.

Shinichi Uesaka, Senior manager,
ESS products Dep. 2, Energy System Group, Tohoku Murata Manufacturing Co., Ltd.
Career
・Executive director, Esstalion Technologies Inc.
・Senior manager, Advanced Battery Development Center, Sony corporation

Koji Sekai, Ph.D, Senior Technical Adviser,
Energy System Group, Murata Manufacturing Co., Ltd. (IEC Expert: TC21/SC21A, TC113）
Career
・General Manger, Battery R&D, Sony corporation
Education
・Ph.D.(Master/Bachelor degree) was awarded at Keio University.

Workshop

Introduction to Hardware in the loop (HIL) simulation

Date: May 20, Monday 15:00 – 16:00, Hall A
Contributors:
Mischa Steurer, Florida State University, USA
Ruben Inzunza, Toshiba Mitsubishi-Electric Industrial Systems Corporation (TMEIC), Japan
Herb Ginn, University of South Carolina, USA

Summary: Hardware-in-the-loop (HIL) real-time simulation is a method that allows testing of power and energy apparatus, controllers, and fault protection in a meaningful system relevant environment. Most of the system, however, is modeled on a real-time simulation platform and the device(s) under test (DUTs) are interfaced with the rest-of-system (ROS) simulation in order to allow both to interact with each other. In particular, we distinguish between controller HIL (CHIL) and power HIL (PHIL) as CHIL only requires signal level interfaces between the DOTs and the ROS simulation, whereas PHIL requires power amplifiers, too. This workshop will introduce this concept of HIL, describe applications in various fields of electrical power systems engineering, including testing of photovoltaic systems for anti-islanding compliance, discuss the latest developments in high speed real-time simulations, and explain the efforts undertaken by the IEEE Working Group P2004 which currently develops a “Recommended Practice for HIL”. The attendees will gain a better understanding of HIL and learn where and how this method is used for de-risking the integration of new technologies into emerging power systems such as MVDC systems.

Michael "Mischa" Steurer received a B.S. and M.S. in Electrical Engineering from the Vienna Technical University in 1994. He received a PhD in Electrical Engineering from the Swiss Federal Institute of Technology in 2001. Since 2001, He is a senior researcher at Florida State University in the Center for Advanced Power Systems where he currently leads the Power Systems group with primarily focus on hardware-in-the-loop real-time simulation and modeling of integrated power and energy systems for all-electric ships and future terrestrial power systems. He has authored and co-authored more than 160 technical papers in the area of shipboard power systems, hardware-in-the-loop real-time simulation, fault protection, and superconductivity. He is a member of the International Council on Large Electric Systems (CIGRE), the American Society of Naval Engineers, and a Senior Member of the Institute of Electrical and Electronic Engineers where he contributes to several working groups. He currently chairs IEEE WG P2004 which develops a recommended practice for HIL simulations. Dr. Steurer is also the recipient of the 2019 ASNE Solberg Award.

Herb Ginn, University of South Carolina, USA

Herbert L. Ginn III is a Professor in the Department of Electrical Engineering at the University of South Carolina. He has over 20 years of professional experience and has held R&D and design positions in leading industrial organizations and research centers. His current research interests include power electronics applications in power systems as well as power phenomena, and compensation in power distribution systems. He has experience in the design, operation and control of power electronic converters such as Modular Multilevel Converters as well as both passive and active harmonic filters. Dr. Ginn's current research activities are focused on the control and coordination of power electronic converters in special case distribution systems such as self-contained vehicular systems and microgrids. He has received numerous sponsored projects as principle investigator funded by DOE, ONR, NSWC, and leading industries such as Northrop Grumman. Dr. Ginn was the site director for Mississippi State University within the Electric Ship Research and Development Consortium (ESRDC) from 2008-2010 and continues his involvement in the ESRDC at the University of South Carolina. He is also a research member of the center for Grid Connected Advanced Power Electronics (GRAPES). Dr. Ginn has published over 60 refereed and invited journal and conference papers and has participated in the writing of several IEEE standards. He is an active member of the IEEE Power Electronics, IEEE Power and Energy, and IEEE Industrial Electronics societies.

Ruben Inzunza, Toshiba Mitsubishi-Electric Industrial Systems Corporation (TMEIC), Japan

Panel discussion

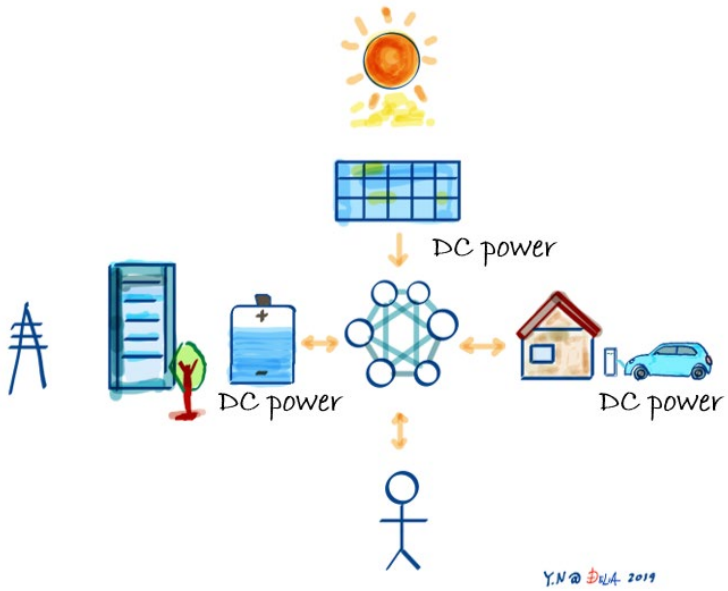
DC power applications by Block chain

Date: May 20, Monday 16:15 – 17:45, Hall A

Moderator
Mr. Yoshimichi Nakamura, Founder, Smart Energy Laboratory Co., Ltd.
Dr. Toshiyuki Zaitsu, Chief Specialist of Technology, OMRON Corporation.

Panelists
Mr. Kazumi Sato, Murata Manufacturing Co., Ltd.
Mr. Izumi Yoshihiro, Manager, NISSIN SYSTEMS Co., Ltd.
Mr. Fumiaki Ishida, Manager, Energy Use Technology Lab., the Kansai Electric Power Co., Inc.
Ms. Asuka Uesaka,
Energy sector manager & ASEAN business development general manager, Chaintope Inc.

Summary: The blackout of electricity was happened throughout Hokkaido due to the Hokkaido earthquake last year. Strengthen power system is needed in Japan also. On the other hand, renewable energy system has to play an important role as key player of power supply in future.
Now, demand-supply environment of energy is going to change rapidly. Distributed ledger (Blockchain technology) and Encryption assets (Bit coin etc.) are begun to spread. And secured solution using these technologies are proposed. These technologies are suitable with distributed energy system and expected to be launched at this area after 2019.
At this seminar, we will introduce forefront of innovative energy system. Specially, you can get information of how energy as a life infrastructure will be changed by block chain technology which paid attention at energy area and what kind of influence does it have on our life



Blockchain Technology creates an Innovative Distributed Energy Business.

Special session

(1) Data Center-centered DC Micro-grid

Date: May 22, Wednesday 9:00 – 10:30, Hall A
Session Chair: Gaku Kamitani (Murata Manufacturing Co., Ltd. Japan)

Summary: Electric capacity of power system in typical Data Center is as huge as 10 MW to 200 MW, and it is supposed to never fail on 24 hours a day, 365 days a year basis. This makes Data Center ideal for micro-grid energy base. Data Center can be operated with DC power, by which the power usage efficiency and the operational reliability can be improved. Furthermore, sustainable energy can be optimally integrated in its power system. In this session, each company will introduce their respective activities regarding said Data Center-centered DC Micro-grid.

Fumio Mura, NTT DATA INTELLILINK CORPORATION
“Data Center-centered DC Micro-grid”

Masashi Osada, ABB Japan
“Coupling Technology between the transmission voltage and generation or consumption voltage”

Yuichi Harada, Kyushu University,
“Science village by DC powering”

Naoya Motegi, Takenaka Corporation
“Multi-Source DC Power Integration in Building Energy Management”

Toshihiro Suzuki, Green Power Project, Nipron Co., Ltd.
“Solar-powered DC Power Supply System with Battery”

Tatsuo Bizen, Director, Murata Manufacturing Co., Ltd.
“Murata’s DC Power System in Data Center Server Rack”

David Scott Beach, Product Manager, Anderson Power Products,
“HIGHER VOLTAGE AC/DC INTERCONNECT FOR RACK POWER”

Doron Lapidot, FAE Manager, Amphenol Information Communications & Commercial
“HVDC-12V@2.4kW Rack Mount Power Distribution Unit (PDU) Design Optimization”

Toshihiro Ikeda, Future Facilities
“Operational and Thermal Performance Advantages of Adopting Direct Current Power Type of ICT Devices in Mission Critical Facility”

(2) A Snapshot of DC Activity in North America

Date: May 22, Wednesday 9:00 – 10:30, Hall B
Session Chair: Daniel Gerber, Lawrence Berkeley National Laboratory, USA

Summary: This special session contains five presentations that showcase current DC microgrid research in the US. Presentation content spans the fields of DC microgrid architectures, control, and fault management, and includes applications in maritime and off-grid villages.

Subhashish Bhattacharya, North Carolina State University, USA
“DC Microgrids - Architectures and Control”

Derek Cowburn, Lumencache, USA
“Embedded Demand Response in DC Nanogrid Control”

Robert Cuzner, University of Wisconsin-Milwaukee, USA
“Architectural and Topological Trade-Offs in Medium Voltage DC Shipboard Distribution Systems”

Michael Steurer, Florida State University, USA
“Emerging Fault Management Approaches for MVDC Systems”

Daniel Zimmerle, Colorado State University, USA
“Very Small: Using of Low Voltage DC to Reduce the Cost of Village Electrification”

Oral Session

Session 1-A: Power Electronics for grids (1)
May 21, 11:00 - 12:30, Hall A
Session Chairs:
Johan Driesen (KU Leuven, Belgium)
Masahito Shoyama (Kyushu University, Japan)

11:00 **Modular Multilevel Photovoltaic Interfaced Converter with Low Voltage Energy Integration for DC Systems**
1-A-1 Mladen Gagic, *Delft University of Technology, Netherlands*
Kewei Huang, *Delft University of Technology, Netherlands*
Zian Qin, *Delft University of Technology, Netherlands*
Braham Ferreira, *Delft University of Technology, Netherlands*

11:18 **350 kVA Multi-Function Converters for DC-Microgrid Applications**
1-A-2 T.-F Wu, *National Tsing Hua University, Taiwan*
Y.-T Liu, *National Tsing Hua University, Taiwan*
Y.-H Huang, *National Tsing Hua University, Taiwan*
T. Sakavov, *National Tsing Hua University, Taiwan*

11:36 **Finite-State Predictive Power Control based Interlink Converter for AC-DC Micro-grid**
1-A-3 Sohit Sharma, *Visvesvaraya National Institute of Technology, India*
Mohan V. Aware, *Visvesvaraya National Institute of Technology, India*
Apekshit Bhowate *Visvesvaraya National Institute of Technology, India*

11:54 **A 13.2kV / 150kVA Solid State Transformer for a Bipolar LVDC Distribution System**
1-A-4 Hosung Kim, *KERI, Korea*
Juwon Baek, *KERI, Korea*
Myoungho Kim, *KERI, Korea*
Hyeokjin Yun, *KERI, Korea*
Dongkeun Jeong, *KERI, Korea*
Jintae Cho, *KERI, Korea*

12:12 **An Inverter Control Method for Remote Island Electric Power System Constituted by Renewable Energy Sources**
1-A-5 Yasuhiro Noro, *Kogakuin university, Japan*

Session 1-B: Technology and demonstration of DC Microgrids
May 21, 11:00 - 12:30, Hall B
Session Chairs:
Hirohisa Aki (University of Tsukuba, Japan)
Chris Marnay (Lawrence Berkeley National Lab, USA)

11:00 **Comparison of Battery Technologies for DC Microgrids with Integrated PV**
1-B-1 Soumya Bandyopadhyay, *Delft University of Technology, Netherlands*
Zian Qin, *Delft University of Technology, Netherlands*
Laura Ramirez-Elizondo, *Delft University of Technology, Netherlands*
Pavol Bauer, *Delft University of Technology, Netherlands*

11:18 **Storage Battery Capacity Reduction Effect on 400V-class DC Power Supplied Office with Consideration for Renewable Energy Ratio**
1-B-2 Kazufumi YUASA, *NTT FACILITIES, INC., Japan*
Miki UESHIMA, *NTT FACILITIES, INC., Japan*
Tadatoshi BABASAKI, *NTT FACILITIES, INC., Japan*

11:36 **Demonstration of a DC Microgrid with Central Operation Strategies on an Island**
1-B-3 Jintae Cho, *KEPCO Research Institute, Korea*
Hongjoo Kim, *KEPCO Research Institute, Korea*
Youngpyo Cho, *KEPCO Research Institute, Korea*
Hyunmin Kim, *KEPCO Research Institute, Korea*
Juyong Kim, *KEPCO Research Institute, Korea*

11:54 **DC Microgrid Experimental System at KIT Hakusan-roku Campus for Regional Areas**
1-B-4 Yoshio Izui, *Kanazawa Institute of Technology, Japan*
Daisuke Natsuume, *Kanazawa Institute of Technology, Japan*
Masashi Saito, *Kanazawa Institute of Technology, Japan*
Hirokazu Tabata, *Kanazawa Institute of Technology, Japan*
Masanori Fujimoto, *Kanazawa Institute of Technology, Japan*

12:12 **Medium voltage cable designs for 100km DC superconducting power transmission line using experimental data of Ishikari Project**
1-B-5 Sataro Yamaguchi, *Chubu University, Japan*
Takashi Iitsuka, *JGC Corporation, Japan*
Takeo Yamada, *JGC Corporation, Japan*
Akio Sato, *JFE Steel, Japan*
Toru Sawamura, *Sakura Internet, Japan*
Victor Sytnikov, *R&D Center, FGC UEC, Russia*

Session 2-A: Power Electronics for grids (2)
May 21, 14:40 - 16:10, Hall A
Session Chairs:
Aditya Shekhar (TU Delft/Dept. ESE, Netherlands)
Wu Tsai-Fu (National Tsing Hua University, Taiwan)

14:40 2-A-1 **Autonomous DC Microgrid Consisting of Triple Active Bridge Converters**
Yuichi Kado, *Kyoto Institute of Technology, Japan*
Shota Okutani, *Kyoto Institute of Technology, Japan*
Keigo Katagiri, *Kyoto Institute of Technology, Japan*
Pin-Yu Huang, *Kyoto Institute of Technology, Japan*

14:58 2-A-2 **Hardware in the loop verification of a fast backup protection scheme for embedded MVDC links within distribution networks**
Lewis Hunter, *University of Strathclyde, Scotland*
Qiteng Hong, *University of Strathclyde, Scotland*
Campbell Booth, *University of Strathclyde, Scotland*
Stephen Finney, *The University of Edinburgh, Scotland*
Adrià Junyent-Ferré, *Imperial College London, UK*

15:16 2-A-3 **Resonance suppression control for flying capacitor type bidirectional three-level chopper circuit**
Noriaki Nagao, *Osaka University, Japan*
Jia Liu, *Osaka University, Japan*
Yushi Miura, *Nagaoka University of Technology, Japan*
Toshifumi Ise, *Osaka University, Japan*
Naoki Morishima, *Toshiba Mitsubishi-Electric Industrial, Japan*

15:34 2-A-4 **Model Predictive Control for isolated DC/DC converters with fast dynamic stabilization in DC Microgrids**
Linglin Chen, *University of Nottingham, United Kingdom*
Luca Tarisciotti, *Universidad Andres Bello Santiago., Chile*
Alessandro Costabebber, *University of Nottingham, United Kingdom*
Pericle Zanchetta, *University of Nottingham, United Kingdom*
Patrick Wheeler, *University of Nottingham, United Kingdom*
Tomislav Dragičević, *Aalborg University, Denmark*

15:52 2-A-5 **Three-level DC-DC Converters versus Half-bridge Voltage Balancers for Bipolar DC Microgrids —An Efficiency Comparison**
Giel Van den Broeck, *KU Leuven, Belgium*
Simon Ravyts, *KU Leuven, Belgium*
Mauricio Dalla Vecchia, *KU Leuven, Belgium*
Leonie Hallemans, *KU Leuven, Belgium*
Johan Driesen, *KU Leuven, Belgium*

Session 2-B: DC Breaker and Arc Detection
May 21, 14:40 - 16:10, Hall B
Session Chairs:
Harry Stokman (Direct Current BV, Netherlands)
Ryoichi Hara (Hokkaido University, Japan)

14:40 **Performance Analysis of Hybrid DC Circuit Breaker based on Counter-Current Injection Method for Low-Voltage DC Grids**
2-B-1 Ali Virdag, *Hager Group, Germany*
Nisar Ahmed Khan, *RWTH Aachen, Germany*
Torsten Hager, *Hager Group, Germany*
Rik. W. DeDoncker, *RWTH Aachen, Germany*

14:58 **A study on estimation of arc parameters for low voltage DC arc breaking process**
2-B-2 Akihiro Tsusaka, *Aichi Institute of Technology, Japan*
Kazuho Hasegawa, *Aichi Institute of Technology, Japan*
Toshiro Matsumura, *Aichi Institute of Technology, Japan*
Kazuto Yukita, *Aichi Institute of Technology, Japan*
Yasuyuki Goto, *Aichi Institute of Technology, Japan*
Atsushi Miyamoto, *Nitto Kogyo corporation, Japan*
Hiroyuki Ito, *Nitto Kogyo corporation, Japan*
Yasunobu Yokomizu, *Nagoya university Nagoya, Japan*

15:16 **Design of the Short Circuit Protection for the Power Flow Control Converter**
2-B-3 Pavel Purgat, *Delft University of Technology, Netherlands*
Zian Qin, *Delft University of Technology, Netherlands*
Pavol Bauer, *Delft University of Technology, Netherlands*

15:34 **Verification of arc discharge phenomenon and connection reliability**
2-B-4 Koichi Kiryu, *Fujitsu Component Limited, Japan*
Tetsugaku Tanaka, *Fujitsu Component Limited, Japan*
Kyohei Seki, *Fujitsu Component Limited, Japan*
Kouki Satou, *Fujitsu Component Limited, Japan*

15:52 **Power Module for Low Voltage DC Hybrid Circuit Breaker**
2-B-5 Kenan Askan, *Eaton Industries Austria GmbH, Austria*
Michael Bartone*k, Eaton Industries Austria GmbH, Austria*
Katharina Weichselbaum*, Eaton Industries Austria GmbH, Austria*

Session 3-A: DC Applications (1)
May 21, 16:30 - 18:00, Hall A
Session Chairs:
Kenji Natori (Chiba University, Japan)
Stefan Lidström (COMSYS, Sweden)

16:30 **Hybrid magnetic EMI filter design for Low Voltage DC distribution (LVDC) network**
3-A-1 Wai Keung Mo, *University of Southern Denmark, Denmark*
Kasper M. Paasch, *University of Southern Denmark, Denmark*
Thomas Ebel, *University of Southern Denmark, Denmark*

16:48 **Comparison of Load Models for Estimating Electrical Efficiency in DC Microgrids**
3-A-2 A. Santos, *Colorado State University, USA*
J. Cale, *Colorado State University, USA*
A. Singh, *Colorado State University, USA*
D. Gerber, *Lawrence Berkeley National Laboratory, USA*
S. Frank, *National Renewable Energy Laboratory, USA*
G. Duggan, *Colorado State University, USA*
D. Zimmerle, *Colorado State University, USA*
R. Brown, *Lawrence Berkeley National Laboratory, USA*

17:06 **Novel Fault Tolerant DC-DC Converter Architecture for LED Lighting Systems Operating in DC Microgrids**
3-A-3 Fernando Bento, *Universidade da Beira Interior, Portugal*
Antonio J. Marques Cardoso, *Universidade da Beira Interior, Portugal*

17:24 **A Verification on a Zero-Current Detection Method of Interleaved Boost Chopper with High Frequency Operation**
3-A-4 Yuudai Ogawa, *Ritsumeikan University Kusatsu, Japan*
Ryo Ito, *Ritsumeikan University Kusatsu, Japan*
Hiroaki Kakigano, *Ritsumeikan University Kusatsu, Japan*

17:42 **Parametric Analysis of Centralized DC Microgrids for Rural Electrification**
3-A-5 Mashood Nasir, *Syed Babar Ali School of Science and Engineering Lahore University of Management Sciences, Pakistan*
Saqib Iqbal, *Syed Babar Ali School of Science and Engineering Lahore University of Management Sciences, Pakistan*
Hassan Abbas Khan, *Syed Babar Ali School of Science and Engineering Lahore University of Management Sciences, Pakistan*

Session 3-B: DC applications for transportation
May 21, 2019 16:30 - 18:00, Hall B
Session Chairs:
Johan Driesen (KU Leuven, Belgium)
Takanori Isobe (University of Tsukuba, Japan)

16:30 **A review on protection systems in DC Railway "microgrids"**
3-B-1 Björn Fischer, *Applied Research Sécheron SA., Switzerland*
Tarek Lamara, *Applied Research Sécheron SA., Switzerland*
Christopher Nazeri, *DC breakers development Sécheron SA., Switzerland*

16:48 **Power Flow Calculation of Shipboard DC Microgrid Power System**
3-B-2 Dawei Yao, *Tsinghua University DC Research Center, China*
Kangsheng Cui, *Tsinghua University DC Research Center, China*
Haibo Li, *Tsinghua University DC Research Center, China*
Chao Yang, *Tsinghua University DC Research Center, China*
Bo Liu, *Shandong Taikai High Voltage Switchgear Co., Ltd DC Application Tech. Center, China*

17:06 **Real-Time HIL Setup for Testing and Evaluating EV integration for DC Microgrids**
3-B-3 Stephan Ledinger, *Austrian Institute of Technology, Australia*
David Reihs, *Austrian Institute of Technology, Australia*
Daniel Stahleder, *Austrian Institute of Technology, Australia*
Catalin Gavriluta, *Austrian Institute of Technology, Australia*
Felix Lehfuss, *Austrian Institute of Technology, Australia*
Georg Lauss, *Austrian Institute of Technology, Australia*

17:24 **Cooperative Control of Multi-Input Modular DC/DC Converter for Electric Off-Highway Vehicles**
3-B-4 Qingyun Piao, *YANMAR CO., LTD., Japan*
Masaaki Konoto, *YANMAR CO., LTD., Japan*
Tasuku Kakisaka, *Nagoya University, Japan*
Jun Imaoka, *Nagoya University, Japan*
Masayoshi Yamamoto, *Nagoya University, Japan*

17:42 **Integrated Charging of EVs Using Existing LVDC Light Rail Infrastructure: A Case Study**
3-B-5 Kyle Smith, *University of Strathclyde, Glasgow, Scotland*
Lewis Hunter, *University of Strathclyde, Glasgow, Scotland*
Stuart Galloway, *University of Strathclyde, Glasgow, Scotland*
Campbell Booth, *University of Strathclyde, Glasgow, Scotland*
Colin Kerr, *Edinburgh Trams, Scotland*
Michael Kellett, *Edinburgh City Council, Scotland*

Organized Session 4-A: Recent trends in DC power supply for electric railway and stations
May 22, 11:00 - 12:30, Hall A
Session Chair: Hitoshi Hayashiya (East Japan Railway Company Tokyo, Japan)

11:00 **Overview of particularities of DC traction power supply system for electric railway**
4-A-1 Hitoshi Hayashiya, *East Japan Railway Company, Tokyo, Japan*

11:18 **Analysis of Stray Current in DC Traction Power Supply System**
4-A-2 Jinkun Tang, *Southwest Jiaotong University, China*
Jiawei Zhao, *Southwest Jiaotong University, China*
Guoyang Sang, *Southwest Jiaotong University, China*
Jinfei Xiong, *Southwest Jiaotong University, China*
Wei Lin, *Southwest Jiaotong University, China*
Fulin Zhou, *Southwest Jiaotong University, China*
Yong Wang, *CRRC Qingdao Sifang Co.,Ltd, China*

11:36 **Energy Saving Effect of DC Distribution System according to Station Type**
4-A-3 Youhei Sonoda, *West Japan Railway Co. Technology Development dept., Japan*
Nobumichi Tsutsui, *West Japan Railway Co. Technology Development dept., Japan*
Jun Nakano, *West Japan Railway Co. Technology Development dept., Japan*
Keiji Kawahara, *West Japan Railway Co. Technology Development dept., Japan*
Kenichi Fukuno, *Mitsubishi Electric Corporation, Japan*
Hayato Takeuchi, *Mitsubishi Electric Corporation, Japan*

11:54 **Development of a High-Speed Circuit Breaker for DC Railway Substations**
4-A-4 Hiroshi Sasaki, *Mitsubishi Electric Corporation, Japan*
Nobumoto Toya, *Mitsubishi Electric Corporation, Japan*
Tomohiro Nakata, *Mitsubishi Electric Corporation, Japan*
Yuta Sagara, *Mitsubishi Electric Corporation, Japan*
Shinji Toba, *Mitsubishi Electric Corporation, Japan*
Sho Tanaka, *Mitsubishi Electric Corporation, Japan*
Yasuhiro Kamino, *Mitsubishi Electric Corporation, Japan*
Yuichi Yamaji, *Mitsubishi Electric Corporation, Japan*

12:12 **Simplification of Electric Substation System by Utilizing Energy Storage System**
4-A-5 Kota Minaminosono, *Environment Eng R&D Center of JR EAST Group East Japan Railway Company Saitama, Japan*
Makoto Hashimoto, *Environment Engineering Research Laboratory, R&D Center of JR EAST Group East Japan Railway Company Saitama, Japan*
Hitoshi Hayashiya, *Electrical & signal network system department, East Japan Railway Company Tokyo, Japan*
Dai Yasukochi, *Railway Systems Business Unit Hitachi, Ltd. Tokyo, Japan*

Session 4-B: Control, Simulation, Emulation and Analysis of Microgrids
May 22, 11:00 - 12:30, Hall B
Session Chairs:
Kazuaki Mino (Murata Manufacturing Co., Ltd., Japan)
Tomislav Dragicevic (Aalborg University, Denmark)

11:00 **Distributed Piecewise Droop Control of DC Microgrid with Improved Load Sharing and Voltage Compensation**
4-B-1 Sucheng Liu, *Anhui University of Technology, China*
Jiazhu Zheng, *Anhui University of Technology, China*
Zhongpeng Li, *Anhui Wanwei Group Co., Ltd Hefei, China*
Run Li, *Anhui University of Technology, China*
Wei Fang, *Anhui University of Technology, China*
Xiaodong Liu, *Anhui University of Technology, China*

11:18 **State of Charge Based Characteristic Diagram Control for Energy Storage Systems within Industrial DC Microgrids**
4-B-2 Alexander Ma¨nnel, *Bosch Rexroth AG, Lohr am Main, Germany*
Elias Knöchelmann, *Institute of Mechatronic Systems, Hannover, Germany*
Tobias Ortmaier, *Institute of Mechatronic Systems, Hannover, Germany*
Svenja Tappe, *Institute of Mechatronic Systems, Hannover, Germany*

11:36 **Voltage Dip Mitigation Techniques for Medium-Voltage DC Networks**
4-B-3 Thomas Hoehn, *CERN, Switzerland*
Francisco Blanquez, *CERN, Switzerland*
Karsten Kahle, *CERN, Switzerland*
Jean-Paul Burnet, *CERN, Switzerland*
Herwig Renner, *Graz University of Technology, Austria*

11:54 **Steady-State Power Flow Analysis of DC Distribution Systems**
4-B-4 Dario Chaifouroosh, *Delft University of Technology, Netherlands*
Nils H. van der Blij, *Delft University of Technology, Netherlands*
Laura Ramirez-Elizondo, *Delft University of Technology, Netherlands*
Pavol Bauer, *Delft University of Technology, Netherlands*

12:12 **Planar transformer design of LLC DC-DC converters with electromagnetics simulation**
4-B-5 Kumpei Yoshikawa, *Shindengen Electric Manufacturing Co., Ltd., Japan*
Tetsuya Oshikata, *Shindengen Electric Manufacturing Co., Ltd., Japan*

Session 5-A: Protection and Safety
May 23, 11:00 - 12:30, Hall A
Session Chairs:
Hiroaki Kakigano (Ritsumeikan University, Japan)
Holger Borcherding (Ostwestfalen-Lippe University of Applied Sciences, Germany)

11:00 **Active and Passive Fault Ride-Through for MVDC Bipolar Short Circuit in Photovoltaic MVDC Collection and Integration System**

5-A-1 Jinggang Yang, *State Grid Jiangsu Electric Power Co., LTD., China*
Xiaolong Xiao, *State Grid Jiangsu Electric Power Co., LTD., China*
Yongyong Jia, *State Grid Jiangsu Electric Power Co., LTD., China*
Shang Gao, *Southeast University, China*
Jianhua Wang, *Southeast University, China*
Zaijun Wu, *Southeast University, China*

11:18 **System Identification Methods for Refined Fault Detection in LVDC-Microgrids**

5-A-2 Christian Strobl, *E-T-A Elektrotechnische Apparate GmbH, Germany*
Maximilian Schäfer, *Multimedia Communications and Signal Processing Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany*
Rudolf Rabenstein, *Multimedia Communications and Signal Processing Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany*

11:36 **Enhanced Protection Selectivity in LVDC networks using a Superconducting Resistance**

5-A-3 Patrick McGuckin, *Abdullah Emhemed and Graeme Burt Institute for Energy and Environment University of Strathclyde, U.K.*
Dong Wang, *Abdullah Emhemed and Graeme Burt Institute for Energy and Environment University of Strathclyde, U.K.*

11:54 **A Comprehensive Approach for Safety in DC-Microgrids**

5-A-4 Julian Kaiser, *Fraunhofer IISB, Germany*
Christian Strobl, *E-T-A Elektrotechnische Apparate GmbH, Germany*
Helmut Mann, *ABL SURSUM Bayerische Elektrozubehör GmbH & Co. KG., Germany*
Helmut Muhm, *Bender GmbH & Co. KG, Germany*
Marc Klimpel, *PHOENIX CONTACT GmbH & Co. KG, Germany*
Franz Schork, *Dehn + Söhne GmbH & Co. KG., Germany*
Martin März, *Fraunhofer IISB, Germany*

12:12 **Arc-Free Bidirectional Hybrid DC Switch using Tungsten or Tungsten-clad Copper Contacts**

5-A-5 Shoya Kubo, *Tokyo Institute of Technology, Japan*
Shunsuke Sato, *Tokyo Institute of Technology, Japan*
Yinming Huang, *Tokyo Institute of Technology, Japan*
Koichi Yasuoka, *Tokyo Institute of Technology, Japan*

Session 5-B: Controls Strategy of DC Microgrids
May 23, 2019 11:00 - 12:30, Hall B
Session Chairs:
Gaku Kamitani (Murata Manufacturing Co., Ltd., Japan)
Vagelis Vossos (Lawrence Berkeley National Lab, USA)

11:00 **DC-Link Voltage Control Strategy for MTDC Grids based on Virtual Synchronous Machines**
5-B-1 Javier Rolda´n-Pe´rez, *IMDEA Energy Institute, Spain*
Alberto Rodrı´ıguez-Cabero, *IMDEA Energy Institute, Spain*
Milan Prodanovic, *IMDEA Energy Institute, Spain*

11:18 **Multi-Hop Network Based Coordination of Converters in DC Microgrids**
5-B-2 Herbert L. Ginn III, *University of South Carolina, U.S.A.*
Castulo Aaron De La O, *University of South Carolina, U.S.A.*
Andrea Benigni, *University of South Carolina, U.S.A.*

11:36 **Cooperative Decentralized Tertiary Based Control of DC Microgrid with Renewable Distributed Generation**
5-B-3 Hossam Aboelsoud Eid Elhassaneen, *Yokohama National University, Japan*
Takao Tsuji, *Yokohama National University, Japan*

11:54 **Decentralized Cost-Optimized Fuzzy Control of DC Microgrids**
5-B-4 Elias Knochelmann, *Gottfried Wilhelm Leibniz Universit at Hannover, Institute of Mechatronic Systems, Germany*
Alexander Mannel, *Bosch Rexroth AG, Germany*
Svenja Tappe, *Gottfried Wilhelm Leibniz Universit at Hannover, Institute of Mechatronic Systems, Germany*
Tobias Ortmaier, *Gottfried Wilhelm Leibniz Universit at Hannover, Institute of Mechatronic Systems, Germany*

12:12 **Dual-EKF Method for State and Parameter Estimation in Nonlinear DC MG**
5-B-5 Navid Vafamand, *Shiraz Universtiy, Iran*
Mohammad Hassan Khooban, *Aarhus University, Denmark*
Tomislav Dragicevic, *Aalborg University, Denmark*

Session 6-A: DC Microgrids in Buildings
May 23, 14:40 - 16:10, Hall A
Session Chairs:
Tilo PÜSCHEL (Bachmann GmbH, Germany)
King Jet Tseng (Singapore Institute of Technology, Singapore)

14:40 **Modular DC/AC Microgrid**
6-A-1 John J. Shea, *Schneider-Electric, USA*
Jonathan Hastings, *Schneider-Electric, USA*
Van Wagner, *Schneider-Electric, USA*
Mike Liptak, *Schneider-Electric, USA*

14:58 **Best Practices for Integrating Direct Current in Zero-Net Energy Buildings in North America**
6-A-2 Vagelis Vossos, *Lawrence Berkeley National Lab Berkeley, CA, USA*
Daniel Gerber, *Lawrence Berkeley National Lab Berkeley, CA, USA*
Eric Mannarino, *ARU, San Francisco, CA. USA*
Richard Brown, *Lawrence Berkeley National Lab Berkeley, CA, USA*
Ruby Heard, *ALINGA Energy Consulting Melbourne, Australia*

15:16 **Earth Fault Analysis and Safety Recommendations for BIPV Module-Level Converters in Low-voltage DC Microgrids**
6-A-3 S. Ravyts, *KU Leuven, Belgium*
M. Dalla Vecchia, *KU Leuven, Belgium*
G. Van den Broeck, *KU Leuven, Belgium*
L. Hallemans, *KU Leuven, Belgium*
K. Stul, *KU Leuven, Belgium*
J. Driesen, *KU Leuven, Belgium*

15:34 **An Efficiency-Focused Design of Direct-DC Loads in Buildings**
6-A-4 Daniel L Gerber, *Bldg Tech Urban Systems (BTUS)Lawrence Berkeley Labs, USA*
Richard Liou, *Elec Eng Comp Sci (EECS)University of California Berkeley, USA*
Richard Brown, *Bldg Tech Urban Systems (BTUS)Lawrence Berkeley Labs, USA*

15:52 **Supercapacitor Assisted LED lighting (SCALED) for DC-micro grids**
6-A-5 Dilini Jayannada, *University of Waikato, New Zealand*
Nihal Kularatna, *University of Waikato, New Zealand*
D. Alistair Steyn-Ross, *University of Waikato, New Zealand*

Session 6-B: DC Applications (2)
May 23, 14:40 - 16:10, Hall B
Session Chairs:
Yuko Hirase (Toyo University, Japan)
Josep Maria Guerrero (Aalborg University, Denmark)

14:40 **Lifetime Calculation for Capacitors in Industrial Micro DC grids**
6-B-1 Simon Puls, *Lenze SE, Germany*
Johann Austermann, *Ostwestfalen-Lippe UAS, Germany*
Holger Borcherding, *Ostwestfalen-Lippe UAS, Germany*

14:58 **Bidirectional Converter with Balancing Capacitor using Multi-stage FET Driving Technique**
6-B-2 Yiki Ishikura, *Murata Manufacturing Co., Ltd., Japan*
Jun Imaoka, *Nagoya University, Japan*
Mostafa Noah, *Nagoya University, Japan*
Masayoshi Yamamoto, *Nagoya University, Japan*

15:16 **Implementation of a Remote Control and Monitoring Network for a DC Microgrid**
6-B-3 Maziar Mobarrez, *ABB Corporate Research Center, USA*
N. Ghanbari, *ECE Department, North Carolina State University, USA*
R. V. Agashe, *ECE Department, North Carolina State University, USA*
S. Bhattacharya, *ECE Department, North Carolina State University, USA*

15:34 **Graphical User Interface of EV Battery Charging Reservation System for Small-Scale Office Building Concerning Net-Zero Energy**
6-B-4 Pradita Octoviandiningrum Hadi, *Shibaura Institute of Technology, Japan*
Keisuke Tagami, *Tanaka, DAI-DAN Co., Ltd., Japan*
Yasunobu *Tanaka, DAI-DAN Co., Ltd., Japan*
Goro Fujita, *Shibaura Institute of Technology, Japan*

15:52 **Power electronics for a LVDC-microgrid with local PV production and electrolytic converter**
6-B-5 Philippe Morey, *HEIG-VD, HES-SO Yverdon Yverdon-les-Bains, Switzerland*
Jean-François Affolter, *HEIG-VD, HES-SO Yverdon Yverdon-les-Bains, Switzerland*
Line Barras, *HEVS, HES-SO Valais-Wallis Sion, Switzerland*
Aurélien Carrupt, *HEVS, HES-SO Valais-Wallis Sion, Switzerland*
Didier Blatter, *HEVS, HES-SO Valais-Wallis Sion, Switzerland*
René Rebord, *HEVS, HES-SO Valais-Wallis Sion, Switzerland*
Thomas Sterren, *HEVS, HES-SO Valais-Wallis Sion, Switzerland*
Philippe Barrade, *HEVS, HES-SO Valais-Wallis Sion, Switzerland*
Christoph Ellert, *HEVS, HES-SO Valais-Wallis Sion, Switzerland*

Session 7-A: Stability and Performance Analysis, Management
May 23, 16:30 - 18:00, Hall A
Session Chairs:
Yushi Miura (Nagaoka University of Technology, Japan)
Javier Roldán, (IMDEA Energy Institute, Madrid, Spain)

16:30 **Short Timescale Energy Management for DC Microgrids**
7-A-1 Fei Gao, *University of Oxford, United Kingdom*
Leong Kit Gan, *Faraday Grid, United Kingdom*
David A. Howey, *University of Oxford, United Kingdom*
Daniel J. Rogers, *University of Oxford, United Kingdom*

16:48 **Stability Control Strategy for DC Micro-grid Considering Constant Power Load**
7-A-2 Wenqiang Xie, *North China Electric Power University, China*
Minxiao Han, *North China Electric Power University, China*
Wenli Yan, *North China Electric Power University, China*
Chao Wang, *North China Electric Power University, China*

17:06 **DC Bus System for Servo Drives and its Stability Analysis**
7-A-3 Takeshi Kiribuchi, *OMRON Corporation, Japan*
Toshiyuki Zaitsu, *OMRON Corporation, Japan*
Masashi Doi, *OMRON Corporation, Japan*
Keisuke Kusaka, *Nagaoka University of Technology, Japan*
Junichi Itoh, *Nagaoka University of Technology, Japan*

17:24 **Stability of DC Distribution Systems: Analytical and Experimental Results**
7-A-4 Nils H. van der Blij, *Delft University of Technology, Netherlands*
Laura M. Ramirez-Elizondo, *Delft University of Technology, Netherlands*
Matthijs T. J. Spaan, *Delft University of Technology, Netherlands*
Wuhua Li, *Zhejiang University, China*
cnPavol Bauer, *Delft University of Technology, Netherlands*

17:42 **Smoothing Effect and Energy Capacity in Photovoltaic Power Smoothing Control Using Spline Function**
7-A-5 Akiko Takahashi, *Okayama University, Japan*
Tatsuya Kajitani, *Okayama University, Japan*
Shigeyuki Funabiki, *Okayama University, Japan*

Session 7-B: DC Applications (3)
May 23, 16:30 - 18:00, Hall B
Session Chairs:
Antonio Marques Cardoso (Universidades da Beira Interior in Portugal, Portugal)
Toshihisa FUNABASHI (University of the Ryukyus, Japan)

16:30 **Common Mode Conductive Noise Cancellation for Multiphase Converter Using Auxiliary Winding**
7-B-1 Mamoru Sasaki, *Nagoya University, Japan*
Jun Imaoka, *Nagoya University, Japan*
Masayoshi Yamamoto, *Nagoya University, Japan*
Akira Nakano, *Alps Alpine Co., Ltd, Japan*
Koji Fuse, *Alps Alpine Co., Ltd, Japan*

16:48 **Supercapacitor-based switching matrix to improve energy conversion efficiency of PV solar systems**
7-B-2 R.S. Ukwatta, *The Open University of Sri Lanka, Sri Lanka*
Thilini Wickramasinghe, *University of Lyon 1, France*
A.G.M. Lokuliyanage, *The Open University of Sri Lanka, Sri Lanka*

17:06 **Weakly Meshing the Radial Distribution Networks with Power Electronic Based Flexible DC Interlinks**
7-B-3 Aditya Shekhar, *Delft University of Technology, Netherlands*
Thiago Batista Soeiro, *Delft University of Technology, Netherlands*
Laura Ram´ırez-Elizondo, *Delft University of Technology, Netherlands*
Pavol Bauer, *Delft University of Technology, Netherlands*

17:24 **Impedance Measurement Method for Solar Cell Evaluation using a Power Converter**
7-B-4 Takeshi Yokoi, *Ritsumeikan University, Japan*
Koji Takechi, *Ritsumeikan University, Japan*
Hiroaki Kakigano*, Ritsumeikan University, Japan*

17:42 **An Improved Simple EMI Modeling Method for Conducted Common Mode Noise Prediction in DC- DC Buck Converter**
7-B-5 Baihua Zhang, *Kyushu University, Japan*
Shuaitao Zhang, *Kyushu University, Japan*
Henan Li, *Kyushu University, Japan*
Masahito Shoyama, *Kyushu University, Japan*
Eiji Takegami, *TDK-Lambda Corporation, Japan*

Poster session

Poster Session (1)
May 21, 2019 13:15 - 14:35, Poster Area
Session Chair: Yushi Miura (Nagaoka University of Technology, Japan)

P1-1 **A Study on Allocation Method of Supply-demand Balancing Capability considering VPP deployment**
Miki Someha, *Nagoya Institute of Technology, Japan*
Mutsumi Aoki, *Nagoya Institute of Technology, Japan*
Suresh Chand, *Nagoya Institute of Technology, Japan*

P1-2 **An Experimental Analysis of Frequency Characteristics in LLC Resonant Converter with Cockcroft-Walton Circuit**
Masataka Minami, *Kobe City College of Technology, Japan*
Hikaru Ouchi, *Kobe City College of Technology, Japan*
Takumi Yasuda, *Kobe City College of Technology, Japan*

P1-3 **Simulation Research on the Operation Characteristics of a DC Microgrid**
Xiaohui Wang, *Beijing University of Civil Engineering and Architecture, China*
Yiming Zheng, *Beijing University of Civil Engineering and Architecture, China*
Zhongshan Lu, *M&E Design Department China Water Resources Beifang Investigation, Design and Research Co. Ltd, China*

P1-4 **Capacitive earthing charge-based method for locating faults within a DC microgrid**
Ahmad Makkieh, *University of Strathclyde, UK*
Rafael Pena-Alzola, *University of Strathclyde, UK*
Abdullah Emhemed, *University of Strathclyde, UK*
Graeme Burt, *University of Strathclyde, UK*
Adria Junyent-Ferre, *Imperial College London, UK*

P1-5 **Fuel cell and Electrolyzer System for Supply and Demand Balancing in DC**
Kentarho Shimomachi, *National Institute of Technology, Hakodate College, Japan*
Yuji Mishima, *National Institute of Technology, Hakodate College, Japan*
Ryoichi Hara, *Hokkaido University, Japan*
Hiroyuki Kita, *Hokkaido University, Japan*

P1-6 **Research on the Control Method based on Virtual Synchronous Machine Technology of AC/DC Distribution Device**
Limin Lu, *State Grid Changzhou Power Supply Company, China*
Xufeng Li, *School of Electrical Engineering Southeast University, China*
Lexiang Cheng, *Lexiang Cheng, China*
Wenbing Li, *School of Electrical Engineering Southeast University, China*
Zhipeng Lv, *China Electric Power Research Institute, China*
Jianhua Wang, *School of Electrical Engineering Southeast University, China*

P1-7 **Distributed High Step-Down Ratio DC Transformer for Interconnection of MVDC and LVDC Grids**

Shang Gao, *School of Electrical Engineering Southeast University, China*
Jinggang Yang, *State Grid Jiangsu Electric Power Co., LTD. Research Institute, China*
Xin Zhan, *State Grid Yangzhou Power Supply Company, China*
Xiaolong Xiao, *State Grid Jiangsu Electric Power Co., LTD. Research Institute, China*
Jianhua Wang, *School of Electrical Engineering Southeast University, China*
Zaijun Wu, *School of Electrical Engineering Southeast University, China*

P1-8 **A Multivariable Hysteresis-Based DC Bus Signaling Control for DC Microgrid With Enhanced Reliability**

Sucheng Liu, *Anhui University of Technology, China*
Run Li, *Anhui University of Technology, China*
Kun Huang, *Anhui University of Technology, China*
Xiang Li, *Anhui University of Technology, China*
Wei Fang, *Anhui University of Technology, China*
Xiaodong Liu, *Anhui University of Technology, China*

P1-9 **Research on electric arc and practice in building LVDC distribution system**

Xiangdong Liu, *Nanjing Golden Cooperate DC Power Distribution Technology Co., Ltd., China*
Wei Zhang, *Nanjing Golden Cooperate DC Power Distribution Technology Co., Ltd., China*
Jianhai Yan, *Nanjing Golden Cooperate DC Power Distribution Technology Co., Ltd, China*
Wenbo Chen, *Nanjing Golden Cooperate DC Power Distribution Technology Co., Ltd, China*
Xiaodong Yuan, *Jiangsu Electric Power Science Research Institute, China*
Xueyi Zou, *Nanjing Golden Cooperate DC Power Distribution Technology Co., Ltd, China*

P1-10 **Research and Practice of Relay Protection in LVDC Distribution Network**

Zhong Li, *Nanjing Golden Cooperate DC Power Distribution Technology Co., Ltd., China*
Jianhai Yan, *Nanjing Golden Cooperate DC Power Distribution Technology Co., Ltd., China*
Xueyi Zou, *Nanjing Golden Cooperate DC Power Distribution Technology Co., Ltd, China*
Yuming Zhao, *Shenzhen Power Supply Co., Ltd, China*
Xuewen Yu, *Nanjing Golden Cooperate DC Power Distribution Technology Co., Ltd., China*
Xiangdong Liu, *Nanjing Golden Cooperate DC Power Distribution Technology Co., Ltd, China*

P1-11 **Modeling of a Building Scale Liquid Energy Storage and Expansion System with ASPEN HYSYS**

Ryan M.Willis, *Graduate School of Engineering and Applied Sciences Naval Postgraduate School, USA*
Anthony G. Pollman, *Graduate School of Engineering and Applied Sciences Naval Postgraduate School, USA*
Anthony J. Gannon, *Graduate School of Engineering and Applied Sciences Naval Postgraduate School, USA*
Alejando Hernandez, *Graduate School of Engineering and Applied Sciences Naval Postgraduate School, USA*

P1-12 **Fault Identification and Interruption Methods in Low Voltage DC Grids – A Review**

L. Hallemans, *KU Leuven, Belgium*
G. Van den Broeck, *KU Leuven, Belgium*
S. Ravyts, *KU Leuven, Belgium*
M. M. Alam, *VITO, Belgium*
M. Dalla Vecchia, *KU Leuven, Belgium*
P. Van Tichelen, *VITO, Belgium*
J. Driesen, *KU Leuven, Belgium*

P1-13 **A Study on Risk of Switching Stop Failure in Non-Isolated Step-Down DC-DC Converter**

Yuichi Noge, *Tokyo University of Agriculture and Technology, Japan*
Ming-cong Deng, *Tokyo University of Agriculture and Technology, Japan*
Toshihiro Amei, *Research and Development Center, SMK corporation, Japan*
Rie Abe, *Research and Development Center, SMK corporation, Japan*
Haruhiko Kondo, *Research and Development Center, SMK corporation, Japan*

P1-14 **Bidirectional Isolated Ripple Cancel Dual Active Bridge DC-DC Converter**

Pin-Yu Huang, *Kyoto Institute of Technology, Japan*
Takahiro Ohta, *Kyoto Institute of Technology, Japan*
Makoto Fujii, *Kyoto Institute of Technology, Japan*
Yuichi Kado, *Kyoto Institute of Technology, Japan*

P1-15 **Polar Coordinate Decoupling Power Flow Control for Triple Active Bridge Converter**

Shota Okutani, *Kyoto Institute of Technology, Japan*
Akira Nishi, *Kyoto Institute of Technology, Japan*
Pin-Yu Huang, *Kyoto Institute of Technology, Japan*
Yuichi Kado, *Kyoto Institute of Technology, Japan*

P1-16 **Comprehensive Cost Comparison and Analysis of Building-Scale Solar DC and AC Microgrid**

N. Ghanbarii, *North Carolina State University, USA*
M. Mobarrez, *North Carolina State University, USA*
M. Madadi, *North Carolina State University, USA*
S. Bhattacharya, *North Carolina State University, USA*

P1-17 **Voltage Control of High-voltage Distribution System Using Distributed Electric Vehicles**
Akiko Takahashi, *Okayama University, Japan*
Motohiro Shirakawa, *Okayama University, Japan*
Shigeyuki Funabiki, *Okayama University, Japan*

P1-18 **An Experimental Study on Extinguishing Property of DC Arc Ignited with Disconnection of Activated PV Array**
Toshiya Yokoi, *Aichi Institute of Technology, Japan*
Akihiro Tsusaka, *Aichi Institute of Technology, Japan*
Kazuho Hasegawa, *Aichi Institute of Technology, Japan*
Toshiro Matsumura *Aichi Institute of Technology, Japan*
Kazuto Yukita, *Aichi Institute of Technology, Japan*
Yasuyuki Goto, *Aichi Institute of Technology, Japan*
Atsushi Miyamoto, *Nitto Kogyo Corporation*
Hiroyuki Ito, *Nitto Kogyo Corporation*

P1-19 **Voltage Stabilization Control Method of DC Microgrid by Eigenvalue Analysis**
Naoya Ikeda, *Graduate School of Science Engineering Yokohama National University, Japan*
Hossam Aboelsoud Eid Elhassaneen, *Graduate School of Science Engineering Yokohama National University, Japan*
Takao Tsuji, *Faculty of Engineering Yokohama National University, Japan*

P1-20 **Influence of voltage rise suppression control with constant output power at the introduction of large photovoltaic device to the end of distribution system**
Masumi Tsukamoto, *Aichi Institute of Technology, Japan*
Toshiro Matsumura, *Aichi Institute of Technology, Japan*
Kazuto Yukita, *Aichi Institute of Technology, Japan*
Yasuyuki Goto, *Aichi Institute of Technology, Japan*
Yasunobu Yokomizu, *Nagoya University*
Kento Tatewaki, *Nagoya University*
Daisuke Iioka, *Tohoku University, Japan*
Hirotaka Shimizu, *Polytechnic University, Japan*
Hideki Iwatsuki, *Chubu Electric Power Co., Inc., Japan*
Hirokazu Uenishi, *Chubu Electric Power Co., Inc., Japan*
Hiroyuki Ishikawa, *Chubu Electric Power Co., Inc., Japan*
Yuuki Kanazawa, *Chubu Electric Power Co., Inc., Japan*

P1-21 **Hybrid AC/DC Microgrid for Residential Applications**
Ameer Hamza, *Syed Babar Ali School of Science and Engineering Lahore University of Management Sciences Lahore, Pakistan*
Hamza Bin Tahir, *Syed Babar Ali School of Science and Engineering Lahore University of Management Sciences Lahore, Pakistan*
Kiran Siraj, *Syed Babar Ali School of Science and Engineering Lahore University of Management Sciences Lahore, Pakistan*
Mashood Nasir, *Syed Babar Ali School of Science and Engineering Lahore University of Management Sciences Lahore, Pakistan*

P1-22 **Experimental study on interruption time in two inductance for 100 V class DC breaking arc**

Takuma Higashitani, *Aichi Institute of Technology, Japan*
Akihiro Tsusaka, *Aichi Institute of Technology, Japan*
Kazuho Hasegawa, *Aichi Institute of Technology, Japan*
Toshiya Yokoi, *Aichi Institute of Technology, Japan*
Toshiro Matsumura, *Aichi Institute of Technology, Japan*
Kazuto Yukita, *Aichi Institute of Technology, Japan*
Yasuyuki Goto, *Aichi Institute of Technology, Japan*
Atsushi Miyamoto, *Nitto Kogyo Corporation, Japan*
Hiroyuki Ito, *Nitto Kogyo Corporation, Japan*
Yasunobu Yokomizu, *Nagoya University*

P1-23 **The Algorithm to Detect and Differentiate Line-Line and Shading Fault in PV System**

Jirada Gosumbonggot, *Shibaura Institute of Technology, Japan*
Goro Fujita, *Shibaura Institute of Technology, Japan*

P1-24 **Performance Evaluation of GaN-MPPT by Transient Characteristics**

Yusuke Kobayashi, *Aichi Institute of Technology, Japan*
Kazuto Yukita, *Aichi Institute of Technology, Japan*
Masayuki Minowa, *Aichi Institute of Technology, Japan*
Toshiro Matsumura, *Aichi Institute of Technology, Japan*
Katusnori Mizuno, *Aichi Institute of Technology, Japan*
Takanori Matsuyama, *Aichi Institute of Technology, Japan*

P1-25 **Study of a microgrid using a private power generator during a utility grid failure**

Kazuhiro Minemura, *Aichi Institute of Technology, Japan*
Daiki Owaki, *Aichi Institute of Technology, Japan*
Kazuto Yukita, *Aichi Institute of Technology, Japan*
Yasuyuki Goto, *Aichi Institute of Technology, Japan*
Takuya Ota, *SANYO DENKI Co., LTD., Japan*
Hiroaki Miyoshi, *SANYO DENKI Co., LTD., Japan*
WANG Beibei, *Southeast University, China*
Li Yang, *Southeast University, China*
Keiichi Hirose, *NTT Facilities, INC., Japan*

P1-26 **Risk of Arc Extension by Multiple Capacitive Discharges in a Fuse for Microgrid**

Tomokazu SAKURABA, *Mersen Japan K.K., Japan*
Song Chen, *Mersen Shanghai, China*
Laurent MILLIERE, *Mersen France SB SAS, France, France*

P1-27 **Terminal Capacitor Compensation Based Stability Design for DC Microgrid**

Fulong Li, *Aston University, UK*
Zhengyu Lin, *Aston University, UK*
Alian Chen, *Shandong University, China*
Jiande Wu, *Zhejiang University, China*

Poster Session (2)
May 23, 2019 13:15 - 14:35, Poster Area
Session Chair: Takao Tsuji (Yokohama National University, Japan)

P2-1 **DC Power Control Using Simple Inverters Constructed by Concise Circuit Configuration**
Keiju Matsui, *Minna-denryoku, Inc. Setagaya Monozukuri Gakko, Japan*
Eiji Oishi, *Minna-denryoku, Inc. Setagaya Monozukuri Gakko, Japan*
Mikio Yasubayashi, *Chubu University, Japan*
Yuuichi Hirate, *Chubu University, Japan*
Steve Adikari, *Chubu University, Japan*
Masaru Hasegawa, *Chubu University, Japan*

P2-2 **Power Packet Dispatching System and Router for Bi-directional Dispatching**
Ryo Takahashi, *Aichi University of Technology, Japan*
Naomitsu Yoshida, *Kyoto University, Japan*
Takashi Hikihara, *Kyoto University, Japan*

P2-3 **The Efficiency Estimation Method for Harvesting Energy Charged into Capacitor**
Takashi Yoshikawa, *Kindai University Technical College, Japan*

P2-4 **Verification of dc Capacitor Control of Modular Multilevel Converters for dc Transmission Systems**
Muneki Funami, *Ritsumeikan University, Japan*
Takahiro Hashimoto, *Ritsumeikan University, Japan*
Hiroaki Kakigano, *Ritsumeikan University, Japan*

P2-5 **Unique Self-Tuning Method for Stability of Grid-Connected Inverter**
Yuhki Kamatani, *OMRON Corporation, Japan*
Takeo Nishikawa, *OMRON Corporation, Japan*
Takeshi Uematsu, *OMRON Corporation, Japan*
Toshiyuki Zaitsu, *OMRON Corporation, Japan*

P2-6 **Supercapacitor Assisted Data Center Power Architecture for 380 V DC-microgrid**
Thilanga Ariyarathna, *University of Waikato, New Zealand*
Nihal Kularatna, *University of Waikato, New Zealand*
D. Alistair Steyn-Ross, *University of Waikato, New Zealand*

P2-7 **Monte Carlo Model for Grid to Grid Connection of Islanded Microgrids**
Jonathan Bowes, *University of Strathclyde, United Kingdom*
Scott Strachan, *University of Strathclyde, United Kingdom*
Campbell Booth, *University of Strathclyde, United Kingdom*

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Hirohisa Aki, *University of Tsukuba, Japan*
Takayuki Kumamoto, *University of Tsukuba, Japan*
Masayoshi Ishida, *University of Tsukuba, Japan*

P2-9 **Demonstration application of LVDC distribution system in building**
Bao Zhang, *Nanjing Golden Cooperate DC Power Distribution Technology Co., Ltd., China*
Jianhai Yan, *Nanjing Golden Cooperate DC Power Distribution Technology Co., Ltd., China*
Hao Tong, *Nanjing Golden Cooperate DC Power Distribution Technology Co., Ltd, China*
Yutong Li, *Shenzhen Power Supply Co., Ltd, China*
Jinhao Wang, *State Grid Electric Power Research Institute of Shanxi Electric Power Company, China*
Jiajie Liu, *Nanjing Golden Cooperate DC Power Distribution Technology Co., Ltd, China*

P2-10 **AC vs. DC Boost Converters: A Detailed Conduction Loss Comparison**
Daniel L Gerber, *Building Technology and Urban Systems Lawrence Berkeley Labs, USA*
Fariborz Musavi, *Engineering and Computer Science Washington State University, USA*

P2-11 **A New Protection Scheme Using an AC/DC Converter for a LVDC Distribution System**
Jintae Cho, *Smart Power Distribution Laboratory KEPRI, Korea*
Youngpyo Cho, *Smart Power Distribution Laboratory KEPRI, Korea*
Hongjoo Kim, *Smart Power Distribution Laboratory KEPRI, Korea*
Hyunmin Kim, *Smart Power Distribution Laboratory KEPRI, Korea*
Juyong Kim, *Smart Power Distribution Laboratory KEPRI, Korea*
Hosung Kim, *Power Conversion Research Center KERI, Korea*

P2-12 **DC Nano Grids for LED Lighting for 24x7 Facilities – Industries, Healthcare**
Vineet Krishna Rohatgi, *Industries, Hospitals., India*
Rajeev Krishna Rohatgi, *Industries, Hospitals., India*

P2-13 **DC Voltage Stabilization in DC/AC Hybrid Microgrid by Cooperative Control of Multiple Energy Storages**
Guohong Wu, *Tohoku Gakuin University, Japan*
Seiya Ishida, *Tohoku Gakuin University, Japan*
Hang Yin, *Tohoku Gakuin University, Japan*

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Toshihisa FUNABASHI, *University of the Ryukyus, Japan*
Kazuto YUKITA, *Aichi Institute of Technology, Japan*

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Yeuntae Yoo, *Korea University, Korea*
Seungmin Jung, *Hanbat National University, Korea*
Minhan Yoon, *Tongmyong University., Korea*
Sungchul Hwang, *Korea University, Korea*
Jaehyeong Lee, *Korea University, Korea*
Gilsoo Jang, *Korea University, Korea*

P2-16 **MVDC ring-cable approach for new DC distribution and restructured AC grids**
Gerhard Jambrich, *Austrian Institute of Technology, Austria*
Johannes Stöckl, *Austrian Institute of Technology, Austria*
Markus Makoschitz, *Austrian Institute of Technology, Austria*

P2-17 **Improving Efficiency, Reliability and Life-time Cost of Data Centers Using DC Technology**
Abdullah AL-Harbi, *Saudi Aramco, Saudi Arabia*
Farooq Al-Jwesm, *Saudi Aramco, Saudi Arabia*
Yasser Al-Howeish, *Saudi Aramco, Saudi Arabia*

P2-18 **Decentralized Control-Scheme for DC-Interconnected Solar Home Systems for Rural Electrification**
Nishant Narayan, *Delft University of Technology, Netherlands*
Laurens Mackay, *DC Opportunities R&D, Netherlands*
Bryan Oscareno Malik, *Delft University of Technology, Netherlands*
Jelena Popovic-Gerber, *Klimop Energy, Netherlands*
Zian Qin, *Delft University of Technology, Netherlands*
Pavol Bauer, *Delft University of Technology, Netherlands*
Miroslav Zeman, *Delft University of Technology, Netherlands*

P2-19 **Improvement of temperature rise of Low voltage fuse**
Shunsuke Hasegawa, *Technical Development dept. Daito Communication Apparatus Co.,Ltd., Japan*
Ying Ren Yun, *Pinggao Intelligent Electric Co., Ltd., China*
Chao He, *Pinggao Group Smart Electric Co., Ltd, China*
Hiroshi Suzuki, *Daito Create Co., Ltd, Japan*
Masami Takada, *Daito Create Co., Ltd, Japan*
Noriaki Otsubo, *Daito Create Co., Ltd, Japan*

P2-20 **Development of Sodium Sulfur Battery**
Naoki Hirai, *NGK Insulators, LTD., Japan*

P2-21 **PV-grid performance under dynamic weather conditions**
Kasper M. Paasch, *University of Southern Denmark, Denmark*
Cristina Cornaro, *University of Rome "Tor Vergata", Italy*
Marco Pierro, *University of Rome "Tor Vergata", Italy*

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Duy-Dinh NGUYEN, *Aichi Institute of Technology, Japan*
Kazuto YUKITA, *Aichi Institute of Technology, Japan*

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Haoyu Zhang, *University of Tsukuba, Japan*
Rene Barrera-Cardenas, *SINTEF Energy Research, Norway*
Ryuji Iijima, *University of Tsukuba, Japan*
Takanori Isobe, *University of Tsukuba, Japan*
Hiroshi Tadano, *University of Tsukuba, Japan*

P2-24 **Study on the Surveying Wiring Path in Solar Power Generation System**
Yuji Iwane, *Aichi Institute of Technology, Japan*
Kazuto Yukita, *Aichi Institute of Technology, Japan*
Toshiro Matsumura, *Aichi Institute of Technology, Japan*
Yasuyuki Goto, *Aichi Institute of Technology, Japan*
Kazuhiko Taniguchi, *Kinden Corporation, Japan*
Hiroshi Morita, *Kinden Corporation, Japan*
Naoya Kubo, *Kinden Corporation, Japan*

P2-25 **Method of Determining Operation Voltage of Dispersed Photovoltaic Generator**
Koki Kato, *Aichi Institute of Technology, Japan*
Yuji Iwane, *Aichi Institute of Technology, Japan*
Shunsuke Horie, *Aichi Institute of Technology, Japan*
Tadahiro Goda, *Aichi Institute of Technology, Japan*
Kazuto Yukita, *Aichi Institute of Technology, Japan*
Toshiro Matsumura, *Aichi Institute of Technology, Japan*
Yasuyuki Goto, *Aichi Institute of Technology, Japan*
Issarachai Ngamroo, King Mongkut's Institute of Technology, Thailand

P2-26 **The Technical Case Study of Low Voltage DC Micro Grid System for Net Zero Energy Building**
Yutong Li, *Shenzhen Institute of building research, China*

P2-27 **Demonstration project MVDC Distribution System**
Ryosuke Ochi, *Power Distribution Systems Centre, Mitsubishi Electric Corporation, Japan*
Kosuke Shinji, *Power Distribution Systems Centre, Mitsubishi Electric Corporation, Japan*

P2-28 **Voltage-Frequency Control in PV Introduction System**
Gouken Fukuyama, *Aichi Institute of Technology, Japan*
Tadahio Godai, *Aichi Institute of Technology, Japan*
Yuji Iwane, *Aichi Institute of Technology, Japan*
Koki Kato, *Aichi Institute of Technology, Japan*
Katsunori Mizuno, *Aichi Institute of Technology, Japan*
Kazuto Yukita, *Aichi Institute of Technology, Japan*
Toshiro Matsumura, *Aichi Institute of Technology, Japan*
Yasuyuki Goto, *Aichi Institute of Technology, Japan*

P2-29 **A Local Voting Protocol Based Cooperative DC Community Microgrids**
Subham Sahoo, *National University of Singapore, Singapore*
Sukumar Mishra, *Indian Institute of Technology Delhi, India*
Tomislav Dragicevic, *Aalborg University, Denmark*

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Oral presentation

Presentation time is 18 min. including Question / Discussion is 3 min. Presenters have to use own laptop computer. The conference organizer will prepare three types interface to projector these are HDMI, VGA and DVI for Windows and Apple. The other interface is not available. When presenter can't use own laptop computer, the organizer will prepare Windows OS laptop computer with MS Power point (PPT). In recess before the session, all the presenters must check the connection to projector. Presenter should meet session chair(s) during recess before the presentation and pass a brief biography and/or business card to session chair(s).

Poster presentation

Presentation time is 80 min. Size of poster is 841x1189 mm (A0). Use the sheet of poster with the shorter side at the top. In recess before the session, presenter must meet session chair. Fail of meeting with session chair may be regarded as "No show". Poster must be removed after the session is finished.

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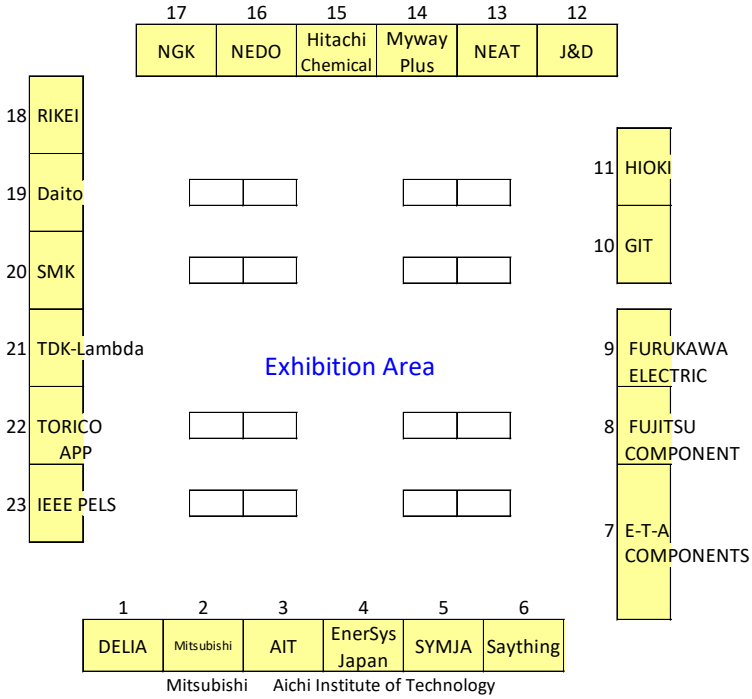
Exhibition

Open hours:

May 20 (Mon) 15:00 – 18:00
May 21 (Tue) 9:00 – 17:00
May 22 (Wed) 9:00 – 13:00
May 23 (Thu) 9:00 – 13:00

Venue: The 1st floor Exhibition area



Exhibitors (in alphabetical order)

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F Solar Package M Type

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ICDCM 2019 Exhibition Booth #1

DELIA

https://www.delia5.org/

DELIA (Distributed Energy Ledger Infrastructure Alliance) was created as an information and application platform development for energy business, and going to expand renewable energy using distributed energy system and innovative technology like a blockchain.

ICDCM 2019 Exhibition Booth #2

MITSUBISHI ELECTRIC

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スマート中低圧直流配電ネットワークシステム

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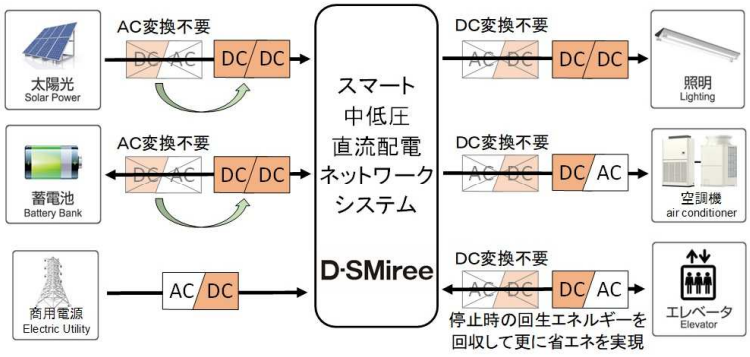

D-SMiree:
Diamond-Smart Medium voltage direct current distribution network system
innovative(革新性) reliability(信頼性) economy(経済性) ecology(環境性)

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・直流配電は交流配電と比べて電力変換回数を低減し、省エネを可能にします。
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DC distribution system can continue running efficiently the system during grid black out, with PV and battery

三菱電機株式会社 受配電システム製作所

ICDCM 2019 Exhibition Booth #3

Eco-electric Power Research Center
Aichi Institute of Technology, Japan

The Eco-electric Power Research Center was established in April 2007 through the FY2006 High-tech Research Center Project for private universities, an initiative led by Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT) to promote social collaboration.

The Eco-electric Power Research Center microgrid is the first of demonstration facility of its kind to be constructed on a university campus in Japan.

We are conducting the multifaceted research on AC / DC hybrid microgrid systems using this demonstration systems.

Contact information

Eco-electric Power Research Center
1247 Yachigusa, Yakusa-cho, Toyota City, Aichi 470-0392
Tel:+81-565-48-8121
Fax:+81-565-48-0277
E-mail：eeprec@aitech.ac.jp
URL:http://www.ait.ac.jp/en/facility/eco-power/

ICDCM 2019 Exhibition Booth #4

EnerSys & Alpha Technologies

EnerSys Group

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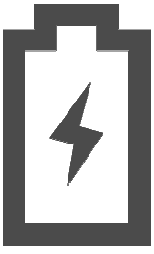
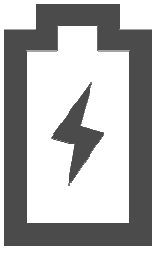
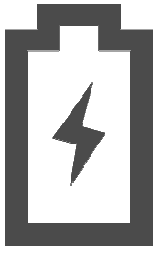


Sodium-Nickel



Lead-Acid



ICDCM 2019 Exhibition Booth #7

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For 70 years E-T-A Elektrotechnische Apparate GmbH, with its corporate headquarters in Altdorf near Nuremberg, has been successful in the global marketplace. Today E-T-A is market leader in the design and production of circuit breakers for equipment protection. In partnership with our customers it is our objective to provide solutions for even the most demanding challenges for electrical overcurrent protection.
E-T-A designs custom solutions for specific applications, supported by our international network of subsidiary companies and representatives enabling us to be in close proximity to the customer at all times. When working with our customers worldwide we seek the best solutions for their electrical protection and control requirements.

We offer one of the widest product ranges in the world regarding overcurrent protection and power distribution – ranging from single components such as circuit breakers for equipment protection, electronic circuit protectors, DC Disconnects and solid state relays to intelligent complete systems. We'll be pleased to design tailor-made solutions for you based on your requirements.

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ICDCM 2019 Exhibition Booth #8

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High current plug-in connector with a Wrong insertion prevention mechanism

Connector crimping condition

Conductor size (mm^2)	Cable kind	Connector crimping condition *1			
		Crimping tool	Crimping die		Crimping times
100	CF/CV/ EM-LMFC etc.	Hydraulic tool *2	Indenter side	70-100	Once one side
			Anvil side	100	
200	CF/CV/ EM-LMFC etc.	Hydraulic tool *2	Indenter side	150-200	Once one side
			Anvil side	200	
325	CF/CV/ EM-LMFC etc.	Hydraulic tool *2	Indenter side	325	Once one side
			Anvil side	325	

*1 : According to JIS C 2805 "Crimp-type terminal lugs for copper conductor"
*2 : According to JIS C 9711 "Compression tools for wire connectors of interior wiring"

FEPS

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Verify the quality of power from a solar power system

Verify the quality of power supplied by an EV rapid charger

ICDCM 2019 Exhibition Booth #12

J&D Electronics Co., Ltd.

J&D Electronics is growing as market leader with developing and manufacturing the current sensor and voltage sensors, which are for power quality and power efficiency measuring for various application such as Wind power, solar power and distribution power lines. Recently, J&D Electronics develops, produces and supplies the key products for electric IoT industry, such as Power efficiency measuring meter for electric devices, power quality meter, digital watthour meter, and etc.

Since 2000, J&D has been pursuing continuous innovation for 19 years, presenting a new chapter in the power electronics industry and growing into a global company. Recently, we developed the new products for DC metering for billing purposes to be a market leader.

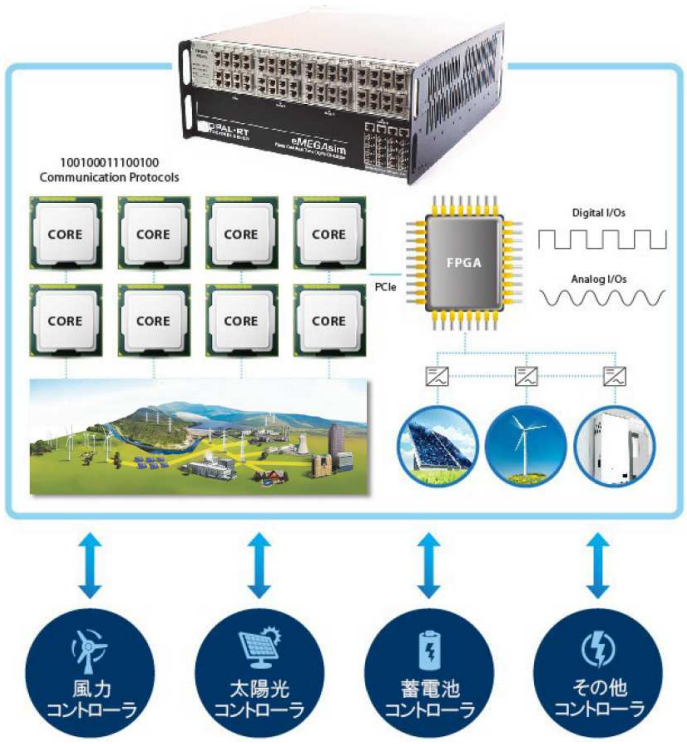
We developed two types of DC electricity meters with accuracy per the 1.0 and 0.5 class. One meter is a single meter for EV fast chargers, and the other one is a transformer-operated meter for ESS. And we developed a high-precision DC current sensor to be used for DC single meters and transformer-operated meters. The final one Is DC voltage sensor for DC transformer-operated meters.

J&D SMART SENSING

ICDCM 2019 Exhibition Booth #13

NEAT Co., LTD.

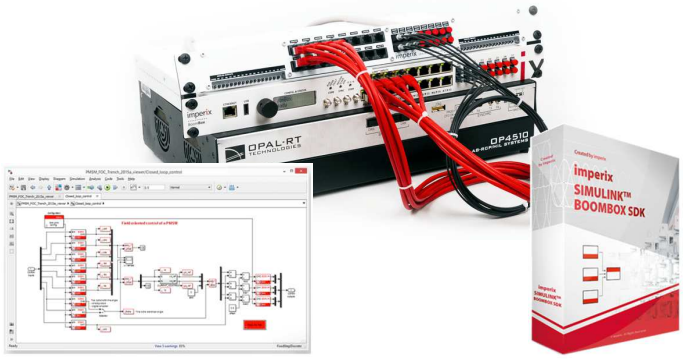
マイクログリッドシステム用 リアルタイム・ソリューション



カナダ OPAL-RT社とスイス Imperix社によって
それぞれ開発された、MATLAB/Simulinkベースの
リアルタイム・ソリューションを活用する事により、
マイクログリッドシステムに関わる様々な検証が
実機を含めた環境で可能になります。

- EVを用いたVehicle to Gridシステムの検証
- 太陽光や風力発電向けの制御システムの検証
- 様々な分散電源を組み合わせた制御システムの検証
- 電力系統におけるサイバーセキュリティ対策の検証

etc...



ICDCM 2019 Exhibition Booth #14

Myway Plus Corporation

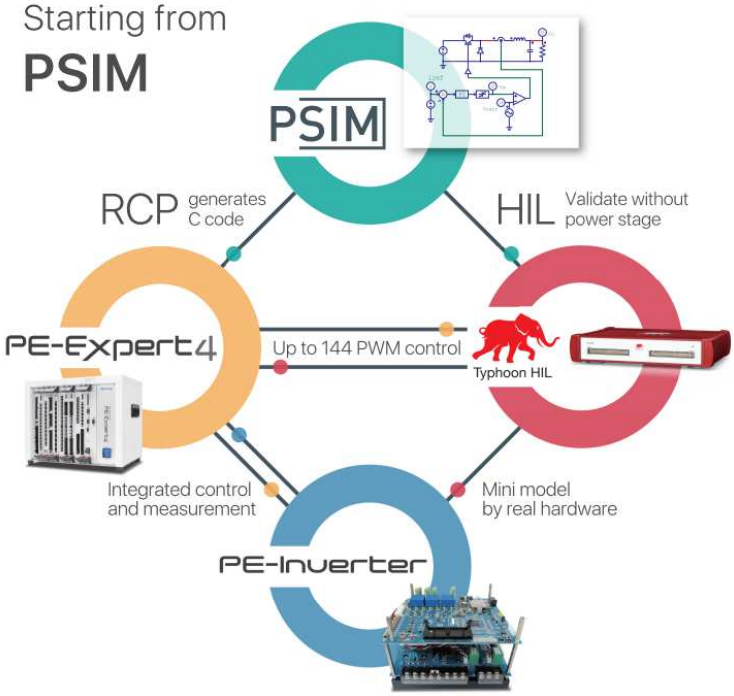
MMC Turnkey

Preprogramed FPGA PWM control
with extension boards supporting up to 144 pwm control & 144 DIO,
with optical signals.

MywayPlus Corporation
www.myway.co.jp

Myway

Ready-to-use
FPGA base Multi PWM Control
Starting from
PSIM



ICDCM 2019 Exhibition Booth #15

Hitachi Chemical Co., Ltd.

Stationary Energy Storage Advanced Valve Regulated Lead-Acid Battery ; LL-G

＜Long Cycle Life＞

LL-G is VRLA battery developed to specialize in the repetition of charging and discharging.

Expected Life* ; 5400 cycles at DoD70% or 20 years
Discharge current ; 1,500A (1.0CA), Charge current ; 900A (0.6CA)

* This is predicted one calculated from experimental results., and is not a guarantee.

＜Easy to Recycle＞

Nearly 100% recyclable (in Japan)

＜Main Applications＞

Output stabilization system of renewable energy
Battery Energy Storage System (Peak shifting, Peak shaving)

Model : LL1500G-8
Capacity : 12kWh (8V-1,500Ah)

Lithium-ion Battery : CH90-6

＜Long Cycle Life＞

6,000 Cycles*

* This is predicted one calculated from experimental results., and is not a guarantee.

<High Rate Capability>

Continuous 225A (2.5CA), short time 300A (3.3CA)

＜High Strength Structure＞

Cylindrical cell case (SUS)

＜Main Applications＞

Industrial mobility (Electric train, Golf cart, AGV etc.)

Model : CH90-6
Capacity : 2kWh (22.2V-90Ah)

ICDCM 2019 Exhibition Booth #16

NEDO

New Energy and Industrial Technology Development Organization (NEDO)

NEDO is one of Japan's largest research and development management organizations. Aiming to address global energy and environmental problems and enhance industrial technologies, in line with those objectives, we have carried out smart community projects.
Panels of our projects will be exhibited in our booth.

We are now preparing to hold **Smart Community Summit 2019 in June 4th at Tokyo**. The program for this year has two main sessions: "Disaster-resistant smart community" and "DC power". You can get detailed information at the NEDO booth.

< NEDO website > https://www.nedo.go.jp/english/index.html

ICDCM 2019 Exhibition Booth #19 Daito Communication Apparatus Co., Ltd.

私たちのユニークなヒューズと技術は、社会の基盤を支える電気・電子機器を重大な障害から守ってきました。
私たちはこれからも、安全・安心を支える企業として、回路保護技術を追求し、環境にやさしくお客様によろこばれる商品の提供を通して社会に貢献します。

Our unique technologies and fuses based on the technologies protected electric and electronic devices, that support infrastructure, from serious accident. Now and forever, we will search the technologies to protect electric circuits, supply the products that is environment friendly and satisfies customers, and contribute to society as the company that support safety and security in the infrastructure.

Our main products fuses line-up (certified by safety standard bodies; UL, CSA and others)

■DC high voltage electric circuit protection

Type No	rated voltage	rated current	Breaking capacity	Shape
HD	DC1,000V	1 ~ 10A	500A	
DGAE	DC550V	40 A	1,000A	
MF66NM	DC450V	1 ~ 20A	400A	
D51, D61	DC450V	1 ~ 20A	400A	(Type MF)
HVDCF	DC380V	15 ~ 30A		Plug in / with
HVUP				alarm function
DCP	DC450V	0.5 ~ 2A	100A	THT 5mm pitch

■DC low voltage electric circuit protection

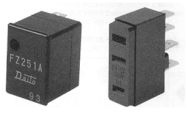
Type No	rated voltage	rated current	Breaking capacity	Shape
CRD	DC76V	10 ~ 30A	1,000A	Tubular
GU	AC250VDC125V	10 ~ 50A	1,000A	THT
RD	DC76V	5 ~ 20A	100A	THT pitch 7.5mm
DM	AC/DC125V	0.3 ~ 3.2A	50A	THT pitch 2.5mm
LM	AC/DC48V	0.3 ~ 5A	50A	THT pitch 5mm
CM	DC76V	0.4 ~ 5A	100A	
KMS	DC76V	1.6 ~ 15A	50A	

■AC supplementary circuit protection

Type No	rated voltage	rated current	Breaking capacity	Shape
CP *	AC/ DC250V	1 ~ 2 A	1,500A	Plug in / with
UP	AC250V/DC125V	7.5 ~ 70A	1,500A	alarm function
GP	AC/DC250V	0.32 ~ 5A	1,500A	
MP	AC/DC125V	0.32 ~ 7.5A	100A	(Type MP)
ES5	AC250V	2 ~ 10A	1,500A	Tubular, certified by CCC
GAC	AC600V/DC125V	0.8 ~ 20A	10,000A	Tubular

■Over-voltage protection

Type No	recommended rated voltage	Shape
FZ820	DC48V	Plug in / with
FZ251	AC/DC 125V	
FZ461	AC/DC 250V	



* Type CP fuses is registered in Chinese State Grid Specifications.

ICDCM 2019 Exhibition Booth #20 SMK SMK corporation

SMK株式会社 本 社 〒142-8511 東京都品川区戸越 6丁目5番5号
TEL(03)3785-1111(代) FAX(03)3785-1878 URL https://www.smk.co.jp/

ICDCM 2019 Exhibition Booth #21

TDK-Lambda

Features

- Step-up/step-down is bi-directionally converted in one converter
- 1U full rack size with high power density more than three times higher than before
- High efficiency of over 95% with isolated converter
- Power up by parallel operation possible

Major Applications

- Storage battery system for renewable energy such as solar power generation
- Backup storage battery system for HVDC

Specifications

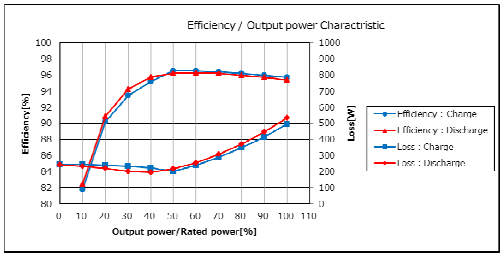
Model	EZA11k-320240		EZA2500-32048	
Item	Charge	Discharge	Charge	Discharge
High Voltage	320V(240-400V)	320V(240-400V)	320V(300-380V)	320V(300-380V)
Efficiency	95%	95%	92%	92%
Storage battery	240V(150-300V)	240V(150-300V)	48V(36-60V)	48V(36-60V)
Rated Power	11kW		2.5kW	
Dimension (W x H x D mm)	422.8×43.6(1U)×530		422.8×43.6(1U)×400	

EZA2500 2.5kW

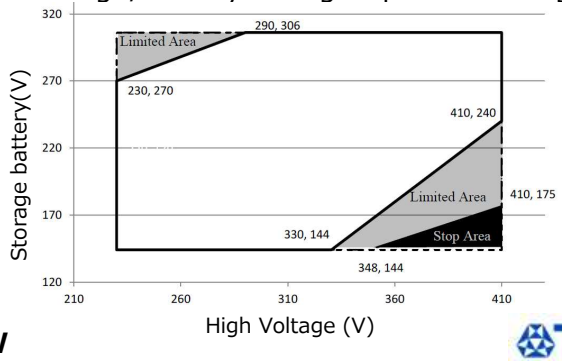
EZA11K 11kW

Characteristics 【EZA11K-320240】

Efficiency High Voltage=320V, Storage Battery=240V



High Voltage/Battery Voltage Operation Range



TDK

ICDCM 2019 Exhibition Booth #22

TRICO APP Anderson Power Products®

ICDCM 2019 Exhibition Booth #23 **IEEE Power Electronics Society (PELS)**

The IEEE Power Electronics Society invites you to celebrate PELS Day on June 20th, 2019. On this day in 1988 PELS became a full-fledged society within IEEE.

IEEE POWER ELECTRONICS SOCIETY
Powering a Sustainable Future

IEEE pels DAY
JUNE 20
POWERING A SUSTAINABLE FUTURE

About PELS

The PELS is one of the fastest growing technical societies of the IEEE. For over 30 years, PELS has facilitated and guided the development and innovation in power electronics technology. This technology encompasses the effective use of electronic components, the application of circuit theory and design techniques, and the development of analytical tools toward efficient conversion, control and condition of electric power. Our members include preeminent researchers, practitioners, and distinguished award winners.

Join us! Visit https://www.ieee-pels.org/