Final Program

66th IEEE Holm Conference on Electrical Contacts

24-27 OCTOBER 2021
Hilton Palacio Del Rio
San Antonio, TX, USA

Sponsored By:
The Electronics Packaging Society
of The Institute of Electrical and
Electronics Engineers, Inc.
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2021 Awards Committee

Gerald Witter  
Koichiro Sawa  
Siegfried Fouvry

2021 Prize Paper Award Committee

Sophie Noel  
Guang Yang  
Deepak Patil
Purpose

To provide a forum for the presentation and discussion of the latest developments in the field of electrical contacts, as well as the application of recent advances in materials and processes in electrical, electronic and telecommunications equipment.

For Whom

Practicing designers, engineers, physicists, and research scientists—those new to the field and those experienced. The 2021 IEEE Holm Conference will include excellent papers submitted in both years 2020 and 2021. These papers are authored by outstanding contributors in this field from USA, China, Germany, Japan, France, United Kingdom, and Norway. These papers will provide the attendees with up-to-date information on a wide range of subjects that makes this conference so attractive to the practicing engineer.

Additionally, the 2021 IEEE Holm Conference will make it possible for any attendee to discuss in-person or virtually, with any author, either additional details concerning the work presented by the author at the conference or any subject related to the author’s field of expertise.

Background

The Holm Conference began in 1953 as a forum for the discussion of electrical contact phenomena and related fields. In 1968, the conference was named the Holm Seminar in honor of Dr. Ragnar Holm, whose contributions to the field of electrical contacts spanned 50 years and forms the foundation of the electrical contacts field, was the inspiration and guide of the Conference from its inception until his death in 1970.

In addition to the Annual Conference, the Conference Organization regularly conducts an intensive course on contacts and participates in the biannual International Conference on Electrical Contacts.
All participants are encouraged to pre-register to avoid lines at conference and to obtain the discounted fee.

**CONFERENCE REGISTRATION**

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<td>Student/Life Member</td>
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See the registration site for INTENSIVE COURSE registration fees and combined Course/Conference rates.

**CONFERENCE REGISTRATION HOURS**

- Sunday 24 October: 4:00PM – 6:00PM
- Monday 25 October: 7:00AM – 5:00PM
- Tuesday 26 October: 7:30AM – 5:00PM
- Wednesday 27 October: 8:00AM – 12:40PM

Registration can be completed online:

[http://www.ieee-holm.org/registration.html](http://www.ieee-holm.org/registration.html)

**Registration payments:**

Checks are to be made out to the IEEE HOLM in US$. Visa, MasterCard, Discover, and American Express are accepted.

For additional information please contact Holm Registrar, at:

US and Canada: +1 800 810 4333  
Elsewhere: +1 732 465 7810  
Email: holmreg@ieee.org

**WELCOME RECEPTION**

All conference attendees are invited to register early and to attend our welcome reception on Sunday, 24 October from 4:00 PM – 6:00 PM at the Stetson, Hilton Palacio del Rio. The hotel was built for the 1968 World’s Fair. This 21-story hotel is famous for being a milestone in employing Modular Building construction techniques.
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The 2021 conference meets in San Antonio, Texas at Hilton Palacio Del Rio, where meeting facilities are well suited to the conference sessions and other activities. The hotel is offering special rates of US$239* single/double occupancy to conference attendees. Rates are subject to state and local tax. To make a reservation please use the Holm Conference link:

[http://www.ieee-holm.org/venue.html](http://www.ieee-holm.org/venue.html)

or call Hilton Palacio Del Rio Reservations 1-210-222-1400, and please refer to the group name as “2021 Holm Conference” in order to receive the group rate. The rate is valid until September 21st, 2021 at 5:00PM EST. Reservations received after this date will be subject to space and availability. Cancellation policies may vary depending on the rate and dates of your reservation. Please refer to your reservation confirmation to verify your cancellation policy. If you need further assistance, call the hotel directly or contact customer service.

Check in time: 3:00PM CST
Check out time: 11:00PM CST

Hilton Palacio Del Rio
200 S Alamo St.
San Antonio, TX 78205, United States
+1 (210)222-1400

### Transportation

**Airport and Driving Directions:**

**FROM SAN ANTONIO INTERNATIONAL AIRPORT – 15 MINUTES/9.5 MILES**

Get on US-281 S from S Terminal Dr and Dee Howard Way. Continue on US-281 S to E Commerce Street. Take exit 141A from I-37 S towards downtown. Continue on E Commerce Street. Turn left onto Losoya Street and continue onto S Alamo Street. Destination will be on the right at 200S Alamo Street.

For specific driving directions consult:

[http://www.ieee-holm.org/venue.html](http://www.ieee-holm.org/venue.html)

or call the hotel directly at +1 (210)222-1400.
The historic Sunset Station got a new name, the ESPEE, in 2020. It was designed by architect Daniel J. Patterson and built in 1902. Known as Southern Pacific (SP) Railroad Station, it was used by Amtrak to serve as the central connection to a multitude of states such as California, Missouri, Louisiana, and many more. It provided tremendous opportunities to the nation over the years, and was tagged with many nicknames such as “the Building of 1000 Lights”, “the Crossroads of America” and “the SP”. In 1998, the Sunset Station underwent an extensive restoration after Amtrak moved its operations to another depot adjacent to the Sunset Station. Today it serves as an entertainment complex. The ESPEE came from the spelling of “the SP” by train lovers.

The IEEE Holm Banquet will be held in the Banking Hall and attendees will have access to the Plaza to enjoy its wonderful night view and the comfortable October weather in San Antonio.

Each conference attendee will receive a ticket to attend the Banquet. Additional tickets may be purchased for the rate of $80 USD.
The Ragnar Holm Scientific Achievement Award derives its significance and prestige from the scientist whose name it carries. The contributions of Dr. Ragnar Holm to electrical contact theory and application are renowned the world over. The award, created in 1971 by the Steering Committee of the Holm Conference, honors the memory of the founder of modern electrical contact science by recognizing outstanding scientists and engineers in the field of electrical contacts or related technologies.

2020 RAGNAR HOLM SCIENTIFIC ACHIEVEMENT AWARDEE VOLKER BEHRENS

Volker Behrens studied physics at the Georg-August-University Göttingen, Lower Saxony, Germany. At the Institute for Metal Physics he received the Dipl.Phys. degree with a diploma thesis on tracer and chemical diffusion in binary alloys (1980) and after his civil service the Dr.rer.nat. degree with a thesis on thermodynamic evaluations (1985).

In 1986 he started his career with Doduco in Pforzheim, Germany with model switch software programming in the electrical test lab. He took over the head of the Contact Material R&D for Power Engineering in 1994 and the head of Application Engineering in 1999. His last position at Doduco was Director R&D Materials and Application Engineering.

Since 1998 he is a member in the German VDE working group ‘Kontaktverhalten und Schalten’ and contributed to different working groups with scientific-technical societies in Germany as ‘Deutsche Gesellschaft für Materialkunde (DGM)’, ‘Deutsche Gesellschaft für Verbindungs- und Schweißtechnik (DVS)’, and ‘Fachvereinigung Edelmetalle (FVEM)’. Since 1998 Dr. Behrens gives tutorials at the ‘Technische Akademie Esslingen (TAE)’ and ‘Technische Akademie Wuppertal (TAW)’ as well as national and international in-house seminars on electrical contacts. Dr. Behrens contributes to the education of professionals for material testing as head of the board of examiners at the ‘Industrie- und Handelskammer (IHK)’ in Pforzheim, Germany since 2005.

Dr. Behrens authored and co-authored numerous conference and journal papers, book chapters, and patents, with the main focus on contact materials for low voltage power engineering switching devices. With that, the development of environmentally friendly silver tin oxide and silver zinc oxide materials to replace silver cadmium oxide was in the center of his and his team’s work for more than two decades.
The National Association of Relay Manufacturers (NARM) awarded Dr. Behrens as 'Fellow in the College of Relay Engineers' (2002), he received the 'Albert-Keil-Award' (2017), and the IEEE Erle-Schobert Prize Paper Award (2019).

Holm Conference
Ragnar Holm Scientific Achievement Award
Nomination Guidelines

History: The Ragnar Holm Scientific Achievement Award was created by the 1971 Holm Conference Steering Committee in honor of the memory of Dr. Ragnar Holm, the founder of the modern science of electrical contacts. This award is to be granted to the living scientist or engineer who has made significant contributions to the theory or practice of electrical contacts, or for work in related technologies which is directly applicable to contacts. In considering a person’s work and selecting a recipient preference will be given for: a.) Nominees that have made contributions to the technology over many years, b.) the originality and scientific importance of contributions, and c.) achievements that have found a high degree of practice. Provided worthy candidates are found, the Award will be granted annually.

Eligibility: Any person may be nominated for this award regardless of IEEE membership. Members of IEEE Holm Awards Committee are not eligible to be considered for the award while serving on this committee. Nominations are not accepted for persons deceased. Candidates must have made contributions to the electrical contact field for a period spanning at least ten years.

Nominator Eligibility: Any person may nominate a candidate for this award, with the following exception: members of the award committee.

Nomination Support Materials
Endorsers: At least two letters of endorsement are required. One is from the nominator and the others are from the endorsers selected by the nominator. Endorsers should be in a position to substantiate the candidate’s contributions by providing explicit detail from personal knowledge. The nominator is responsible for submission of the letters of endorsement.

Candidate Personal Data/Education/Work: “Name”, provide complete name of candidate, not initials. “Personal”, provide date of birth, and citizenship. “Education”, list year and exact degree of institute. “Society Membership”, list various professional society affiliations. Under society activities list officers and major committee work. “Professional History”, list present occupation followed by previous career experiences. Indicate positions held, years, and briefly explain each responsibility.
Technical Accomplishments: “Technical Publications”, such as books, papers, reports, and standards are to be listed in chronological order giving author’s names, title, book, journal, or proceedings. “Patents”, should be listed by date, number, title, and country of origin. Documentation authentication “Development of Products or processes”, may be listed for items not covered by patents. “Technical Presentations”, such as keynote addresses or courses developed by the candidate should also be listed.

Significant Contributions: Describe the candidate’s outstanding contributions in terms of specific items. Provide a short paragraph to each one including a general description of the item, the degree of originality and creativity, and importance of the work to the electrical contact field and the time period over which the contribution was made. Also, state cases of examples of practices which were developed or modified through contributions of the candidate.

Forward Nominations To: IEEE Holm Award Committee, c/o IEEE Holm Conference Planner, 445 Hoes Lane, Piscataway, NJ 08854 USA

2022 Nominations Deadline: 1 February 2022
The Morton Antler Lecture is an annual technical presentation given at the IEEE Holm Conference on a topic of special interest to the electrical contact community. The lecture series was established in honor of Dr. Morton Antler, a longtime member of the Holm Steering Committee and participant in the Holm Conference. Dr. Antler was a distinguished scientist and lecturer in the fields of electrical contacts, tribology, corrosion, and electrodeposition.

Electric Vehicle Challenges

Peter Lee
Chief Tribologist
Southwest Research Institute

Abstract:
Electric vehicles are becoming mainstream, with many manufacturers claiming they will stop internal combustion engine production entirely over the next few decades. Electric vehicles operate at considerably higher voltages, often over 100v, and as such there are increasing challenges in building, safe operation and servicing these vehicles. New materials are being developed for battery use as well as switchgear and electrical components being operated in fluids, both aqueous and mineral. In this presentation some of the challenges and new developments will be discussed.
The Holm Conference Prize Paper Award was established in 1970. At that time, the Conference Steering Committee recognized that at each Conference there was at least one paper that stood out from the others in its technical content and quality of presentation. Therefore, the Prize Paper Award Committee was established. The Committee’s purpose is to review each paper, listen to each presentation and then judge which paper should receive the Prize Paper Award. The award is presented to the authors of the Prize Paper Award at the following year’s Holm Conference.

2019 IEEE Erle Shobert Prize Paper Award

Analytical Methods to Identify Root Causes for Early Failure of an AC Contactor with Heavy Load Service Life Test

V. Behrens, H. Cinaroglu, B. Meidel, S. Fuchs and Th. Honig
DODUCO Contacts and Refining GmBH

Paul and Dee Dee Slade Young Investigator Award

The Paul and Dee Dee Slade Young Investigator Award was established in 2011 with the objective to recognize outstanding achievement of young investigators in the field of Electrical Contacts and to encourage young scientists and engineers to enter this field. To be eligible for the Award, the candidate must be under the age of 35 as of the closing date of the conference, and present a paper at the conference in which s/he is either the sole author or the first author of a multi-author paper. The award is presented at the conference awards luncheon and will be prominently mentioned in the proceedings of the following conference.

2019 Paul and Dee Dee Slade Young Investigator Award

Modelling of Transient Heating and Softening Behavior of Contact Points During Current Pulses and Short Circuits

Toni Israel¹, Stephan Schlegel¹, Steffen Großmann¹, Tom Kufner² and George Freudiger²
¹Technische Universität Dresden
²Stäubli Electrical Connectors AG
Sponsors of 66th IEEE Holm Conference on Electrical Contacts

Platinum Level
Checon Corporation

Gold Level
Heraeus Deutschland GmbH & Co. KG
NAECO
DODUCO Contact and Refining GmbH
TE Connectivity
Umicore Electrical Materials USA

Silver Level
Metalor Technologies USA
Esgee Technologies Inc.

Bronze Level
Eaton
Molex
Technical Program

MONDAY, 25 OCTOBER 2021

8:00AM – 8:10AM
INTRODUCTION AND OPENING REMARKS
XIN ZHOU, 2021 IEEE Holm Conference Chair

8:10AM – 9:30AM
YOUNG INVESTIGATOR SESSION
CHAIR: DAVID WILLIAMS
CO-CHAIR: ROBERT JACKSON

1.1 Deterioration and Break-down Mechanisms in Force-fitted Current-carrying Connections Between Aluminum and Tin
Marcella Oberst, Christian Hildmann, Stephan Schlegel Technische Universität Dresden

1.2 Electric Field between Contacts of Fast Mechanical Disconnect Switches subjected to Fretting Wear
Tushar Damle, Chunmeng Xu, Michael Varenberg, Lukas Graber
Georgia Institute of Technology

1.3 Electro-thermo-mechanical Contact Analysis Considering Temperature Dependent Material Properties and Electrical Contact Resistance Determination
Swarna Saha, Samuel Wynne, Robert L. Jackson Auburn University

1.4 Investigation of Electrical Chatter in Bifurcated Contact Receptacles
Benjamin Zastrow¹, Robert Flicek², Kelsey Johnson¹, Karl Walczak², Benjamin Pacini², Brianna Johnson², Christopher Schumann¹, Fadi Rafeedi²
¹ATA Engineering, Inc, ²Sandia National Laboratories

9:30AM – 9:45AM BREAK

9:45AM – 10:45AM
HOLM AWARD
CHAIR: JERRY WITTER

0.1 Electrical Contacts and Hazardous Substances - Technical Backgrounds, Legal Restrictions and Substitutions
Volker Behrens

10:45AM – 11:00AM BREAK

11:00AM – 12:20AM
ARC MODELING
CHAIR: GUANG YANG
CO-CHAIR: ROLAND TIMSIT
2.1 3D Simulation of Electric Arcing and Pressure increase in an Automotive HVDC Relay During a Short Circuit Situation
Crispin Ewuntomah¹, Jens Oberrath²
¹Institute of Product and Process Innovation Leuphana University Lüneburg, ²South Westphalia University of Applied Sciences

2.2 Feature Enhancement Method for Weak Photovoltaic Series Arc Fault Signals
Silei Chen¹, Yu Meng², Jing Wang³, Xingwen Li²
¹Xi’an University of Technology, ²Xi’an Jiaotong University, ³Shenzhen Power Supply Bureau

2.3 Numerical Study of Electrode Vaporization Rates in an Automotive HVDC Relay in Hydrogen and Open-air in a Short Circuit Situation
Crispin Ewuntomah¹, Jens Oberrath²
¹Institute of Product and Process Innovation Leuphana University Lüneburg, ²South Westphalia University of Applied Sciences

2.4 Fast Numerical Algorithms for Arc Fault Detection
Karsten Wenzlaff¹, Deborah Luhnau¹, Peter Schegner¹, Michael Anheuserk²
¹TU Dresden, ²Siemens AG

12:20PM – 1:20PM LUNCH (ON YOUR OWN)

YOUNG INVESTIGATOR POSTER SESSION (CLOSED TO JUDGES ONLY, LOCATION TO BE DECIDED)

1:20PM – 2:40PM
FRETTING
CHAIR: GEORGE FLOWERS
CO-CHAIR: DEEPAK PATIL

3.1 Effect of Direction of Motion on Fretting Corrosion Behaviour
Haomiao Yuan, Dirk Hilmert, Abhay Shukla, Jian Song
Ostwestfalen-Lippe Univ. of Applied Sciences and Arts

3.2 Analysis of Fretting Behavior of Silver and Gold Flashed Palladium-nickel Dissimilar Coatings for Connectors
A. Torrealba¹, S. Noël¹, A. Brézard-Oudot¹, A. Fares Karam², D. Comte², J. Toran³
¹Université Paris-Sud, ²Amphenol-ICC France, ³Amphenol-ICC USA

3.3 Contact Resistance Prediction from Observed Image and Oxide Volume Analysis
Keiji Mashimo, Atsushi Shimoyamada, Hirokazu Sasaki
Furukawa Electric Co., Ltd.

3.4 Mitigation Schemes for the Reduction of Fretting Wear and Fatigue
Huaidong Yang, Itzhak Green
Georgia Institute of Technology
4.1 Observations of Peculiar Break Arc Motion of AgSnO$_2$ Contacts Under Applied External Magnetic Field in Inductive DC Load Conditions up to 20V-17A
Makoto Hasegawa, Seika Tokumitsu
Chitose Institute of Science and Technology

4.2 Observed Characteristics of Vacuum Arc Anode Phenomena Regarding the Influence of Electrode Material
Sergey Gortschakow$^1$, Diego Gonzalez$^1$, Mike Boening$^2$, Dirk Uhrland$^1$, Sabine Boening$^2$
$^1$Leibniz Institute for Plasma Science and Technology, $^2$PLANSEE Powertech AG

4.3 An Investigation of the Electrical Contact Resistance Change, Lubrication, and Wear Properties of a Nanolubricant
Larking Crilly$^1$, Robert L. Jackson$^1$, Samuel Bond$^1$, German Mills$^1$, Suvrat Bhargava$^2$
$^1$Auburn University, $^2$TE Connectivity

P1.1 Study of Measurement and Detection Algorithm of LVDC Residual Current
Zhimin Xie$^1$, Xingwen Li$^1$, Jing Wang$^2$, Silei Chen$^3$
$^1$Xi’an Jiaotong University, $^2$Shenzhen Power Supply, $^3$Xi’an University of Technology

P1.2 Analysis of Thermal Characteristics of Switch Cabinet with Multi-Physics Field Coupling Method
Nian Tang$^1$, Hongyu Xu$^2$, Xiaofeng Bai$^2$, Xingwen Li$^2$
$^1$Electric Power Research Institute of Guangdong Power Grid Co. Ltd, $^2$Xi’an Jiaotong University

P1.3 Experimental Evaluation of Outgassing Characteristics of Polymers on Air Arc Behavior
Jianning Yin$^1$, Qian Wang$^1$, Xingwen Li$^2$, Tian Tian$^2$, Hongwu Liu$^3$
$^1$Xi’an University of Technology, $^2$Xi’an Jiaotong University, $^3$Changshu Switchgear MFG. Co., Ltd.

P1.4 Comparison of Electrical Properties of CuCr30 Contacts Manufactured by Two Powder Metallurgies Technology
Kai Liu, Peng Li, Shisong Zhang, Xiaojun Wang, Gang Li, Xiaoyun Shi, Wenbin Wang
ShaanXi Sirui Advance Material. Co., LTD
P1.5  Impact of Physical Dimensions and Dielectric Materials in Fuzz Button Interconnection Area on Signal Transmission
Wenjia Wang¹, Jinchun Gao¹, George T. Flowers²,
Ziren Wang¹, Junyu Luo¹, Wei Yi²
¹Beijing University of Posts and Telecommunications,
²Auburn University

P1.6  Simulation of Residual Current in Low Voltage DC Systems
Jing Wang¹, Zhimin Xie², Silei Chen³, Xingwen Li²,
¹Shenzhen Power Supply Bureau, ²Xi’an Jiaotong University, ³Xi’an University of Technology

6:30PM CONFERENCE BANQUET – THE ESPEE
TUESDAY, 26 OCTOBER 2021

8:00AM – 9:00AM
ARC FAULT SAFETY
CHAIR: ROBERT JACKSON
CO-CHAIR: DAVID WILLIAMS

5.1 Kalman Filter for Detecting Serial Arc Faults in a Domestic Electrical Network
Edwin Calderon, Schweitzer Patrick, Weber Serge
*University of Lorraine*

5.2 Research on the Influence of Different Electrode Materials on DC Arc Fault Detection Characteristics
Jing Wang¹, Yu Meng², Xingwen Li², Silei Chen³,
¹Shenzhen Power Supply Bureau, ²Xi’an Jiaotong University, ³Xi’an University of Technology

5.3 The Influence of DC Household Electrical Appliances on Series Arc Fault Characteristics
Silei Chen¹, Yuming Zhao², Yu Meng³, Xingwen Li³,
Zhigang Zhao⁴, Jinrong Yuan⁴
¹Xi’an University of Technology, ²Shenzhen Power Supply Bureau, ³Xi’an Jiaotong University, ⁴Zhuhai Geli Electrical Appliances Co., Ltd.

9:00AM – 9:15AM BREAK

9:15AM – 10:15AM
MORTON ANTLER LECTURE
CHAIR: GERALD WITTER

Electric Vehicle Challenges
Peter Lee
Chief Tribologist
Southwest Research Institute

10:15AM – 10:30AM BREAK

10:30AM – 11:20AM
CONNECTOR FINISH MATERIALS 1
CHAIR: JINGYE LI
CO-CHAIR: MIKE MCOLASH

6.1 Contact Finish Considerations for High-Frequency Ground Connections
Rod Martens, Suvrat Bhargava, John Consoli,
Chan Morgan, Daniel Hubbard
*TE Connectivity*

6.2 Breakdown Voltage in Multi Walled Carbon-nanotubes during Low Voltage (4V) DC Switching
John McBride, Thomas Bull
*University of Southampton*
6.3 The Influence of Coating Technology on Contact Resistance During Life Testing of Reed Switches
Philip Lees, Eric Hafenstein, Joshua Koeppel, Tony Spies
Littelfuse

11:30PM – 1:30PM AWARDS LUNCHEON

1:30PM – 2:50PM CONTACT MODELING 1
CHAIR: KARUMBU MEYYAPPAN
CO-CHAIR: ROLAND TIMSIT

7.1 Impact of Impedance Change Caused by Bonding Wire Connection on Signal Transmission
Ziren Wang1,2, George T. Flowers2, Jinchun Gao1, Zekun Wang2, Kaixuan Song1
1Beijing University of Posts and Telecommunications, 2Auburn University

7.2 The Impact of Plating on Equipotential Surfaces and Contact Resistance
Robert D. Malucci
RD Malucci Consulting

7.3 Development and Validation of the Statistical Elastic and Elastic-plastic Rough Surface Contact Model for Small Contact to Complete Contact
Swarna Saha1, Yang Xu2, Kyle Schulze1, Robert L. Jackson1
1Auburn University, 2University of Glasgow

7.4 The relationship between Contact Resistance and Roughness (Sq) of a Bi-layered Surface using a Finite Element Model
John McBride1, Hong Liu2
1University of Southampton, 2Jiangsu University

2:50PM – 3:05PM BREAK

3:05PM – 4:05PM CONNECTOR FINISH MATERIALS 2
CHAIR: PETER HALE
CO-CHAIR: JINGYE LI

8.1 Improving the Inductive Crimping Technology in the Production of Electric Motors
Alexander Kuehl, Joerg Franke
Friedrich-Alexander-University

8.2 A Durable Electroplated Silver Contact Finish for Reusable Connectors
Youngmin Yoon, Jamie Chen, Michael Lipschutz, Patricia Gumbley, Miguel Rodriguez, Kristen Griffin
DuPont Electronics & Industrial
8.3 Experimental Study on the Adhesion Characteristics for AgSnO$_2$ Contacts of a Relay
Zhaobin Wang, Zhen Li, Kangning Chen, Zhan Wang, Shang Shang
Jiangsu University of Science and Technology

4:15PM – 5:15PM TC1 MEETING
CHAIR: GERALD WITTER

5:15PM – 6:15PM
VIRTUAL POSTER SESSION
CHAIR: DAVID WILLIAMS
CO-CHAIR: ROBERT JACKSON

P2.1 Study of the Movable Contact Fallback Phenomenon in MCCB
Xiaofeng Bai¹, Zijie Liao¹, Qian Wang², Jianning Yin², Xingwen Li³
¹State Key Laboratory of Electrical Insulation and Power Equipment, ²Xi’an University of Technology, ³Xi’an Jiaotong University

P2.2 Investigation of Switching Characteristics of Contact Materials for Inductive Load
Yubin He, Xu Zhang, Wanbin Ren
Harbin institute of Technology

P2.3 Surface Degradation of Electrical Connectors Stressed by Multivariable Lifetime Tests
Philipp Kolmer¹, Markus Rojer¹, Jian Song², Dieter Schramm³
¹Volkswagen AG, ²Ostwestfalen-Lippe University of Applied Sciences and Arts, ³University Duisburg-Essen

P2.4 Effects of Molybdenum Disulfide Shot Treatment on Electrical Sliding Current of a Slip Ring
Yuki Kawashima, Yoshitada Watanabe, Koichiro Sawa, Takahiro Ueno
Nippon Institute of Technology

P2.5 Impact of the Ball Grid Array Connection Failures on Signal Integrity
Kaixuan Song¹, Jinchun Gao¹, George T. Flowers², Ziren Wang¹,², Qingya Li¹, Wei Yi²
¹Beijing University of Posts and Telecommunications, ²Auburn University

P2.6 Relationship between Brush Current Change and Contact Voltage Drop in Sliding Contact with Steel Slip Ring and Various Silver Graphite Brushes
Naoki Fukuda, Koichiro Sawa, Takahiro Ueno
Nippon Institute of Technology

P2.7 Contact Resistance and Temperature Rise of Cable Connections in Cable Distribution Cabinets
Elin Fjeld¹, Wilhelm Rondeel¹, Gunn Kristin Sønsteby¹, Finn Werner Bekken², Thomas Ranvik Eriksen²
¹University of South-Eastern Norway, ²Skagerak Energi AS
9.1 Investigation of Making Process and Associated Contact Bounce Behaviors for Alternating Current Contactor
Chunen Yang, Zhe Zheng, Wanbin Ren
*Harbin Institute of Technology*

9.2 Experimental Investigation of Alternating Current Arc Behavior and Associated Contact Welding Failure for General-purpose Relay
Zhe Zheng, Tianyang Wang, Xu Zhang, Wanbin Ren
*Harbin Institute of Technology*

9.3 Presentation of a Novel and Laboratory Proved Method to Determine Efficiently the Minimum Deionization Time in Hybrid Circuit Contactor
Frederik Anspach, Patrick Vieth, Dirk Bosch, Lars Claassen, Ernst-Dieter Wilkening, Michael Kurrat
*TU Braunschweig*

9.4 Research on a Calculation Method of Permanent Magnet for Balanced Force Relay based on Attractive-Counter Force Coordination Curve
Ding Ding¹, Yufei Qiao¹, Libing Shi², Chenglong Zhou², Rui Tu³, Guofu Zhai¹
¹*Harbin Institute of Technology*, ²*Shaanxi Qunli Electrician Co., Ltd*, ³*Sungrow Power Supply Co.,Ltd*

9:20AM – 9:35AM BREAK

9:35AM – 11:15AM
CONNECTOR MODELING 2
CHAIR: DEEPAL PATIL
CO-CHAIR: KARUMBU MAYYAPPAN

10.1 Making Electrical Contact to Layered Surfaces
Robert D. Malucci
*RD Malucci Consulting*

10.2 Special Functions and HHL Quantum Algorithm for Solving Moving Boundary Value Problems Occurring in Electric Contact Phenomena
Merey M. Sarsengeldina, Zuhair M. Nashed
*University of Central Florida*

10.3 Computational study for electronic interconnects and performance of solders and solder paste
Waliul Matin, Michael Morrison, Khan M. Ashraf
*Saginaw Valley State University*

10.4 Impact of Signal Frequency on Passive Intermodulation in Coaxial Connectors
Lingyu Bi¹, George T. Flowers², Jinchun Gao¹, Junyu Luo¹, Wenjia Wang¹
¹*Beijing University of Posts and Telecommunications*, ²*Auburn University*
10.5 A Finite Element Method to Investigate Electrical Contact Behaviors Considering Asperity Interactions
Chao Zhang¹, Wanbin Ren¹, Guotao Wang²
¹Harbin Institute of Technology, ²Heilongjiang University

11:15AM –11:30AM BREAK

11:30AM – 12:10PM
MOVING CONTACTS AND RELAYS
CHAIR: MIKE MCOLASH
CO-CHAIR: HENRY CZAJKOWSKI

11.1 Evaluation of Arc Erosion of Cu-graphite Brush Used in Small DC Motors with and without Quenching Device
Koichiro Sawa¹, Takahiro Ueno¹, Keisaku Nakano²
¹Nippon Institute of Technology, ²Panasonic Corporation

11.2 Failure Simulation and Analysis Method of Hermetical Seal Electromagnetic Relay under Long-term Load
Jiaxin You, Rao Fu, Huimin Liang, Jiahe Zhang, Xiangdong Feng
Harbin Institute of Technology

12:10PM – 1:30PM LUNCH (ON YOUR OWN)

1:30PM – 2:30PM
ELECTRICAL SAFETY AND RELIABILITY
CHAIR: BRETT RICKETT
CO-CHAIR: MIKE MCOLASH

12.1 Bus Bar Bolted Connections: Reliability and Testing
Paul G. Slade, Consultant

12.2 The Influence of Limitation of Sputtered Tin Area Through Mesh Grids on Sn Whiskering
Zekun Wang, George T. Flowers, and Michael Bozack
Auburn University

12.3 Electrical and Morphologic Investigations of Electrical Contacts used in Low-Voltage-Circuit-Breakers
Marion Kubler-Riedinger¹, Jean-Marc Bauchire², Dunpin Hong², Gauthier Déplauze¹, Patrice Joyeux¹
¹Pôle de compétence électrique Hager Electro SAS, ²Université d’Orléans/CNRS

2:30PM –2:45 PM BREAK
13.1 Impact of Mechanical Parameters on Switching Results of Electro-Mechanical Contactors
Timo Mützel¹, Christian Hubrich², Johannes Tasch²
¹DODUCO Contacts & Refining GmbH, ²SAXONIA Technical Materials GmbH

13.2 Investigation of a Mechanical Switch within a Hybrid Circuit Breaker for Protection in DC Grids
Lars Claassen, Frederik Anspach, Ernst-Dieter Wilkening, Michael Kurrat
TU Braunschweig

13.3 Hybrid DC Molded Case Circuit Breaker Technology
Xin Zhou¹, Yanjun Feng², John Shen², Slobodan Krstic³
¹Eaton, ²Illinois Institute of Technology, ³Krstic Power Solutions

13.4 Design Considerations for Fast Mechanical Switches Using Piezoelectric Actuators
Tushar Damle, Adrian Munoz, Chunmeng Xu, Lukas Graber
Georgia Institute of Technology

4:10PM
CLOSING REMARKS
XIN ZHOU, 2021 HOLM CONFERENCE CHAIR