

# **2019 European Space Power Conference (ESPC 2019)**

**Juan-les-Pins, France  
30 September – 4 October 2019**



**IEEE Catalog Number: CFP19T97-POD  
ISBN: 978-1-7281-2127-7**

**Copyright © 2019 by the Institute of Electrical and Electronics Engineers, Inc.  
All Rights Reserved**

*Copyright and Reprint Permissions:* Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

***\*\*\* This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.***

|                         |                   |
|-------------------------|-------------------|
| IEEE Catalog Number:    | CFP19T97-POD      |
| ISBN (Print-On-Demand): | 978-1-7281-2127-7 |
| ISBN (Online):          | 978-1-7281-2126-0 |

**Additional Copies of This Publication Are Available From:**

Curran Associates, Inc  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: (845) 758-0400  
Fax: (845) 758-2633  
E-mail: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

CURRAN ASSOCIATES INC.  
**proceedings**  
.com

# TABLE OF CONTENTS

|                                                                                                                                                                       |            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| <b>PRELIMINARY STUDY FOR ANALYZING PLANETARY ATMOSPHERE USING SOLAR PANEL OUTPUT CURRENT .....</b>                                                                    | <b>1</b>   |
| <i>Hiroyuki Toyota ; Iku Shinohara</i>                                                                                                                                |            |
| <b>ALSAT-1B SOLAR ARRAY ASSEMBLY DESIGN AND FLIGHT QUALIFICATION.....</b>                                                                                             | <b>5</b>   |
| <i>Nassima Khorchef ; Rick Kimber</i>                                                                                                                                 |            |
| <b>DYNAMIC R<sub>ON</sub> EVALUATION OF COMMERCIAL GAN HEMT UNDER DIFFERENT SWITCHING AND RADIATION CONDITIONS .....</b>                                              | <b>12</b>  |
| <i>Pedro J. Martinez ; Enrique Maset ; David Gilabert ; Esteban Sanchis-Kilders</i>                                                                                   |            |
| <b>A GALLIUM-NITRIDE POINT-OF-LOAD DC-DC CONVERTER FOR SPACE APPLICATIONS.....</b>                                                                                    | <b>17</b>  |
| <i>Xiangnan You ; Xiaofeng Sun ; Jingming Fei ; Minghua Zhang ; Binbin Zhang ; Tao Chen ; Yuqi Qin ; Nana Rong ; Chengan Wan</i>                                      |            |
| <b>TIN-BASED MATERIALS: THE FUTURE OF ANODE MATERIALS FOR LITHIUM ION BATTERY?.....</b>                                                                               | <b>23</b>  |
| <i>Charlotte Gervillie ; Aurélie Boisard ; Julien Labbé ; Sandrine Berthon-Fabry ; Katia Guérin</i>                                                                   |            |
| <b>SIMULATION AND EXPERIMENTAL STUDY OF HIGH-POWER POWER CONDITIONING UNIT .....</b>                                                                                  | <b>27</b>  |
| <i>Wei Lu ; Baoping Wang ; Chunyang Zhao ; Hongtao Chen ; Kai Wang ; Taifeng Zhang</i>                                                                                |            |
| <b>AN OPTIMIZATION STRATEGY FOR BATTERY CHARGING IN SMALL SATELLITES .....</b>                                                                                        | <b>31</b>  |
| <i>Elisa Mostacciolo ; Francesco Vasca ; Silvio Baccari ; Luigi Iannelli ; Salvatore Sagnelli ; Raffaele Luisi ; Vincenzo Stanzione</i>                               |            |
| <b>A CHARACTERIZATION SYSTEM FOR LEO SATELLITES BATTERIES .....</b>                                                                                                   | <b>39</b>  |
| <i>Silvio Baccari ; Francesco Vasca ; Elisa Mostacciolo ; Luigi Iannelli ; Salvatore Sagnelli ; Raffaele Luisi ; Vincenzo Stanzione</i>                               |            |
| <b>LITHIUM-ION BATTERY FLIGHT EXPERIENCE RETURN ON CHINA LARGE GEO COMMUNICATION SATELLITE .....</b>                                                                  | <b>45</b>  |
| <i>Honglin Li ; Luc Sanchez ; Qiang Wei ; Jie Xing ; Wentao Yu ; Zhi Huang ; Xuan Zhang</i>                                                                           |            |
| <b>SOLAR ORBITER SOLAR ARRAY - EXCEPTIONAL DESIGN FOR A HOT MISSION .....</b>                                                                                         | <b>50</b>  |
| <i>Anton Lindner ; Carola Oberhüttinger ; Carola Paarmann ; Jens Müller ; Stein Strandmoe ; Ian Costello</i>                                                          |            |
| <b>THERMAL MANAGEMENT OF PLANAR MAGNETICS FOR SPACECRAFTS: CHARACTERIZATION AND MODELING .....</b>                                                                    | <b>57</b>  |
| <i>Guillermo Salinas ; Jesús A. Oliver ; Javier Muñoz-Antón ; Arturo Fernández ; Roberto Prieto</i>                                                                   |            |
| <b>CHARACTERIZATION OF SOLAR ARRAY'S CELLS TO SUBSTRATE BONDING INTERFACE.....</b>                                                                                    | <b>63</b>  |
| <i>Romain Cariou ; Bernard Boulanger ; Philippe Voarino ; Yannick Roujol ; Romain Couderc ; Honorine Boirard ; Etienne Rapp ; Frédéric Bourcier</i>                   |            |
| <b>POWER ASSESSMENT INDICES OF SOLAR ARRAYS UNDER MPPT AND DET METHODS FOR SPACECRAFT .....</b>                                                                       | <b>68</b>  |
| <i>Xuan Zhang ; Qing Kang ; Wentao Yu ; Jie Xing ; Feng Li ; Xiangnan You</i>                                                                                         |            |
| <b>A SPACE SELF-INTEGRATED MICRO-CONCENTRATOR DESIGN: THE SLIT .....</b>                                                                                              | <b>72</b>  |
| <i>Philippe Voarino ; Arnaud Ritou ; Bernard Boulanger ; Caroline Seraine ; Romain Couderc ; Honorine Boirard ; Etienne Rapp</i>                                      |            |
| <b>SPACE GRID: SMART AND DISTRIBUTED POWER ARCHITECTURE AND CONTROL FOR ELECTRICAL GRID .....</b>                                                                     | <b>78</b>  |
| <i>Quentin Hilpert ; Stéphane Caux ; François Bonnet ; Marc Malagoli</i>                                                                                              |            |
| <b>LOW POWER DCDC CONVERTER BASED ON AUTOMOTIVE-GRADE COMPONENTS FEATURING MAXIMUM SEE IMMUNITY .....</b>                                                             | <b>84</b>  |
| <i>Franz Stoegerer ; Thomas Panhofer</i>                                                                                                                              |            |
| <b>DELTA REFERENCE, THE LATEST HIGH TEMPERATURE COMPENSATED VOLTAGE REFERENCE CONCEPT .....</b>                                                                       | <b>90</b>  |
| <i>Viorel Banu ; Melania Popescu ; Philippe Godignon</i>                                                                                                              |            |
| <b>HIGH-EFFICIENCY LOW VOLTAGE/HIGH CURRENT POWER SUPPLIES FOR HIGH PERFORMANCE DIGITAL EQUIPMENT BY USING GAN FET TECHNOLOGY .....</b>                               | <b>98</b>  |
| <i>Franz Stoegerer ; Thomas Panhofer</i>                                                                                                                              |            |
| <b>DC2I, CONFIGURABLE AND COMPACT ISOLATED MULTI-OUTPUT DC-DC CONVERTER .....</b>                                                                                     | <b>105</b> |
| <i>Lorenzo Fontani ; Mario Migliaro ; Maurizio Inversi ; Maurizio Bacci ; Franco Bigongiari ; Francesco Petroni ; Elena Casali ; Mariel Triggianese ; David Levaq</i> |            |

|                                                                                                                                                                                  |            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| <b>SPACE III-V MULTIJUNCTION SOLAR CELLS ON GE/SI VIRTUAL SUBSTRATES .....</b>                                                                                                   | <b>112</b> |
| <i>Iván García ; Ignacio Rey-Stolle ; Manuel Hinojosa ; Iván Lombardero ; Luis Cifuentes ; Carlos Algora ; Huy Nguyen ; Aled Morgan ; Andrew Johnson</i>                         |            |
| <b>ADVANCED DIGITAL CONTROL FOR RUGGED POWER SUPPLIES .....</b>                                                                                                                  | <b>118</b> |
| <i>Erik Mache ; Felice Forrisi ; Alan Mallmann ; Martin Blaser</i>                                                                                                               |            |
| <b>LOW-INTENSITY LOW-TEMPERATURE (LILT) POWER PREDICTION OF JUICE SOLAR<br/>ARRAY .....</b>                                                                                      | <b>123</b> |
| <i>Martin Kroon ; Ed Bongers ; Cyril Cavel ; Carsten Baur ; Francesco Faleg ; Stefano Riva</i>                                                                                   |            |
| <b>NATURAL TRAJECTORIES AND DIGITAL IMPLEMENTATION OF LOAD DYNAMIC AND<br/>SOFT START-UP FOR LLC CONVERTERS .....</b>                                                            | <b>128</b> |
| <i>Xuan Zhang ; Renwei Zou ; Feng Li ; Jie Xing ; Qing Kang ; Wenshuan Zhang</i>                                                                                                 |            |
| <b>DEMONSTRATION OF IMPROVED FUSE CLEARING ENERGY WHEN AUGMENTED BY<br/>ULTRA-FAST EFUSE PROTECTION .....</b>                                                                    | <b>132</b> |
| <i>Timothy L. Meade ; Owen Watry ; James Colley ; Younes Lotfi</i>                                                                                                               |            |
| <b>EVALUATION OF THE RELIABILITY OF SPACE SOLAR CELLS BY MEANS OF<br/>SEQUENTIAL ACCELERATED LIFE TESTS .....</b>                                                                | <b>140</b> |
| <i>Manuel Vázquez ; Neftalí Nuñez ; Carlos Algora</i>                                                                                                                            |            |
| <b>INNOVATIVE TEMPERATURE ACCELERATED LIFE TEST FOR THE DETERMINATION OF<br/>THE ACTIVATION ENERGY OF SPACE SOLAR CELLS .....</b>                                                | <b>145</b> |
| <i>Neftalí Nuñez ; Manuel Vazquez ; Laura Barrutia ; Jesus Bautista ; Ivan Lombardero ; Juan Carlos Zamorano ; Manuel Hinojosa ; Mercedes Gabas ; Carlos Algora</i>              |            |
| <b>EXTENDED LEO MISSIONS ON KOMPSAT SERIES .....</b>                                                                                                                             | <b>152</b> |
| <i>Sungwoo Park ; Emma Prestigiacomo ; Kyudong Kim ; Yungsu Youn ; Remy Stéphane</i>                                                                                             |            |
| <b>APPLICATION OF MICRO-OPTICS TO SOLAR GENERATOR: RESULTS AND<br/>MANUFACTURING ROUTES .....</b>                                                                                | <b>157</b> |
| <i>Mane-Si-Laure Lee ; Anne Delboulbé ; Brigitte Loiseaux ; Julie Cholet ; Gaele Lehoucq ; Bernard Boulanger ; Honorine Boirard ; Etienne Rapp</i>                               |            |
| <b>DISCRETE CATHODE POWER SUPPLIES FOR LOW POWER HALL EFFECT THRUSTERS .....</b>                                                                                                 | <b>163</b> |
| <i>Spiridon Savvas ; Pavlos Ramnalis ; Alexandros Manoudis ; Luca Benetti ; Luca Onida ; Lorenzo Fontani ; Tommaso Misuri</i>                                                    |            |
| <b>QUALIFICATION OF A MODULAR LI-ION BATTERY PACK FOR LEO SATELLITES BASED<br/>ON CELLS NOT SPECIFICALLY DESIGNED FOR SPACE APPLICATIONS .....</b>                               | <b>168</b> |
| <i>Valerio Giuliani ; Stéphane Remy</i>                                                                                                                                          |            |
| <b>PPU OPTIMIZATIONS FOR A LOW POWER EPS.....</b>                                                                                                                                | <b>176</b> |
| <i>Pavlos Ramnalis ; Spiridon Savvas ; Alexandros Manoudis ; Luca Benetti ; Luca Onida ; Lorenzo Fontani ; Tommaso Misuri</i>                                                    |            |
| <b>LIFE TESTING OF COTS CELLS FOR OPTIMUM BATTERY SIZING .....</b>                                                                                                               | <b>181</b> |
| <i>Rachel Buckle</i>                                                                                                                                                             |            |
| <b>HIGH EFFICIENCY LATTICE-MATCHED 4J SPACE SOLAR CELLS ON GAAS.....</b>                                                                                                         | <b>188</b> |
| <i>Arto Aho ; Marianna Raappana ; Riku Isoaho ; Timo Aho ; Ville Polojärvi ; Antti Tukiainen ; Elina Anttola ; Severi Mäkelä ; Jarno Reuna ; Arttu Hietalahti ; Mircea Guina</i> |            |
| <b>AVERAGE CURRENT CONTROL WITH ASYMMETRICAL SAWTOOTH OR PEAK CURRENT<br/>CONTROL .....</b>                                                                                      | <b>191</b> |
| <i>Christophe Delepaut ; Hadrien Carbonnier</i>                                                                                                                                  |            |
| <b>PERFORMANCE OF SOLAR CELL GRIDS BASED ON AG, AU, AND AL FOR COST-<br/>EFFECTIVE MANUFACTURING .....</b>                                                                       | <b>199</b> |
| <i>Marianna Raappana ; Arto Aho ; Timo Aho ; Riku Isoaho ; Elina Anttola ; Ninja Kajas ; Ville Polojärvi ; Antti Tukiainen ; Mircea Guina</i>                                    |            |
| <b>DESIGN AND IMPLEMENTATION OF A COTS, GAN-BASED POWER CONVERTER FOR<br/>SPACECRAFT APPLICATIONS .....</b>                                                                      | <b>202</b> |
| <i>D Schofield</i>                                                                                                                                                               |            |
| <b>COMPACT LOW COST HIGH VOLTAGE POWER SUPPLY FOR SPACE APPLICATIONS .....</b>                                                                                                   | <b>206</b> |
| <i>Felice Forrisi ; Erik Mache ; Alan Mallmann ; Martin Blaser</i>                                                                                                               |            |
| <b>ALL-SOLID STATE BATTERIES FOR SPACE EXPLORATION.....</b>                                                                                                                      | <b>211</b> |
| <i>Alexander Beutl ; Ningxin Zhang ; Marcus Jahn ; Maria Nestoridi</i>                                                                                                           |            |
| <b>INNOVATIVE LITHIUM-ION POUCH CELL OPERATING AT LOW TEMPERATURE (-40 C):<br/>COMPARISON OF DIFFERENT CELL DESIGNS .....</b>                                                    | <b>219</b> |
| <i>Subburaj Thiruvengadam ; Filippas Farmakis ; Costas Elmasides ; Dimitris Tsiplakides ; Stella Balomenou ; Willy Brevet ; Bruno Samaniego ; Maria Nestoridi</i>                |            |
| <b>HYBRID RADIOISOTOPE-SOLAR POWER SYSTEMS AS A KEY TO SUSTAINED LUNAR<br/>EXPLORATION .....</b>                                                                                 | <b>224</b> |
| <i>Keith Stephenson ; Markus Landgraf</i>                                                                                                                                        |            |

|                                                                                                                                                                           |            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| <b>IDENTIFICATION OF COTS CELLS TO MEET SPACE MARKET SEGMENT REQUIREMENTS .....</b>                                                                                       | <b>228</b> |
| <i>Alex Clarke ; Rachel Buckle</i>                                                                                                                                        |            |
| <b>FEASIBILITY STUDY OF LOW POWER PPU WITH COTS COMPONENTS AND EGAN FETS .....</b>                                                                                        | <b>232</b> |
| <i>Alexandros Manoudis ; Spiridon Savvas ; Pavlos Ramnalis</i>                                                                                                            |            |
| <b>III-V ON SI SOLAR CELLS BEHAVIOR AT NIRT AND LILT CONDITIONS FOR SPACE APPLICATIONS .....</b>                                                                          | <b>238</b> |
| <i>Karim Medjoubi ; Romain Cariou ; Jérémie Lefevre ; Laura Vauche ; Elias Veinberg-Vidal ; Christophe Jany ; Cedric Roasting ; Vincent Amalbert ; Bruno Boizot</i>       |            |
| <b>TRANSFORMER OPTIMIZATION FOR 3D PLUS UNIVERSAL RCN FRONT END CONVERTER.....</b>                                                                                        | <b>245</b> |
| <i>Cédric Colonna ; Patrick Dubus ; Denis Labrousse</i>                                                                                                                   |            |
| <b>AVERAGE CURRENT CONTROL WITH SYMMETRICAL SAWTOOTH OR PEAK AND VALLEY CURRENT CONTROL .....</b>                                                                         | <b>253</b> |
| <i>Christophe Delepaut ; Hadrien Carbonnier</i>                                                                                                                           |            |
| <b>UHETSAT SMALL POWER SYSTEM FOR HIGH DEMANDING PAYLOADS.....</b>                                                                                                        | <b>261</b> |
| <i>A. Tambini ; F. Antonini ; N. Melega ; G. Mariotti ; V. Centonze ; A. Gabriele</i>                                                                                     |            |
| <b>REVERSE AND FORWARD MODELLING OF MULTI JUNCTION SOLAR CELLS WITH ECOSIM.....</b>                                                                                       | <b>268</b> |
| <i>José Ramón González ; Denisa Dosenovicova ; Pablo Fernández ; Carsten Baur ; Emilio Fernández ; Winfried Alius</i>                                                     |            |
| <b>MP XLR BATTERY RANGE FOR CONSTELLATION .....</b>                                                                                                                       | <b>274</b> |
| <i>Armel Vanessa ; Clemente Jacky ; Jeremy Hyvert ; Godon Aurelie ; Peres Jean Paul ; Remy Stephane ; Borthomieu Yannick</i>                                              |            |
| <b>SATELLITE'S ENERGY BALANCE, MODELLING AND SIZING TOOL WITH ECOSIMPRO .....</b>                                                                                         | <b>282</b> |
| <i>Eduardo Olmeda Diaz ; Jon Inigo Caudepon ; Sergio Alia</i>                                                                                                             |            |
| <b>AEOLUS FIRST YEAR IN ORBIT POWER SYSTEM PERFORMANCE.....</b>                                                                                                           | <b>287</b> |
| <i>Giulio Simonelli ; Christian Brandt ; Mehrdad Rezazad</i>                                                                                                              |            |
| <b>LI-S CELLS FOR SPACE APPLICATIONS (LISSA) .....</b>                                                                                                                    | <b>291</b> |
| <i>Delphine Mourembles ; Brandon Buerghler ; Laurent Gajewski ; Ashley Cooke ; Céline Barchasz</i>                                                                        |            |
| <b>PROTOTYPING AND CHARACTERIZATION OF RADIATION HARDENED SIC MOS STRUCTURES .....</b>                                                                                    | <b>296</b> |
| <i>Francesco Pintacuda ; Vincenzo Cantarella ; Michele Muschitiello ; Silvia Massetti</i>                                                                                 |            |
| <b>FIRST SPACE CONCENTRATOR PROTOTYPE USING III-V/SI CELLS.....</b>                                                                                                       | <b>304</b> |
| <i>Anderson Bermudez-Garcia ; Philippe Voarino ; Romain Cariou ; Laura Vauche ; Karim Medjoubi ; Christophe Jany ; Olivier Raccurt</i>                                    |            |
| <b>ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY FOR ONLINE SATELLITE BATTERY MONITORING USING SQUARE WAVE EXCITATION .....</b>                                                  | <b>311</b> |
| <i>Hadrien Carbonnier ; Henri Barde ; Lorenzo Riga ; Aurore Carre</i>                                                                                                     |            |
| <b>BATTERY HANDLING STRATEGY DURING ECLIPSE ON GALILEO CONSTELLATION.....</b>                                                                                             | <b>317</b> |
| <i>Ylenia Di Crescenzo</i>                                                                                                                                                |            |
| <b>EXPERIMENTAL DEMONSTRATION OF PEAK AND VALLEY CURRENT CONTROL .....</b>                                                                                                | <b>321</b> |
| <i>Hadrien Carbonnier ; Christophe Delepaut</i>                                                                                                                           |            |
| <b>SEGR AND PIGS FAILURE ANALYSIS OF SIC MOSFET .....</b>                                                                                                                 | <b>328</b> |
| <i>F. Pintacuda ; S. Massetti ; E. Vitanza ; M. Muschitiello ; V. Cantarella</i>                                                                                          |            |
| <b>TID TEST RESULTS OF RADIATION HARDENED SIC MOS STRUCTURES PRE-TEMPERATURE STRESSED .....</b>                                                                           | <b>332</b> |
| <i>F. Pintacuda ; S. Massetti ; M. Muschitiello ; V. Cantarella</i>                                                                                                       |            |
| <b>QUALIFICATION OF LOW COST TRIPLE JUNCTION GAINP/GAAS/GE SOLAR CELL ASSEMBLIES WITH EXTERNAL BYPASS DIODE CONNECTED BY INSULATED CELL P/DIODE N INTERCONNECTS .....</b> | <b>336</b> |
| <i>Giuseppe Gabetta ; Davide Cospito ; Roberta Campesato ; Mariacristina Casale ; Emilio Fernandez Lisbona</i>                                                            |            |
| <b>EFFECTIVE COATING FOR HIGH EFFICIENCY TRIPLE JUNCTION SOLAR CELLS.....</b>                                                                                             | <b>341</b> |
| <i>Roberta Campesato ; Erminio Greco ; Alessandro Mezzetti ; Fabio Di Fonzo ; Francesco Bissoli ; Alessandro Di Mezza</i>                                                 |            |
| <b>CIRCUIT PROPOSALS FOR HIGH-VOLTAGE LATCHING CURRENT LIMITERS .....</b>                                                                                                 | <b>346</b> |
| <i>D. Marroqui ; A. Garrigos ; J. M. Blanes ; R. Gutiérrez ; E. Maset</i>                                                                                                 |            |
| <b>IMPROVED POWER TRANSFORMER PERFORMANCE USING LEAKAGE INDUCTANCE SHIELDING .....</b>                                                                                    | <b>354</b> |
| <i>Tim Strous ; Giulio Simonelli</i>                                                                                                                                      |            |
| <b>1989 – 2019: THREE DECADES OF POWER SYSTEMS EVOLUTION THROUGH THE PRISM OF ESPC .....</b>                                                                              | <b>360</b> |
| <i>Henri Barde</i>                                                                                                                                                        |            |

|                                                                                                                                                                                |            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| <b>EXTERNAL PARTIAL DISCHARGE ANALYSIS IN DESIGN PROCESS OF ELECTRICAL SPACE COMPONENTS.....</b>                                                                               | <b>365</b> |
| <i>Martin T. Arentsen ; Claus L. Bak ; F. Faria Da Silva ; Søren Lorenzen</i>                                                                                                  |            |
| <b>TESTING OF THERMAL RUNAWAY TOLERANT BATTERY DESIGNS UTILIZING HIGH ENERGY DENSITY 18650 LITHIUM ION CELLS .....</b>                                                         | <b>370</b> |
| <i>Kyle Adams ; Blake Cardwell ; Joshua Fedders</i>                                                                                                                            |            |
| <b>RHRMPOLS01 POINT OF LOAD: QUALIFICATION &amp; RADIATION TESTS.....</b>                                                                                                      | <b>377</b> |
| <i>Salvatore Pappalardo ; Carmelo Ardizzone ; Orazio Principato ; Agatino Alessandro ; Ignazio Mirabella ; Ferdinando Tonicello</i>                                            |            |
| <b>DEVELOPMENT OF THE BEAST PLUS ELECTRICAL ANALYSIS SIMULATION TOOL.....</b>                                                                                                  | <b>385</b> |
| <i>Adam Harris ; Carl Thwaite</i>                                                                                                                                              |            |
| <b>DEVELOPMENT OF AN ELECTROSTATIC GROUNDING TECHNOLOGY FOR JUICE PHOTOVOLTAIC ASSEMBLY .....</b>                                                                              | <b>387</b> |
| <i>Francesco Faleg ; Pietro Zanella ; Stefano Riva ; Romano Romani ; Paolo Fidanzi</i>                                                                                         |            |
| <b>ELECTROSTATIC DISCHARGE TESTS FOR JUICE PHOTOVOLTAIC ASSEMBLY .....</b>                                                                                                     | <b>392</b> |
| <i>Francesco Faleg ; Pietro Zanella ; Stefano Riva ; Paolo Fidanzi ; Virginie Inguibert ; Gael Murat</i>                                                                       |            |
| <b>DEVELOPMENT OF HIGH POWER, HIGH VOLTAGE MAGNETIC COMPONENTS AND ENCAPSULATED INDUCTOR FOR POWER PROPULSION UNIT .....</b>                                                   | <b>397</b> |
| <i>Søren Lund Lorenzen ; Lars Gregersen ; Michael Simpson</i>                                                                                                                  |            |
| <b>THE RHRPMICL1A INTEGRATED CURRENT LIMITER: RADIATION TESTS AND HIGH VOLTAGE APPLICATION .....</b>                                                                           | <b>401</b> |
| <i>Salvatore Pappalardo ; Ignazio Mirabella ; Géraldine Chaumont</i>                                                                                                           |            |
| <b>RHPWM01 RADIATION HARDENED DUAL CHANNEL CURRENT MODE PWM.....</b>                                                                                                           | <b>409</b> |
| <i>Salvatore Pappalardo ; Carmelo Ardizzone ; Orazio Principato ; Agatino Alessandro ; Ignazio Mirabella ; Ferdinando Tonicello ; Michail Tourloukis</i>                       |            |
| <b>AM0 IRRADIANCE CONDITIONS FOR ELECTRICAL PERFORMANCE MEASUREMENTS OF TRIPLE JUNCTION CELLS AT EXTREME LOW AND HIGH TEMPERATURES .....</b>                                   | <b>417</b> |
| <i>G. Jüngst ; A. Grás ; C. Baur</i>                                                                                                                                           |            |
| <b>DESIGN OF SPACE MICROGRID FOR MANNED LUNAR BASE: SPINNING-IN TERRESTRIAL TECHNOLOGIES .....</b>                                                                             | <b>422</b> |
| <i>Angelina D. Bintoudi ; Christos Timplalexis ; Gonçalo Mendes ; Josep M. Guerrero ; Charis Demoulis</i>                                                                      |            |
| <b>CONFIGURABLE HIGH VOLTAGE POWER SUPPLY FOR FULL ELECTRIC PROPULSION SPACECRAFT .....</b>                                                                                    | <b>430</b> |
| <i>Marc Bekemans ; François Bronchart ; Thierry Scalais ; Andreas Franke</i>                                                                                                   |            |
| <b>DEVELOPMENT AND QUALIFICATION OF THE EUROSTAR NEO SOLAR ARRAY.....</b>                                                                                                      | <b>435</b> |
| <i>Claus G. Zimmermann ; Friedrich Schlerka ; Christel Nömayr ; Rainer Müller ; Helmut Nesswetter ; Andreas Übner ; Marco Gruber ; Christian Grünwald</i>                      |            |
| <b>EFFICIENT 200W LOW VOLTAGE DC/DC FOR REDUNDANT ON-BOARD PROCESSING SYSTEMS .....</b>                                                                                        | <b>440</b> |
| <i>Martin Persson ; Søren Petersen ; Bjarne Søderberg</i>                                                                                                                      |            |
| <b>ESEO POWER SYSTEM .....</b>                                                                                                                                                 | <b>445</b> |
| <i>A. Tambini ; F. Antonini ; A. De Luca ; Jozsef Szabo ; Hadrien Carbonnier ; Antal Bánfalvi ; László Csurgai-Horváth ; Zsolt Váradi</i>                                      |            |
| <b>FEF<sub>3</sub> AS A CATHODE MATERIAL IN LITHIUM ION BATTERIES WORKING IN SPACECRAFT CONDITIONS.....</b>                                                                    | <b>452</b> |
| <i>Eveillard Fabien ; Delbègue Diane ; Sougrati Moulay-Tahar ; Guérin Katia</i>                                                                                                |            |
| <b>GEO TELECOM SATELLITE STRUCTURE PRIMARY CURRENT RETURNS MAPPING ANALYSIS .....</b>                                                                                          | <b>457</b> |
| <i>Celina Desparoir-Kossiavas</i>                                                                                                                                              |            |
| <b>HIGH-ALTITUDE SPACE SOLAR CELL CALIBRATION ON SMALL BALLOONS.....</b>                                                                                                       | <b>460</b> |
| <i>David M. Wilt ; Alexander Haas ; Phillip P. Jenkins ; Justin Lorentzen ; Casey Hare ; Daniel Hernández ; Ana Gras ; Graciano Martínez ; Justin Baker ; Raymond Hoheisel</i> |            |
| <b>IMPLEMENTATION OF DOUBLE INSULATION AT SATELLITE LEVEL: AN APPROACH .....</b>                                                                                               | <b>463</b> |
| <i>Mario Buffardo ; Emiliano Scione ; Catalano Toni Fabio ; Cariani Daniele ; Ruà Emanuele Giovanni</i>                                                                        |            |
| <b>INTERNATIONAL SPACE STATION LITHIUM-ION BATTERIES FOR PRIMARY ELECTRIC POWER SYSTEM.....</b>                                                                                | <b>468</b> |
| <i>Eugene Schwanbeck ; Penni Dalton</i>                                                                                                                                        |            |
| <b>A COMPARISON BETWEEN DIFFERENT LCL ARCHITECTURES IN SPACE POWER SYSTEMS .....</b>                                                                                           | <b>469</b> |
| <i>Antonio Gabriele ; Giovanni Palmisano ; Vito Centonze ; Caterina Ciminelli</i>                                                                                              |            |
| <b>MULTIPORT ENERGY ROUTER FOR SATELLITE BASED ON HIGH-FREQUENCY TRANSFORMER.....</b>                                                                                          | <b>475</b> |
| <i>Qing Kang ; Xuan Zhang ; Jie Xing ; Feng Li ; Haiping Shi</i>                                                                                                               |            |

|                                                                                                                                                                                                                                                                  |            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| <b>POTENTIAL OF THE THREE-TERMINAL HETEROJUNCTION BIPOLAR TRANSISTOR</b>                                                                                                                                                                                         |            |
| <b>SOLAR CELL FOR SPACE APPLICATIONS .....</b>                                                                                                                                                                                                                   | <b>479</b> |
| <i>Antonio Martí ; Pablo García-Linares ; Marius Zehender ; Simon A. Svatek ; Irene Artacho ; Ana B. Cristóbal ; José R. González ; Carsten Baur ; Iñigo Ramiro ; Federica Cappelluti ; Elisa Antolín</i>                                                        |            |
| <b>PVA FACTORY 4.0: A HARDWARE-DRIVEN APPROACH TO ASSESS, DEVELOP AND QUALIFY INDUSTRY 4.0 PROCESSES AND MEANS FOR THE MANUFACTURING OF PHOTOVOLTAIC ASSEMBLIES .....</b>                                                                                        | <b>484</b> |
| <i>Elie Dawidowicz ; Christiaan Beljaars ; Frédéric Maloron ; Daniel Bouric ; Mikael Thibaudeau</i>                                                                                                                                                              |            |
| <b>RADIATION HARD FOUR-JUNCTION SPACE SOLAR CELL BASED ON GAINASP ALLOYS .....</b>                                                                                                                                                                               | <b>489</b> |
| <i>David Lackner ; Jonas Schön ; Robin Lang ; Birte-Julia Godejohann ; Felix Predan ; Michael Schachtner ; Bruno Boizot ; Jérémie Lefèvre ; Christoph Flötgen ; Joerg Schwar ; Frank Dimroth</i>                                                                 |            |
| <b>REGOLITH PACKED BED THERMAL ENERGY STORAGE FOR LUNAR NIGHT SURVIVAL .....</b>                                                                                                                                                                                 | <b>492</b> |
| <i>Sonia Fereres ; Sergio Escario ; Cristina Prieto ; Sonia De La Rosa</i>                                                                                                                                                                                       |            |
| <b>SOLAR ARRAYS THERMAL CONDITIONS AND POWER PRODUCTION MODELING WITH GPU-BASED APPROACH .....</b>                                                                                                                                                               | <b>498</b> |
| <i>Vasilij Sazonov ; Ivan Samylovskiy ; Oleg Morozov ; Arseniy Sapelkin</i>                                                                                                                                                                                      |            |
| <b>TECHNOLOGY DEMONSTRATION OF USING CUBESAT METHODOLOGIES FOR POWER CONTROL AND DISTRIBUTION IN A RADIO-ASTRONOMY INSTRUMENT WITHIN THE CHANG'E 4 MISSION .....</b>                                                                                             | <b>501</b> |
| <i>Pablo Hernandez ; Eric Bertels ; Miguel Fernandez ; Mark Ruiter ; Klaas Visser ; Marc Klein Wolt</i>                                                                                                                                                          |            |
| <b>TOWARDS VALIDATION OF BATTERY MISSION LIFETIME FOR NANO-SATELLITES: FAST, CHEAP AND ACCURATE THROUGH A REPRESENTATIVE MISSION PROFILE .....</b>                                                                                                               | <b>508</b> |
| <i>Vaclav Knap ; Lars Kjeldgaard Vestergaard ; Daniel-Ioan Stroe</i>                                                                                                                                                                                             |            |
| <b>USING GAN HFET TO REPLACE MOSFET IN DC/DC FOR SPACE APPLICATIONS .....</b>                                                                                                                                                                                    | <b>513</b> |
| <i>Michaël Notarianni ; Benoit Messant ; Paul Maynadier</i>                                                                                                                                                                                                      |            |
| <b>A POWER CONTROL AND DISTRIBUTION UNIT FOR SMALL SATELLITE PLATFORMS .....</b>                                                                                                                                                                                 | <b>516</b> |
| <i>A. Gabriele ; V. Centonze ; D. Lobifaro ; C. Attanasio ; G. Maiullari ; A. Costa</i>                                                                                                                                                                          |            |
| <b>WIDE BANDGAP COMPONENTS FOR SPACE APPLICATIONS .....</b>                                                                                                                                                                                                      | <b>523</b> |
| <i>S. K. Bernard ; O. E. Mansilla ; L. G. Pearce ; W. H. Newman ; E. J. Thomson</i>                                                                                                                                                                              |            |
| <b>A ROBUST DESIGN AGAINST FAILURE PROPAGATION OF AN ALL-IN MULTI-CHIP HYBRID DC-DC CONVERTERS CONTROLLER .....</b>                                                                                                                                              | <b>527</b> |
| <i>Franco Bigongiari ; Maurizio Bacci ; Elena Casali ; Lorenzo Fontani ; Maurizio Inversi ; Mario Migliaro ; David Levacq ; Mariel Triggianese ; Cesar Boatella Polo</i>                                                                                         |            |
| <b>ACCURATE SOLAR CELL MEASUREMENTS AT LOW TEMPERATURES USING A CRYOSTAT .....</b>                                                                                                                                                                               | <b>533</b> |
| <i>Gerald Siefer ; Elvira Fehrenbacher ; Michael Schachtner ; Alexander Wekkeli</i>                                                                                                                                                                              |            |
| <b>AN OVERVIEW OF GAN FET TECHNOLOGY, RELIABILITY, RADIATION AND MARKET FOR FUTURE SPACE APPLICATION .....</b>                                                                                                                                                   | <b>537</b> |
| <i>Marco Carbone ; Klaus Hirche ; Sébastien Morand ; Marc Marin ; Sylvain Prevot ; Alexandre Guidoin ; Nicolas Neugnot ; Mario Gomez Alonso ; Miguel Rodríguez Álvarez ; Fernando Javier Pinto Marin ; Emilio Padilla Lapeña ; Fernando Gómez-Carpintero</i>     |            |
| <b>ANALYSIS OF REQUIREMENTS FOR A MODERN PWM CONTROLLER IC FOR SPACE APPLICATIONS .....</b>                                                                                                                                                                      | <b>541</b> |
| <i>Tobias Salomon ; Volodymyr Burkhay ; Uwe Gieselmann</i>                                                                                                                                                                                                       |            |
| <b>ASSESSMENT OF PROTECTIVE COATINGS ON FLEXIBLE CIGS MODULES FOR SATELLITES .....</b>                                                                                                                                                                           | <b>545</b> |
| <i>Udayan Banik ; Nies Reininghaus ; Patric Seefeldt ; Maciej Sznajder ; Kai Gehrke ; Martin Vehse ; Peter Spietz ; Tom Sproewitz ; Carsten Agert</i>                                                                                                            |            |
| <b>BATTERIES FOR SATELLITES CONSTELLATION, USING LEAN MANUFACTURING FOR SPACE INDUSTRY .....</b>                                                                                                                                                                 | <b>550</b> |
| <i>Laurence Perino-Gallice ; Olivier Masson ; Michel Bel ; Florence Fusalba</i>                                                                                                                                                                                  |            |
| <b>CONCEPT FOR A CASCADED MULTI-MISSION RADIOISOTOPE THERMOELECTRIC GENERATOR .....</b>                                                                                                                                                                          | <b>556</b> |
| <i>Chadwick Barklay ; Daniel Kramer ; Christofer Whiting ; Richard Ambrosi ; Ramy Mesalam</i>                                                                                                                                                                    |            |
| <b>CRITICAL TECHNOLOGIES FOR Q-BAND EPCS .....</b>                                                                                                                                                                                                               | <b>561</b> |
| <i>Scherb Volker ; Nathan Adolf ; Blatt Sébastien</i>                                                                                                                                                                                                            |            |
| <b>THE EXOMARS ROVER SOLAR ARRAY ASSEMBLY .....</b>                                                                                                                                                                                                              | <b>568</b> |
| <i>Stefano Riva ; Pietro Zanella ; Romano Romani ; Raffaella Contini ; Jose Maria Arroyo ; Juan Carlos Bahillo ; Cristina Borque ; Fernando Del Campo ; Jon Laguna ; Lorenzo Serafini ; Stephen Amos ; Marco Cimino ; Gianfelice D'Accolti ; Stephen Durrant</i> |            |

|                                                                                                                                                                                                 |            |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| <b>THE JUICE PHOTOVOLTAIC ASSEMBLY - FROM PREQUALIFICATION COUPONS TO FULL-SCALE QUALIFICATION MODEL .....</b>                                                                                  | <b>573</b> |
| <i>Stefano Riva ; Francesco Faleg ; Pietro Zanella ; Paolo Fidanzati ; Laura Proserpio ; Ludovico Sora ; Ed Bongers ; Christophe Sabourin ; Arielle Chastel ; Carsten Baur ; Sam Verstaen</i>   |            |
| <b>LOW INTENSITY LOW TEMPERATURE / DARK MEASUREMENT CAMPAIGN FOR THE JUICE PHOTOVOLTAIC ASSEMBLY - FROM SOLAR CELL TO FULL-SCALE QUALIFICATION MODEL .....</b>                                  | <b>579</b> |
| <i>Stefano Riva ; Francesco Faleg ; Pietro Zanella ; Paolo Fidanzati ; Sascha Van Riesen ; Ana Gras ; Richard Schmidt ; Martin Kroon ; Ed Bongers ; Emilio Fernandez Lisbona ; Carsten Baur</i> |            |
| <b>REVISED STABILITY CRITERIA FOR CASCADED DC-DC CONVERTERS IN SPACE APPLICATIONS .....</b>                                                                                                     | <b>585</b> |
| <i>Mariel Triggianese ; Hadrien Carbonnier ; Ferdinando Tonicello</i>                                                                                                                           |            |
| <b>MAGNETIC TESTS AND ANALYSIS OF JUICE SOLAR ARRAY .....</b>                                                                                                                                   | <b>591</b> |
| <i>Martin Kroon ; Ed Bongers ; Klaus Bubeck</i>                                                                                                                                                 |            |
| <b>EFFECT OF THE CYCLIC FREEZE-THAW EXPOSURE ON THE PERFORMANCE OF PEM FUEL CELLS .....</b>                                                                                                     | <b>596</b> |
| <i>Stanislav Gorelkov ; Susanne Palecki ; Angelika Heinzel</i>                                                                                                                                  |            |
| <b>EXOMARS 2020 MISSION DESCENT MODULE &amp; ROVER BATTERIES .....</b>                                                                                                                          | <b>600</b> |
| <i>Hélène Tricot ; Paul Brochard</i>                                                                                                                                                            |            |
| <b>IMPROVED EMI NOISE PERFORMANCE BY THE REDUCED INPUT RIPPLE OF THE SATELLITE CONVERTER .....</b>                                                                                              | <b>604</b> |
| <i>Nayoung Lee ; Tae-Yoon Kim ; Ju-Young Lee ; Sang-Kyoo Han ; Tae-Jin Chung ; Jae-Dong Choi</i>                                                                                                |            |
| <b>DC-DC CONVERTER LINEARIZED MODEL .....</b>                                                                                                                                                   | <b>609</b> |
| <i>Hans Jensen</i>                                                                                                                                                                              |            |
| <b>DESIGN AND MODELING OF USEFUL TOOL FOR SATELLITE SOLAR ARRAY PRELIMINARY SIZING AND POWER SYSTEM ANALYSIS .....</b>                                                                          | <b>613</b> |
| <i>Abdelkader Hadj Dida</i>                                                                                                                                                                     |            |
| <b>Author Index</b>                                                                                                                                                                             |            |