

2017 IEEE Conference on Energy Conversion (CENCON 2017)

**Kuala Lumpur, Malaysia
30-31 October 2017**



**IEEE Catalog Number: CFP17CEO-POD
ISBN: 978-1-5386-3936-8**

**Copyright © 2017 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:	CFP17CEO-POD
ISBN (Print-On-Demand):	978-1-5386-3936-8
ISBN (Online):	978-1-5386-3935-1

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
Web: www.proceedings.com

CURRAN ASSOCIATES INC.
proceedings
.com

TECHNICAL PROGRAM

CENCON 2017

REGISTRATION

Date: 30 Oct 2017, Monday
Time: 0800-0845

KEYNOTE SESSION

Keynote Chair: **Dr Shahrin Md Ayob**
Date: **30 Oct 2017, Monday**
Time: **0845-1030**
Venue: **Seminar Room A**

0845-0900 Welcoming speech

0900-0945 Keynote Address 1
Power Electronics - The Key Technology for Renewable Energy System Integration N/A
Prof. Frede Blaabjerg; Aalborg University, Aalborg, Denmark

0945-1030 Keynote Address 2
High Altitude Wind Energy Power Generating System N/A
Prof. Sanjib Kumar Panda; National University of Singapore, Singapore

SESSION 1A Photovoltaic System 1

Session Chair: **Kermadi Mostefa**
Date: **30 Oct 2017, Monday**
Seminar Room: **Seminar Room A**

1100-1120 **1A.1**
A New Maximum Power Point Tracking Method for PV String Under Partial Shading Condition 1
Chih-Chiang Hua and Wei-Yi Kuo (National Yunlin University of Science and Technology, Taiwan)

1120-1140 **1A.2**
Modified Perturb and Observe MPPT with Zero Oscillation in Steady-State for PV Systems Under Partial Shaded Conditions 5
Chih-Chiang Hua and Yi-min Chen (National Yunlin University of Science and Technology, Taiwan)

1140-1200 **1A.3**
Binary Search Algorithm as Maximum Power Point Tracking Technique for Photovoltaic System Under Partial Shaded Conditions 10
Tiong, M.C., Daniyal, H., Sulaiman, M.H. and Bakar, M.S. (Universiti Malaysia Pahang, Malaysia)

1200-1220 **1A.4**
An Optimal Current Controller for Photovoltaic System Based Three Phase Grid Using Whales Optimization Algorithm 15
Qazi, S.H., Mustafa, M.W. and Larik, R.M. (Universiti Teknologi Malaysia, Malaysia); Soomro, S. (Mehran UET SZAB Campus, Khairpur Mir's, Pakistan)

SESSION 1B Multilevel Inverters
Session Chair: **NorJulia Mohamad Nordin**
Date: **30 Oct 2017, Monday**
Seminar Room: **Seminar Room B**

1100-1120 **1B.1**
Interconnection and Damping Assignment Passivity-Based Controller for Cascaded H-bridge Multilevel Inverter 21
Ramlan, N.H. (Universiti Malaysia Pahang, Malaysia); Azli, N.A., Jambari, H. and Nordin, N.M. (Universiti Teknologi Malaysia, Malaysia)

1120-1140 **1B.2**
Analysis of Switches Blocking Voltages in A Voltage Taps Based Cascaded Multilevel Inverter Topology 27
Mohamad, A.S. (Universiti Kuala Lumpur, Malaysia); Radzi, M.A.M., Mailah, N.F. and Othman, M.L. (Universiti Putra Malaysia, Malaysia)

1140-1200 **1B.3**
FPGA Hardware-in-loop Co-simulation for THIPWM Controlled Multilevel Inverter 32
Pandey, R., Tripathi, R.N. and Hanamoto, T. (Kyushu Institute of Technology, Japan)

SESSION 1C Power Electronic Converters 1
Session Chair: **Rahimi Baharom**
Date: **30 Oct 2017, Monday**
Seminar Room: **Seminar Room C**

1100-1120 **1C.1**
Transformerless DC Traction Power Conversion System Design for Light-Rail-Transit (LRT) 38
Chua, T.Z.Y, Ong, Y.T. and Toh, C.L. (Universiti Tenaga Nasional, Malaysia)

1120-1140 **1C.2**
A Novel Multiple-Battery Charger with Flying-Capacitor Three-Level Converter and Four-Stage Charging Method for Fast Charging 44
Chih-Chiang Hua, and Hao-Yuan Lin (National Yunlin University of Science and

Technology, Taiwan)

1120-1140 **1C.3**
Line Current Improvement of Three-phase Four-wire Vienna Rectifier Using Dead-Beat Control 49
Lee, K.B., Park, J.H. and Kwon, Y.D. (Ajou University, Korea); Kim, K.M. (Korea District Heating Corporation)

1140-1200 **1C.4**
Interleaved Boost Converter for Fuel Cell Application with Constant Voltage Technique 55
Khanipah, N.H.A., Azri, M. and Ibrahim, Z. (Universiti Teknikal Malaysia Melaka, Malaysia); Rahim, N.A. (University of Malaya, Malaysia)

SESSION 2A Energy Storage System

Session Chair: **Mohd Junaidi Abdul Aziz**

Date: **30 Oct 2017, Monday**

Seminar Room: **Seminar Room A**

1400-1420 **2A.1**
State of Charge Estimation and State Space Model Analysis of the Ni-MH Battery System 61
Alghodhaifi, H. and Hafeez, A (University of Michigan - Dearborn, USA) Sadeq, T. (University Tunku Abdul Rahman, Malaysia)

1420-1440 **2A.2**
State of Charge Estimation for Liquid Metal Battery Using Kalman Filter 67
Wang, Q., Zhang, K., Shen, C. and Zheng, L. (Hainan University, P.R. China)

1440-1500 **2A.3**
Super-capacitor and Li-polymer Battery Hybrid Energy Storage for Kinetic Energy Harvesting Applications 73
Wang, Q., Zhang, K., Shen, C. and Zheng, L. (Hainan University, P.R. China)

1500-1520 **2A.4**
Modeling and Simulation of an Energy Storage Based Multi-Machine Power System for Transient Stability Study 78
Ahsan, H., Mufti, M. and Lone, S.A. (NIT Srinagar, India); Salam, Z. (Universiti Teknologi Malaysia, Malaysia)

SESSION 2B Power Electronic Converters 2

Session Chair: **Toh Chuen Ling**

Date: **30 Oct 2017, Monday**

Seminar Room: **Seminar Room B**

1400-1420 **2B.1**
Comparison of LCL Resonant Converter with Fixed Frequency, and Variable Frequency Controllers 84

Salem, M., Jusoh, A. and Idris, N.R.N. (Universiti Teknologi Malaysia, Malaysia); Alhamrouni, I. (University Kuala Lumpur British Malaysian Institute, Malaysia)

1420-1440

2B.2

Analysis to Optimize Output Power of Energy Harvester with Boost Converter in CMOS Rectifier Circuit 90

Radzuan, R., Salleh, M.K.M. and Baharom, R. (Universiti Teknologi Mara, Malaysia)

1440-1500

2B.3

Current Control Scheme for Unbalanced Current Distribution in a Four-Phase Converter 96

Yahaya, J.A.F. and Mansor, M. (Universiti Tenaga Nasional, Malaysia)

1500-1520

2B.4

A Compact and Reliable Pulse Generator Using Dual 555-Timer IC to Produce PWM Method 100

Kasri, N.F. and Piah, M.A.M. (Universiti Teknologi Malaysia, Malaysia)

SESSION 2C**Renewable Energy 1**

Session Chair:

Mohd Zaki Daud

Date:

30 Oct 2017, Monday

Seminar Room:

Seminar Room C

1400-1420

2C.1

An Analysis of Energy Performance of A Commercial Building Using Energy Modeling 105

Hamid, M.F.A., Ramli, N.A. and Kamal, N.M.F.S.N.M. (Universiti Kuala Lumpur; International College, Malaysia)

1420-1440

2C.2

Voltage Stability Indices Studies on Optimal Location of Wind Farm in Distribution Network 111

Ismail, B., Naain M.N.M., Wahab, N.I.A., Shaberon, N.S.M. Awal L.J. and Alhamrouni, I. (University Kuala Lumpur British Malaysian Institute, Malaysia)

1440-1500

2C.3

A Modified High Output-Gain Cuk Converter Circuit Configuration for Renewable Applications - A Comprehensive Investigation 117

Oluwafemi, A.W., Ozsoy, E. and Sanjeevikumar, P. (University of Johannesburg); Fedák, V. (Technical University of Kosice, Kosice); Ramachandramurthy, V.K. (Universiti Tenaga Nasional)

1500-1520

2C.4

Analyzing the Static and Dynamic Characteristics of Wind Energy Conversion System Using Wind Turbine Simulator 123

Bhayo M.A., (Universiti Teknologi Malaysia and QUEST Nawabshah Pakistan, Malaysia); Aziz, M.J.A., Yatim, A.H.M. and Idris, N.R.N. (Universiti Teknologi Malaysia, Malaysia)

SESSION 3A Motor Drives 1

Session Chair: **Dahaman Ishak**
 Date: **30 Oct 2017, Tuesday**
 Seminar Room: **Seminar Room A**

- 1540-1600 **3A.1**
 Modified Frequency Carriers for Improving DTC with Constant Frequency Torque Controller of Induction Machines 128
Alsofyani, I.M. and Lee K.B. (Ajou University, Korea)
- 1600-1620 **3A.2**
 Adaptive Sliding Mode Control of DFIG Fed by Matrix Converter During Grid Faults 133
Alalei, A. and Hazzab, A. (Université de Bechar, Algérie); Kermadi, M. (National Polytechnic School, Algeria), Nesba, A. (Ecole Normale Supérieure de Kouba, Algiers, Algeria)
- 1620-1640 **3A.3**
 Improving Flux Regulation of DTC Induction Motor drive by Modifying the index to the FPGA-based Lookup Table 139
Ajlan, A. and Idris, N.R.N. (Universiti Teknologi Malaysia, Malaysia); Lee, S.S. (University of Southampton Malaysia Campus, Malaysia)
- 1640-1700 **3A.4**
 Sensorless PMSM Drives Using Extended Kalman Filter (EKF) 145
Termizi, M.S., Talib, M.H.N., Lazi, J.M. and Ibrahim, Z. (Universiti Teknikal Malaysia Melaka, Malaysia); Ayob, S.M. and Aziz, M.J.A. (Universiti Teknologi Malaysia, Malaysia)

SESSION 3B Z-Source Inverters

Session Chair: **Awang Jusoh**
 Date: **30 Oct 2017, Monday**
 Seminar Room: **Seminar Room B**

- 1540-1600 **3B.1**
 Modified PI-SVM for Quasi Z-Source Inverter Under Balanced Load Conditions 151
Mustafar, I., Azli, N.A., and Nordin, N.M. (Universiti Teknologi Malaysia, Malaysia)
- 1600-1620 **3B.2**
 CCM and DCM Analysis of quasi-Z-Source Inverter 157
Xuan, J.O.S., Khan, K.Y.S., Haw, L.K. and Qin, W.N.P. (Curtin University Sarawak, Malaysia); Dahidah, M. (Newcastle University, UK)
- 1620-1640 **3B.3**
 Applying of MPPT Algorithm in Z Source Inverter for PV Solar Generation 163
Teng, H.C., Zulkifli, S.A. and Shah, N.M.B. (Universiti Tun Hussein Onn Malaysia, Malaysia)

SESSION 3C Photovoltaic System 2Session Chair: **Tan Chee Wei**Date: **30 Oct 2017, Monday**Seminar Room: **Seminar Room A****1540-1600 3C.1**

Ideality Factor Estimation and Modeling of Monocrystalline PV Module 169

*Hoo, L.Y.H. and Tan, R.H.G. (UCSI University, Malaysia); Ramachandaramurthy, V.K. (Universiti Tenaga Nasional, Malaysia); Tan, C.K. (University of Malaya, Malaysia)***1600-1620 3C.2**

Comparative Study of Photovoltaic Based Power Converter Topologies for Pumping Applications 174

*Arun, S.V.K. and Umashankar, S. (VIT University, Vellore, India); Sanjeevikumar, P. and Mahajan, S.B. (University of Johannesburg, Auckland Park); Ramachandaramurthy, V.K. (Universiti Tenaga Nasional)***1620-1640 3C.3**

An Adaptive Sliding Mode Control Technique Applied in Grid-Connected PV System with Reduced Chattering Effect 180

*Kermadi, M. (National Polytechnic School, Algeria); Salam, Z. (Universiti Teknologi Malaysia, Malaysia); Berkouk, E.M. (National Polytechnic School of Algiers, Algeria)***1640-1700 3C.4**

Arc Flash Assessment on Photovoltaic Grid Connected System 186

*Yahaya, J.A.F. (Universiti Tenaga Nasional, Malaysia); Mansor, M. (Universiti Tenaga Nasioanal, Malaysia)***SESSION 4A Smart Grid and Energy Storage**Session Chair: **Prof Dr Mairaj ud-din Mufti**Date: **31 Oct 2017, Tuesday**Seminar Room: **Seminar Room A****0900-0920 4A.1**

Information Flows and Optimization for an Holistic Industrial Energy Management 190

*Graus, M., Nienke, S., Schuh, G. and Stich, V. (FIR an der RWTH Aachen, Germany)***0920-0940 4A.2**

Hybrid Energy Storage System for Life Cycle Improvement 196

*Jamahori H.F. and Rahman, H.A. (Universiti Teknologi Malaysia (UTM), Malaysia)***0940-1000 4A.3**

Optimal Placement of TCSC in Transmission Network Using Sensitivity Based Method for Multi Objectives Optimization 201

Bakar, N.A. and Desa, M.K.M. (Universiti Sains Malaysia (USM), Malaysia)

SESSION 4B Renewable Energy 2Session Chair: **Naziha Ahmad Azli**Date: **31 Oct 2017, Tuesday**Seminar Room: **Seminar Room B**

0900-0920

4B.1

A Review on Two Different Systems in Municipal Sewage Treatment Plant 207
Ramli, N.A. and Hamid, M.F.A. (Universiti Kuala Lumpur & International College, Malaysia)

0920-0940

4B.2

A Day-Ahead Generation Scheduling with Demand Response Considering Thermal Cycling Ramp 212
Tan, W.S. and Abdullah, M.P. (Universiti Teknologi Malaysia, Malaysia); Shaaban, M. (Universiti Malaysia Sarawak, Malaysia)

0940-1000

4B.3

A Novel Switched-Inductor Configuration for Modified SEPIC DC-to-DC Converter for Renewable Energy Applications 218
Pandav, K.M. and Sanjeevikumar, P. (University of Johannesburg); Blaabjerg, F. (Aalborg University, Denmark); Fedák, V. (Technical University of Kosice, Kosice); Siano, P. (University of Salerno); Ramachandaramurthy, V.K. (Universiti Tenaga Nasional)

1000-1020

4B.4

In-situ Fast Thermal Detection Method for Large-Scale Photovoltaic Field Under Shading Conditions 224
Shareef, H., Omer, Z.M. and Zareer, M.N. (United Arab Emirates University, United Arab Emirates)

SESSION 4C Motor Drives 2Session Chair: **Gobbi Ramasamy**Date: **31 Oct 2017, Tuesday**Seminar Room: **Seminar Room C**

0900-0920

4C.1

Multiobjective Design of Permanent Magnet Synchronous Machines Based on Analytical Sub-Domain Particle Swarm Optimization 230
Rezal, M. (UniKL MSI, Malaysia); Ishak, D. (Universiti Sains Malaysia, Malaysia); Salah, W.A. (Palestine Technical University - Kadoorie, Palestine)

0920-0940

4C.2

Verification of Actual Mechanical Losses on the Rotor of Induction Machine 236
Veg, L., Laksar, J. and Sobra, J. (University of West Bohemia, Faculty of Electrical Engineering, Czech Republic)

- 0940-1000 **4C.3**
A New Potential Balancing Control Strategy of NPC Inverter for DTC Fed Induction Motor N/A
Azlan, N.A.N., Jidin, A., Jidin, A.Z., Azri, M., Khanipah, N.H.A. and Tarusan, S.A.A. (Universiti Teknikal Malaysia Melaka, Malaysia)

SESSION 5A High Voltage Engineering

Session Chair: **Nor Hidayah Rahim**

Date: **31 Oct 2017, Tuesday**

Seminar Room: **Seminar Room A**

- 1040-1100 **5A.1**
Factors and Models of Pollution Flashover on High Voltage Outdoor Insulators: Review 241
Salem, A.A., Rahman, R.A., Kamarudin, M.S. and Othman, N.A. (University Tun Hussien Onn Malaysia, Malaysia)
- 1100-1120 **5A.2**
Effects of SiO₂ and ZrO₂ on the AC Breakdown Performance of Polyethylene 247
Rahim, N.H. and Mohamad, N (Universiti Teknikal Malaysia Melaka, Malaysia); Lau, K.Y and Rahman W.A.W.A. (Universiti Teknologi Malaysia, Malaysia); Muhamad, N.A. (Universiti Sains Malaysia, Malaysia)
- 1100-1120 **5A.3**
The Effect of Non-Isothermal Crystallization on the AC Breakdown Performance of Polyethylene/Silicon Dioxide Nanocomposites 251
Kamarudin, H., Lau, K.Y and Rahman, W.A.W.A. (Universiti Teknologi Malaysia, Malaysia)
- 1120-1140 **5A.4**
Transformer Insulation Diagnosis Using Hybrid Artificial Intelligence-Modified Particle Swarm Optimisation 255
Illias, H.A. and Chai, X.R. (University of Malaya, Malaysia)

SESSION 5B Inverters

Session Chair: **Shamsul Aizam Zulkifli**

Date: **31 Oct 2017, Tuesday**

Seminar Room: **Seminar Room B**

- 1040-1100 **5B.1**
Real Time Implementation of Space Vector Pulse Width Modulation for Three Level Neutral Point Clamped (NPC) Inverter using Arduino DUE Board 259
Kherroubi, Z.E.A. (Renault SAS, France), Kermadi, M. and Berkouk, E.M. (National Polytechnic School of Algiers, Algeria), Salam, Z. (Universiti Teknologi Malaysia, Malaysia)

- 1100-1120 **5B.2**
Capacitor Voltage Balancing in Switch-Sharing-Based Multilevel Inverter with PI Controller 265
Ramli, Z., Jamaludin. J. and Rahim, N.A. (University Malaya, Malaysia)
- 1120-1140 **5B.3**
Simplified Reference Signal Generator Equation for Single Phase Grid-Tied Photovoltaic Inverters 271
Nor Syafawati Ahmad, Teng-Way Tsai and Yaow-Ming Chen (National Taiwan University, Taipei, Taiwan); Yung-Ruei Chang (Institute of Nuclear Energy Research, Taoyuan, Taiwan)
- 1140-1200 **5B.4**
Multi-loop Control Strategies of Three-phase Two-level Current Source Inverter for Grid Interfacing Photovoltaic System 277
Azmi, S.A., Tajuddin, M.F.N., Mohamed M.F. and Hwai, L.J. (Universiti Malaysia Perlis, Malaysia)
- 1200-1220 **5B.5**
A Hybrid Multilevel Inverter with Reduced Power Electronic Components with Unipolar Trapezoidal Pulse Width Modulation 283
Prabaharan, N. (Madanapalle Institute of Technology and Science, India); Salam, Z. (Universiti Teknologi Malaysia, Malaysia); Palanisamy, K. (VIT University, India)
- SESSION 5C DC-DC Converters 1**
Session Chair: **Mohd Rodhi Sahid**
Date: **31 Oct 2017, Tuesday**
Seminar Room: **Seminar Room C**
- 1040-1100 **5C.1**
A Two-Stage Bidirectional DC/DC Converter with SiC-MOSFET for Vehicle-to-Grid (V2G) Application 288
Park, J.H. and Lee K.B. (Ajou University, South Korea)
- 1100-1120 **5C.2**
Analysis of High Voltage Gain Hybrid DC-DC Converters with RBFN Based MPPT for Renewable Photovoltaic Application 294
Kumar. K, Tiwari, R. and Babu. N.R. (VIT University, Vellore, India); Sanjeevikumar, P. and Bhaskar M.S. (University of Johannesburg, Auckland); Ramachandaramurthy, V.K. (Universiti Tenaga Nasional)
- 1120-1140 **5C.3**
A High Gain Modified SEPIC DC-to-DC Boost Converter for Renewable Energy Application 300
Maroti, P.K., Sanjeevikumar, P. and Bhaskar, M.S. (University of Johannesburg); Blaabjerg, F. (Aalborg University, Denmark); Siano, P. (University of Salerno); Fedák, V. (Technical University of Kosice, Kosice); Ramachandaramurthy, V.K. (Universiti Tenaga Nasional)
- 1140-1200 **5C.4**
A DC-DC Buck Converter with Maximum Power Point Tracking Implementation for Photovoltaic Module Application 305

Altamimi, A. and Khan, Z.A. (University of Birmingham, United Kingdom)

- 1200-1220 **5C.5**
 Multistage Switched Inductor Boost Converter for Renewable Energy Application 311
Maroti, P.K., Sanjeevikumar, P. and Bhaskar, M.S. (University of Johannesburg);
Blaabjerg, F. (Aalborg University, Denmark); Ramachandaramurthy, V.K. (Universiti
Tenaga Nasional); Siano, P. (University of Salerno); Fedák, V. (Technical University
of Kosice, Kosice)

SESSION 6A DC-DC Converters 2

Session Chair: **Nik Din**

Date: **31 Oct 2017, Tuesday**

Seminar Room: **Seminar Room A**

- 1400-1420 **6A.1**
 Modified SEPIC DC-to-DC Boost Converter with High Output-Gain Configuration for Renewable Applications 317
Muranda, C., Ozsoy, E. and Sanjeevikumar, P. (University of Johannesburg); Fedák, V. (Technical University of Kosice, Kosice); Ramachandaramurthy, V.K. (Universiti
Tenaga Nasional)

- 1420-1440 **6A.2**
 A Novel 2L-Y DC-DC Converter Topologies for High Conversion Ratio Renewable Application 323
Maroti, P.K., Sanjeevikumar, P. and Bhaskar, M.S. (University of Johannesburg);
Blaabjerg, F. (Aalborg University, Denmark); Ramachandaramurthy, V.K. (Universiti
Tenaga Nasional); Siano, P. (University of Salerno); Fedák, V. (Technical University
of Kosice, Kosice)

- 1440-1500 **6A.3**
 Phase-shifted Series Resonant DC-DC Converter for Wide Load Variations Using Variable Frequency Control 329
Salem, M., Jusoh, A., Idris, N.R.N. and Tan, C.W. (Universiti Teknologi Malaysia, Malaysia)

SESSION 6B Power Electronics Converters 3

Session Chair: **Kyo Beum Lee**

Date: **31 Oct 2017, Tuesday**

Seminar Room: **Seminar Room C**

- 1400-1420 **6B.1**
 Comparison of Two and Four Switches Inverter Feeding Series Resonant Converter 334
Alhamrouni, I. (Universiti Kuala Lumpur, Malaysia); Jusoh, A., Idris, N.R.N. and
Salem, M. (Universiti Teknologi Malaysia, Malaysia)

- 1420-1440 **6B.2**
 Active Cell Balancing Circuit with AC-Link Technique Based on Current-Fed-Push-

Pull Converter 339

Wei-Yang Lim and Chih-Chiang Hua (National Yunlin University of Science and Technology, Taiwan)

1440-1500

6B.3

DigSILENT Modelling of a Three-phase Four-leg Power Converter Using a Triangular Carrier Wave 343

Kamil, H.S., Said, D.M., Mustafa, M.W., Miveh, M.R., Rosmin, N. and Ahmad, N. (Universiti Teknologi Malaysia, Malaysia)

1500-1520

6B.4

Output Voltage Control of Dual Input Single Ended Primary Inductor Converter (SEPIC) for Hybrid Photovoltaic- Piezoelectric System 349

Yong, H.Y., Rusli, N.I. and Tajuddin, M.F.N. (Universiti Malaysia Perlis, Malaysia)