

IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT

A PUBLICATION OF THE IEEE INSTRUMENTATION AND MEASUREMENT SOCIETY



JUNE 2017

VOLUME 66

NUMBER 6

IEIMAO

(ISSN 0018-9456)

SPECIAL SECTION ON THE CONFERENCE ON PRECISION ELECTROMAGNETIC MEASUREMENTS (CPEM) 2016

GUEST EDITORIAL

Special Section on the Conference on Precision Electromagnetic Measurements (CPEM) 2016	
..... <i>B. Djokić, B. Ghohroodi-Ghamsari, F. Piquemal, and D. Allal</i>	1080

SPECIAL SECTION PAPERS

A/D and D/A Conversion, Analog and Digital Instrumentation

A Novel TDM-Based High-Precision Wattmeter	<i>L. D. Jovanović</i>	1083
Keysight 3458A Noise Performance in DCV Sampling Mode	<i>R. Lapuh, B. Voljć, M. Lindić, and O. F. O. Kieler</i>	1089

Controls and Control Systems Instrumentation and Measurement

Application of Robust Control to a Cryogenic Current Comparator		
..... <i>M. E. Bierzychudek, M. Götz, R. S. Sánchez-Peña, R. Iuzzolino, and D. Drung</i>		1095

Instrumentation for Measurement of Electric Power Systems, Energy Metering, Electric Power Quality

Modified Step-Up Method for Calibration of DC High-Voltage Dividers	<i>K.-T. Kim, J. K. Jung, K. M. Yu, Y. B. Kim, and Y. S. Song</i>	1103
Improvement of Agilent 3458A Performances in Wideband Complex Transfer Function Measurement	<i>G. Crotti, D. Giordano, M. Luiso, and P. Pescetto</i>	1108
Application of Ellipse Fitting Algorithm in Incoherent Sampling Measurements of Complex Ratio of AC Voltages	<i>J. Augustyn and M. Kampik</i>	1117
A Calibration Setup for IEC 61850-9-2 Devices	<i>M. Agostoni and A. Mortara</i>	1124
Traceability of No-Load Loss Measurements of High-Voltage Transmission Lines	<i>E. So and R. Arseneau</i>	1131
Asynchronous Phase Comparator for Characterization of Devices for PMUs Calibrator	<i>B. Trinchera, D. Serazio, and U. Pogliano</i>	1139
Frequency Response of MV Voltage Transformer Under Actual Waveforms	<i>G. Crotti, D. Gallo, D. Giordano, C. Landi, M. Luiso, and M. Modarres</i>	1146
A Novel Approach to Noninvasive Measurement of Overhead Line Impedance Parameters	<i>D. Ritzmann, J. Rens, P. S. Wright, W. Holderbaum, and B. Potter</i>	1155
A Novel Modular Positive-Sequence Synchrophasor Estimation Algorithm for PMUs	<i>F. Messina, P. Marchi, L. Rey Vega, C. G. Galarza, and H. Laiz</i>	1164
Multiple-Site Amplitude and Phase Measurements of Harmonics for Analysis of Harmonic Propagation on Bornholm Island	<i>P. S. Wright, A. E. Christensen, P. N. Davis, and T. Lippert</i>	1176
A Computer-Controlled Calibrator for Instrument Transformer Test Sets	<i>S. Siegenthaler and C. Mester</i>	1184

(Contents Continued on Page 1077)



Measurement of Materials and Applications	
New Permittivity Measurement Methods Using Resonant Phenomena For High-Permittivity Materials	Y. Kato and M. Horibe 1191
Improvement of Transmission/Reflection Method for Permittivity Measurement Using Long Fixtures With Time-Domain Analysis Approach	Y. Kato and M. Horibe 1201
Medical and Biomedical Instrumentation and Applications	
Experimental Setup to Compare Measurements and Numerical Simulations in Magnetic Resonance Imaging RF Dosimetry	U. Zanovello, M. Borsero, D. Giordano, Luca Zilberti, F. Maggiorelli, and G. Tiberi 1208
Measurement Techniques	
Further Investigation for Piecewise Sampling to Overcome Transient Effect of Staircase Waveform	Z. Lu, Y. Yang, L. Huang, L. Wang, X. Pan, J. Zhang, and E. So 1217
Nonlinearity Testing of Capacitance Bridges Using Programmable Capacitors	Y. Yu, A. D. Koffman, and Y. Wang 1227
A New Generation of Multijunction Thermal Current Converters	T. E. Lipe 1232
Experimental Demonstration of Current Dependence Evaluation of Voltage Divider Based on Quantized Hall Resistance Voltage Divider	A. Domae, T. Oe, S. Kiryu, and N.-H. Kaneko 1237
Precise Measurement of Inhomogeneity of 2-D System by Six-Point Method	K. Szymański and P. Zaleski 1243
Study of Contact Resistance in Connectors With Physical Simulation Using Nanofabrication	Y. Fukuyama, N. Sakamoto, T. Kondo, M. Onuma, and N.-H. Kaneko 1248
Expansion of the Impedance and Frequency Measurement Ranges of AC Shunt Resistors	S. Kon and T. Yamada 1254
Identification and Correction of Artifact in the Measurement of Pulsed Magnetic Fields	L. Giaccone, D. Giordano, and G. Crotti 1260
Metrology, Standards and Calibration	
<i>Fundamental Constants</i>	
Realization of the Kilogram Based on the Planck Constant at NMIJ	N. Kuramoto, L. Zhang, S. Mizushima, K. Fujita, Y. Azuma, A. Kurokawa, and K. Fujii 1267
Mass Measurement of ²⁸ Si-Enriched Spheres at NMIJ for the Determination of the Avogadro Constant	S. Mizushima, N. Kuramoto, L. Zhang, and K. Fujii 1275
Surface Layer Analysis of a ²⁸ Si-Enriched Sphere Both in Vacuum and in Air by Ellipsometry	K. Fujita, N. Kuramoto, Y. Azuma, S. Mizushima, and K. Fujii 1283
Designing Model and Optimization of the Permanent Magnet for Joule Balance NIM-2	Q. You, J. Xu, Z. Li, and S. Li 1289
Thickness Measurement of Oxide and Carbonaceous Layers on a ²⁸ Si Sphere by XPS	L. Zhang, N. Kuramoto, Y. Azuma, A. Kurokawa, and K. Fujii 1297
Uniformity Evaluation of Lattice Spacing of ²⁸ Si Single Crystals	A. Waseda, H. Fujimoto, X. W. Zhang, N. Kuramoto, and K. Fujii 1304
A Five-Freedom Active Damping and Alignment Device Used in the Joule Balance	J. Xu, Q. You, Z. Zhang, Z. Li, and S. Li 1309
Gravity Measurement for the KRISS Watt Balance	I.-M. Choi, K.-C. Lee, S. Lee, D. Kim, and H.-Y. Lee 1317
Measuring the Boltzmann's Constant Using Superconducting Integrated Circuit	C. Urano, T. Yamada, M. Maetzawa, K. Yamazawa, and N.-H. Kaneko 1323
The Design and Construction of the Joule Balance NIM-2	Z. Li, Z. Zhang, Y. Lu, P. Hu, Y. Liu, J. Xu, Y. Bai, T. Zeng, G. Wang, Q. You, C. Li, S. Li, K. Wang, Q. He, and J. Tan 1329
<i>Time and Frequency</i>	
Multiple Access Interference Suppression for TWSTFT Applications	Y.-J. Huang, H.-W. Tsao, H.-T. Lin, and C.-S. Liao 1337
Drift-Compensated Low-Noise Frequency Synthesis Based on a cryoCSO for the KRISS-F1	M.-S. Heo, S. E. Park, W.-K. Lee, S.-B. Lee, H.-G. Hong, T. Y. Kwon, C. Y. Park, D.-H. Yu, G. Santarelli, A. P. Hilton, A. N. Luiten, and J. G. Hartnett 1343
Operating Atomic Fountain Clock Using Robust DBR Laser: Short-Term Stability Analysis	S. Lee, M.-S. Heo, T. Y. Kwon, H.-G. Hong, S.-B. Lee, A. P. Hilton, A. N. Luiten, J. G. Hartnett, and S. E. Park 1349
<i>Voltage</i>	
Digital Sampling Setup for Measurement of Complex Voltage Ratio	S. Mašláň, M. Štra, V. N. Zachovalová, and J. Streit 1355
Extension of AC–DC Transfer Standards From 100 Down to 2 mV Using RVDs	H. Fujiki and Y. Amagai 1364
Calculable AC Voltage Standards for 10 kHz-1 MHz Frequency Range	M. Grzenik and M. Kampik 1372
Comparison of a Planar Thin-Film Thermal AC Voltage Standard up to 1 MHz	M. Kampik, M. Grzenik, T. Lippert, and B. Trinchera 1379
A Precision Microvolt-Synthesizer Based on a Pulse-Driven Josephson Voltage Standard	R. Behr, O. Kieler, and B. Schumacher 1385
AC–DC Calibrations With a Pulse-Driven AC Josephson Voltage Standard Operated in a Small Cryostat	H. E. van den Brom, O. F. O. Kieler, S. Bauer, and E. Houtzager 1391
Digital Phase Standard of High Accuracy Up To the Megahertz Range	W. G. Kürten Ihlenfeld 1397

Voltage Ratio Traceability of 10 kV Low-Voltage Excited Two-Stage Voltage Transformer	H. Zhang, H. Shao, J. Wang, W. Wang, F. Lin, T. Sun, W. Zhao, C. Li, and Y. Wu	1405
<i>Current</i>		
AC–DC Current Transfer Standards Suitable for Use Below 1 mA and up to 1 MHz	T. Funck and T. Spiegel	1411
New Generation of Low-Frequency Current Comparators Operated at Room Temperature	A. Satrapinski, M. Götz, E. Pesel, N. Fletcher, P. Gournay, and B. Rolland	1417
Ultrastable Low-Noise Current Amplifiers With Extended Range and Improved Accuracy	D. Drung and C. Krause	1425
An AC Current Transformer Standard Measuring System for Power Frequencies	E. Mohns, G. Roeissle, S. Fricke, and F. Pauling	1433
<i>Power</i>		
Precision Measurement System for the Calibration of Phasor Measurement Units	D. Georgakopoulos and S. Quigg	1441
An Electronic Load to Verify Harmonic Emission Compliance	P. N. Davis and P. S. Wright	1446
<i>Resistance</i>		
AC–DC Disk Resistors Made of Surface Mount Components	T. Funck and T. Spiegel	1454
AC Quantum Hall Effect in Epitaxial Graphene	F. Lüönd, C.-C. Kalmbach, F. Overney, J. Schurr, B. Jeanneret, A. Müller, M. Kruskopf, K. Pierz, and F. Ahlers	1459
Stability and Performance of the Binary Compensation Unit for Cryogenic Current Comparator Bridges	M. Götz and D. Drung	1467
Development of 1 M Ω Quantum Hall Array Resistance Standards	T. Oe, S. Gorwadkar, T. Itatani, and N.-H. Kaneko	1475
Development of 1 Ω and 10 Ω Metal-Foil Standard Resistors	N.-H. Kaneko, T. Oe, T. Abe, M. Kumagai, and M. Zama	1482
Preparation and Characterization of Sn-BSTS Topological Insulator for Universality Test of the Quantum Hall Effect	T. Misawa, Y. Fukuyama, Y. Okazaki, S. Nakamura, N. Nasaka, T. Sasagawa, and N.-H. Kaneko	1489
<i>Impedance</i>		
A Three-Arm Current Comparator Digitally Assisted Bridge for the Comparison of Arbitrary Four Terminal-Pair Impedances	M. Ortolano, V. D’Elia, and L. Callegaro	1496
Evaluation of a Continuously Variable Calculable Capacitor	Y. Wang, Y. Yu, and J. R. Pratt	1503
Bilateral International Inductance Comparison Using Traveling Standards in Thermoregulated Enclosures	T. Funck, H. Bothe, A. Kölling, A. Satrapinski, and E.-P. Suomalainen	1511
Calibration of an LCR-Meter at Arbitrary Phase Angles Using a Fully Automated Impedance Simulator	F. Overney and B. Jeanneret	1516
Evaluation of Atypical-Ratio Wideband Voltage Dividers With Consideration for Impedance Mismatches	T. Yamada, S. Kon, and N. Sakamoto	1524
A New Calibration Transformer and Measurement Setup for Bridge Standard Calibrations Up To 5 kHz	M. F. Beug, A. Kölling, and H. Moser	1531
A Josephson Impedance Bridge Based on Programmable Josephson Voltage Standards	T. Hagen, L. Palafox, and R. Behr	1539
A Digital Five-Terminal Impedance Bridge	W. G. Kürten Ihlenfeld and R. T. de Barros e Vasconcellos	1546
Coaxial and Digital Impedance Bridges for Capacitance Measurements at the nF Range	R. T. de Barros e Vasconcellos, V. R. de Lima, W. G. Kürten Ihlenfeld, and F. da Silveira	1553
Evaluation of Automatic Coaxial Mechanical Scanners for Precise Resistance and Capacitance Measurements	T. Oe, A. Domae, N. Sakamoto, and N.-H. Kaneko	1560
Coaxial Connector Conversion Method for Traceable Scattering Parameter Measurement	R. Kishikawa, S. Nakamura, K. Sato, and M. Horibe	1566
A Programmable Capacitor for Inductance Measurements	B. Waltrip and F. Seifert	1572
Optical Instrumentation, Measurement and Systems		
A Six-Axis Heterodyne Interferometer System for the Joule Balance	Y. Bai, P. Hu, Y. Lu, Z. Li, Z. Zhang, and J. Tan	1579
RF, Microwave, Millimeter Wave and Tera-Hertz		
Calibration of a Terahertz Attenuator by a DC Power Substitution Method	H. Iida, M. Kinoshita, and K. Amemiya	1586
Electromagnetic Field Sensor Based on Atomic Candle	M. Kinoshita and M. Ishii	1592
V-Band Waveguide Microcalorimeter for Millimeter-Wave Power Standards	J.-Y. Kwon, T.-W. Kang, and N.-W. Kang	1598
Measurement Uncertainty Model for Vector Network Analyzers With Frequency Extension Modules at Terahertz Frequencies	M. Horibe	1605
Characterization of High-Speed Balanced Photodetectors	P. Struszewski, M. Bieler, D. Humphreys, H. Bao, M. Peccianti, and A. Pasquazi	1613
Development of S-Parameter Calibration System for Type-N, 75- Ω Connector Below 12 GHz	M. Horibe and R. Kishikawa	1621

REGULAR PAPERS

Metrology, Standards and Calibration

Current

A Comparison of Two Current Transformer Calibration Systems at NRC Canada	1628
..... <i>B. V. Djokić, H. Parks, N. Wise, D. Naumović-Vuković, S. P. Škundrić, A. D. Žigić, and V. Polužanski</i>	
Improvements in the Performance of a Calibration System for Rogowski Coils at High Pulsed Currents	1636
..... <i>B. V. Djokić</i>	
