

Progress Report on Electricity and Magnetism Activities

at National Institute of Standards (NIS), Egypt

To the 32nd meeting of the Consultative Committee for Electricity and Magnetism (CCEM), 14-15 April 2021 (Online)

Prof. Dr. Mohammed Helmy Abd El-Raouf

Head of Electrical Quantities Metrology Department, Vice Chair of AFRIMETS TCEM

mohammed.helmy@nis.sci.eg

In this report, a brief description of NIS activities and research development in the field of electricity and magnetism during the period from March 2019 to March 2021 is presented.

1. Published CMCs

In January, February, March and April 2021, the following CMCs have been published on the BIPM_KCDB website:

https://kcdb.bipm.org/appendixC/country_list_search.asp?CountSelected=EG&type=EM

Quantity	Instrument or Artifact	Measurand	Uncertainty	Approval Date
DC Current: Intermediate values	Multi-function calibrator	(1E-04 to 1) A	[1.3E+01 to 2.6e+01] μ A/A (Relative)	2021-01-04
DC voltage (up to 1100 V), DC voltage meters: intermediate values	Digital Multi-meter	(0.1 to 1000) V	[9.4 to 4.4E+04] μ V (Absolute)	2021-01-04
DC resistance	Digital Multi-meter	(100 to 10000) Ω	[1.2E+01 to 9E+02] m Ω (Absolute)	2021-01-08
DC current meters: intermediate values	Digital Multi-meter	(0.01 to 1) A	[5 to 6.1E+02] μ A (Absolute)	2021-02-18
DC Voltage: Intermediate Values	DC voltage sources	[100, 1000] V	[2.4E-05, 2.9E-05] V (Absolute)	2021-02-18
DC Voltage: Intermediate Values	DC voltage sources	(0.01 to 10) V	[1.1E-05, 3.2E-05] V (Absolute)	2021-02-18
AC Voltage, V: meters	Digital Multi-meter	(0.1 to 700) V	[9.7E+01 to 5.8E+05] μ V (Absolute)	2021-03-18
AC/DC transfer difference at lower voltage	AC/DC Transfer Standard	10 mV	41 μ V/V (Relative)	2021-03-18
AC Current, A: meters	Digital Multi-meter	(0.01 to 1) A 40 Hz and 1 kHz	[2.1E+01 to 1.5E+03] μ A (Absolute)	2021-04-05

Scattering parameters (vectors): transmission coefficient (S_{ij}) in coaxial, magnitude (absolute value)	3 dB, 20 dB Fixed attenuators (50-ohm, Type N)	[3.0, 20.0] dB	[0.074, 0.076] dB (Absolute)	2021-02-13
Reflection coefficient (S_{ii}) in coaxial line (values in linear terms: magnitude)	passive device: (50 Ohm, Type N)	[0.0, 1.0] (dimensionless)	[0.006, 0.028] (dimensionless) (Absolute)	2021-03-18

2. Submitted CMCs

Quantity	Instrument or Artifact	Measurand	Uncertainty
AC/DC transfer difference at medium voltage	AC/DC Transfer Standard	3 V	[6.0 to 3.6E+01] $\mu\text{V/V}$ (Relative)
AC/DC transfer difference at Higher voltage	AC/DC Transfer Standard	1000 V	[1.0E+01 to 1.8E+01] $\mu\text{V/V}$ (Relative)
AC power and energy: single phase (frequency \leq 400 Hz), active energy	Energy meter	10 Wh	[3.7E1, 4.8E1] $\mu\text{Wh (Vah)}^{-1}$ (Relative)
AC power and energy: single phase (frequency \leq 400 Hz), Active Power	Power Meter	[6, 600] W	[3.6E1, 4.6E1] $\mu\text{W/VA}$ (Relative)

3. Comparisons

- 3.1 Comparison in calibration of Digital Multimeter (DMM) AFRIMETS.EM-S2, measurements are going on.
- 3.2 Draft B of AFRIMETS.EM-S1 supplementary comparison, resistance standards at 1 Ω , 10 Ω , 100 Ω , 1 k Ω and 10 k Ω , is under review by the Chair of the CCEM-WGLF.
- 3.3 Draft B of Gulfmet_EM-S3 Comparison in calibration of AC-DC Voltage Transfer, had been finished.
- 3.4 Final Report on COOMET Key Comparison of Power, COOMET.EM-K5, had been finished.
- 3.5 Final Report of the Bi-Lateral Comparison of 50/60 Hz Energy, SIM.EM-S14, had been finished.

4. Projects

Final Report for 15RPT01 RF Microwave project, "Development of RF and microwave metrology capability", has been issued and published on the EURAMET site, in June 2019. Through this project 3 comparisons were arranged:

- Final report of the comparison of Type N Reflection coefficient (S-parameter comparison) had been finished and published on the EURAMET site.
 - Final report of the comparison of calibration factor of power sensors and thermistor had been finished and published on the EURAMET site.
 - Final report of the comparison of Voltage reflection coefficient (VRC) of an RF source had been finished and published on the EURAMET site.
- Comparison in Effective efficiency of type N thermistor mount arranged by EURAMET, measurement was sent on October 2019.

5. Ongoing Comparisons with the AFRIMETS

NIS is contributing in the following comparisons plan that were approved by the AFRIMETS TCEM:

Year	Identifier	Description	Participants	Pilot	Status
2021	AFRIMETS.EM-S1	DC resistance at 1 Ω , 10 Ω , 100 Ω , 1 k Ω and 10 k Ω	NMISA, LPEE/LNM, DEF-NAT, KEBS, NIS, UNBS, NMIE	NMISA	under review by the Chair of the CCEM-WGLF
2020	AFRIMETS.EM-S2	ACV: 200 mV, 200 V @ 40 Hz and 1 kHz. ACI: 100 mA, 1 A @ 40 Hz and 1 kHz. DCI: 10 mA and 1 A. DCV: 100 V and 1000 V Artefact: 6 ½ DMM	NMISA, LPEE/LNM, DEF-NAT, KEBS, NIS, UNBS, NMIE, SON-NMI, SIRDC-NMI	NIS	Measurements are going on

6. Research Activities

There are many research activities in the field of electricity and magnetism at NIS. Some of them are listed in the following sections:

6.1 Low Frequency Impedance

1. Heba A. M. Hamed, A. Eliwa Gad, and M. Helmy A. Raouf, "New proposed method for traceability dissemination of capacitance measurements", International Journal of Electrical and Computer Engineering (IJECE), Vol. 11, No. 3, PP. 1969 - 1975, June 2021.
2. A. Eliwa Gad, M. Helmy A. Raouf, and A. A. Ammar, "Fabrication and Performance Verification of a New Programmable Inductive Voltage Divider", International Journal of Advanced Science and Technology, Vol. 29, No. 6, PP. 9387 - 9400, June 2020.

6.2 AC/DC Voltage and Current

1. Rasha S. M. Ali, and M. Helmy A. Raouf, "New Method for Measurement of AC Voltages above 1V using TVC and Voltage Divider", MAPAN-Journal of Metrology Society of India, Vol. 34, No. 2, PP. 267-271, June 2019.

6.3 Resistance

1. Rasha S. M. Ali, and M. Helmy A. Raouf, "Automated Hamon Transfer Standard for High Resistance Traceability in the Range from 100 M Ω to 10 G Ω ", International Journal of Scientific & Engineering Research, Vol. 10, Issue 4, PP. 114-119, April 2019.
2. Rasha S. M. Ali, and M. Helmy A. Raouf, "Verification of the Main Ratios of the 6010C Automatic Bridge Used for Resistance Measurement", MAPAN-Journal of Metrology Society of India, Vol. 34, No. 1, PP. 49-53, March 2019.

6.4 High Voltage

1. Hala M. Abdel Mageed, Adel S. Nada, Salama Abu-Zaid, R. S. Salah Eldeen, "Effects of Waveforms Distortion for Household Appliances on Power Quality," MAPAN-Journal of Metrology Society of India, Vol. 34, No. 4, 2019, pp. 559-572.
2. Hala M. Abdel Mageed, and Rehab sherif, " Adapted Technique for Calibrating Voltage Dividers of AC High Voltage Measuring Systems," MAPAN-Journal of Metrology Society of India, Vol. 35, No. 1, 2020, pp. 11-17.
3. Hala M. Abdel Mageed, W. El Maguid Ahmed, S. Mohamed, and A. A. Saleh, "Validation of an Improved Optimization Technique for Photovoltaic Modeling," MAPAN-Journal of Metrology Society of India, Vol. 35, No. 3, 2020, pp. 365-376.

7. Improved Measurement Capabilities

1. New Impedance Analyzer, E4990A Impedance Analyzer- 120MHz.
2. New Instruments for EMC on electricity meters according to IEC 62052-11:2020.