

Progress Report on the CCEM Related Laboratories at TUBITAK UME**(Feb. 2013 – Feb. 2015)****1. RF & MICROWAVE LABORATORY****New Facilities/Developments:**

Establishment of Microcalorimeter System for Egypt Metrology Institute (NIS):

In the scope of the project, twin type microcalorimeter with N type (working frequency range is 10 MHz -18 GHz) connector is producing.

EMRP/EMPIR Project:

The EURAMET project namely "Implementation New Kelvin" was started in October 2012. The responsibility of the laboratory is to develop and characterize the microwave transmission lines and microwave probes. The first generation of transmission lines were completed successfully in 2013. Now we are working on the second generation transmission line for INRIM cavity. The second generation transmission line is going to be adapted for INRIM system.

Comparisons:

- "CCEM.RF-K5c.CL Scattering coefficients by broad band methods 100 MHz – 33 GHz – 3.5 mm connector" comparison. Measurements were performed at UME in May 2014.
- "CIPM Key Comparison CCEM-RF-K26 (CCEM GT-RF/13-18) Attenuation at 18 GHz, 26.5 GHz and 40 GHz using a step attenuator". Measurements will be done in November 2015 at UME.

SCI Papers and Proceedings:

1. M. Celep, Ş. Yaran, C. Hayırlı, A. Dolma, "Development of radiometer operating between 50 MHz and 26.5 GHz using gain-stabilized LNA", Turk. J. Elec. Eng. & Comp. Sci., in press.
2. M. Celep and H. Sakarya, "Design and test of gas tight microwave transmission lines for resonance frequency measurements with cavity resonators up to 830 K", CPEM 2014 Conference, pp. 170-171, Brasil, August 2014.
3. M. Celep, C. Hayırlı, Ş. Yaran, H. Sakarya and A. Dolma "Realization of Low Power Measurement System in the Range of -60 dBm – -120 dBm up to 26.5 GHz", CPEM 2014 Conference, pp. 172-173, Brasil, August 2014.
4. A. Kartal Doğan, M. Celep, S. Ogan, "Dipole Antenna Construction and characterization for SAR Measurements", Pamukkale Univ. Eng Sci, 20 (8), pp. 310-313, 2014 (in Turkish).
5. M. Celep, Ş. Yaran, C. Hayırlı, H. Sakarya, "Interlaboratory Comparison of Microwave Power Measurement Using Type N Coaxial Line", 19th IMEKO TC 4 Symposium, Barcelona, Spain, July 18-19, 2013.
6. M. Celep, Ş. Yaran, C. Hayırlı, A. Dolma, "Establishment and testing total power radiometer in the range of 50 MHz – 26,5 GHz", EMO Scientific Issue, Vol 3, No 5, pp. 7-15, June 2013 (in Turkish).

7. M. Celep, H. Sakarya, Ö. Tuncel, "Design and characterization adaptor for LISN calibration", EMC 2013 2nd National Electromagnetic Compatibility Conference, Işık Univ., İstanbul, 9-11 September 2013 (in Turkish).

2. IMPEDANCE LABORATORY

New Facilities/Developments:

Impedance Laboratory has developed reference ultra low DC current source for one of the company in Turkey. Device current range is between 1 fA and 100 pA. The DC current stability at 1 fA current is order of 0,3 mA/A. The working principle of the device developed at Impedance Laboratory is based on application of a ramp voltage on the capacitors with values of 1, 10, 100 and 1000 pF. The device has a relay card which can automatically select the appropriate capacitors without affecting the loss factor of capacitors. The device is fully automated with a computer. The capacitance standards are kept in temperature controlled box. One month temperature stability of the standards is better than 10 mK.

Laboratory has developed and manufactured several inductive voltage dividers for LNE and METAS and several DC current shunts for Saudi National Metrology Institute.

EMRP/EMPIR Project:

UME Impedance Laboratory has participated SIB53 AIM QuTE "Automated Impedance Metrology Extending the Toolbox for Electricity" Project. Impedance Laboratory of UME has been designed and constructed temperature controlled impedance standards for the Project. The measurement results showed that temperature stability of the standards better than 1 mK level. Impedance Laboratory has been constructed six machined housings for passive impedance standards whose phase values close to minus and plus 30° and 60°.

Comparisons:

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SCI Papers and Proceedings:

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3. VOLTAGE LABORATORY

New Facilities/Developments:

Developing AC Quantum Voltmeter is in progress. System is based on PTB programmable chip and commercial electronics. Currently, we are focused on design of the cryprobe and control software.

New ac-dc current shunts from 10 mA to 10 A based on squirrel cage design are under construction.

A low thermal voltage divider for calibration of DC voltmeters below 100 mV is constructed. Short time stability of the divider is less than 1 ppm/h, the total voltage dependence is less than 3 ppm for inputs less than 10 V and the thermal drift is less than 10 nV/(h/°C).

Software for calibration of high precision multimeters is prepared (Fluke 8508A, Keysight 3458A)

EMRP/EMPIR Project:

SIB59 Q-Wave "A quantum standard for sampled electrical measurements", in progress.

JRP- r01 "ACQ PRO_Towards the propagation of ac quantum voltage standards" is proposed, it will start in June 2015

SCI Papers and Proceedings:

8. T. C. Öztürk, J. Kohlmann, O. Kieler, T. Möhring, R. Behr, H. Çaycı, M. Arifoviç, S. Turhan, L.D. Ata, "Error Analysis In Waveforms Synthesized With A Combined Josephson System for AC Component Characterization", CPEM 2014 ,Brazil Rio De Jenairo

Additional:

TÜBİTAK UME has been accredited by Turkish Accreditation Agency (TÜRKAK), which is a signatory of ILAC MRA, since 2006. TÜBİTAK UME successfully passed the surveillance and re-accreditation assessments conducted in 2013 and 2014 respectively, covering the fields of voltage, current, resistance, impedance, electrical power/energy, high voltage and RF & microwave in electricity and magnetism.

TÜBİTAK UME expert contributed the revision of the EURAMET Calibration Guide "CG-15 Calibration of digital multimeters" as a member of the working group.

TÜBİTAK UME organized a workshop on "Comparison on calibration of multimeter" within the framework of the activities of the EURAMET Focus Group on Facilitating National Metrology Infrastructure Development (FG-FNMID) Action 3.4: Comparison on Digital Multimeters on December 8-9, 2014. 14 experts from 6 NMIs (Croatia, Albania, Kosovo, Montenegro, Macedonia and Bosnia and Herzegovina) were participated to the workshop which was held in TÜBİTAK UME in Gebze, Turkey.

TÜBİTAK UME experts took a part in the CMC review of EURAMET.EM.12.2014 as a reviewer for the service category of DC voltage and capacitance.

Comparisons:

- EURAMET.EM.BIPM-K10.b for EM/DC voltage. The parameter will be 10 Volt DC.
- EURAMET Project 1341for EM/DC voltage, DC current, AC Voltage, AC current and Resistance. The parameters will be DC voltage: 100 mV, 10 V, 100 V, 1000 V, DC current: 100 μ A, 10 mA, 1 A
AC Voltage: 100 mV, 10 V, 100 V (55 Hz, 1 kHz, 100 kHz), AC Current: 10 mA, 1 A (300 Hz, 1 kHz) and Resistance:10 Ω , 10 k Ω , 1 M Ω (planned)
- EURAMET.EM-K12 for EM/AC current. The parameters will be Current: 10 mA and 5 A, Frequency: 10 Hz, 55 Hz, 1 kHz, 10 kHz, 20 kHz, 50 kHz and 100 kHz.

4. ELECTROMAGNETIC (EMC) LABORATORY

New Facilities/Developments:

A screened chamber has been changed into a semi-anechoic chamber by covering the internal walls with tile and foam absorbers in order to facilitate military radiated emission measurements at 1 m.

A reverberation chamber has been installed and the acceptance measurements will be completed within this year. The reverberation chamber will be utilized for high-level radiated immunity tests beyond 200 MHz.

EMRP/EMPIR Project:

EMRP IND60 EMC project: The main target of the project is the improvement and development of alternative EMC test methods for the industry and establishment of the links between the industry and laboratory.

Comparisons:

EURAMET Supplementary Comparison EURAMET.EM.RF-S27 Antenna factor for Loop Antennas

SCI Papers and Proceedings:

9. S.Cakir, O. Sen, M.Cinar, M. Cetintas, "Alternative Conducted Emission Measurements for Industry", EMC Europe 2014, Gothenburg, Sweden, pp. 1037-1042, 1-4 September 2014.
10. S.Cakir, O. Sen, M. Cinar, A. Ayaydin, M. Cetintas, F. Ustuner, "Effects of Sensor Positions on Military Radiated Susceptibility Tests", CPEM 2014, Rio De Janeiro, pp. 584-585, 24-29 August 2014.
11. M. Cetintas, S.Cakir, O. Sen, M. Cinar, F. Ustuner, "Loop Antenna Pattern Measurement", CPEM 2014, Rio De Janeiro, pp. 192-193, 24-29 August 2014.

5. POWER & ENERGY LABORATORY

New Facilities/Developments:

- Transient current and electromagnetic interference analysis on the high speed trains.
- Design of zero-flux current transformers and study on the precise detection of error currents.
- Study on a new calibration method for electronically-compensated isolation current transformers and development of a calibrator.
- Design of a reference low voltage voltmeter to use in the reference radiation thermometer.
- Design and characterization of Electromagnetic Partial Discharge Sensors for Power Transformers.
- Analysis of electromagnetic characteristics of the air-gap magnetic cores and using them for the design of current transformer burdens.
- Analysis of electromagnetic influences on the ac high voltage resistive dividers and design of appropriate shielding.
- Development of a test set for the testing of electronic current transformers (LPCTs).
- Development of a test set for the testing of electronic voltage transformers (resistive dividers).
- Development of a transconductance amplifier for the testing of electronic current transformers.
- Development of a voltage amplifier for the testing of electronic voltage transformers.
- Development of a calibration method for on-site calibration of power loss measurement systems.
- Development of a calibrator for on-site calibration of energy analyzers.

EMRP/EMPIR Projects:

- ENG04 Smart Grid (Metrology for Smart Electrical Grids): A project team member attended to the Workshop in June in Netherlands. Project has just been finalised and nowadays final reports are being prepared.
- S05 Q-Wave (A Quantum Standard for Sampled Electrical Measurements): Laboratory is working on the design of wide-band amplifier by examining CFA type amplifiers with Spice analysis.
- IND60 EMC (Improved EMC Test Methods in Industrial Environments): Laboratory is working on the development of alternative test methods for power quality parameters.
- ENG61 FutureGrids (Non-Conventional Voltage and Current Sensors for Future Power Grids): Laboratory is responsible for the development of high precision Rogowski Coils (RCs), high precision voltage to current transducers and step-up and step-down voltage transformers.
- ENG63 GridSens (Sensor Network Metrology for the Determination of Electrical Grid Characteristics): Laboratory liaising with a Turkish grid operator is responsible for providing topology information and data from sensors installed on the distribution grids and obtaining actual smart meter data for state estimation algorithms.

Comparisons:

- EURAMET Project 1187: Comparison of Instrument Current Transformers up to 10kA.
- 3 National Comparisons on power & energy measurements since 2013.
- 4 National Comparisons on instrument current & voltage transformers measurements since 2013.

Additional:

- "Design of multi-stage electronically-compensated current transformer and burden sets for ENPAY-Magnetic Core Manufacturer", 2013
- "Automation in calibration of reference energy meters for TEIAS-Turkish Electricity Transmission Company", 2013-2014
- "Development of Electronically-compensated Isolation Current Transformers (ICTs) for KEDS-Kosovo Electricity Distribution Company", 2014
- "Design of Energy Analyzer Calibrators for TEIAS-Turkish Electricity Transmission Company". 2014-2015
- "Design of Power & Energy Measurement Standards for SASO-Metrology Institute of Saudi Arabia", 2014-2016
- "Robust Design of High Precision Instrument Current and Voltage Transformers and Kombi Sensors", National Support Programme for Cooperation Between Universities and Industry (1505), project no: 5130048, 2014-2015.

Extending Capabilities:

- Calibration of Current Transformers up to 10kA.
- Calibration of Electronic Current Transformers with analog outputs: Rogowski, LPCT
- Calibration of Electronic Voltage Transformers: Resistive and Capacitive Voltage Dividers with the output voltages in mV level and few Volts.

SCI Papers and Proceedings:

12. H.Cayci, "Designing Precise Current Comparators and Their Application to Electrical Metrology", ISH2013, August 25-30, 2013, Seoul, Korea
13. K.Gulnihar, H. Cayci, M. Ugur, "Design of Electromagnetic Partial Discharge Sensors for Power Transformers", ISH2013, August 25-30, 2013, Seoul, Korea
14. Hüseyin Çaycı, "Reliability of Electricity Meters And Traceability in Measurements: A Case Study", ICSG 2014, Istanbul, Turkey, 8-9 May 2014
15. Özlem Yılmaz, Gökmen Hasancebi, Hüseyin ÇAYCI, "State Estimation in Smart Electrical Grids", ICSG 2014, Istanbul, Turkey, 8-9 May 2014
16. Hüseyin Çaycı, "A Simple Method for the Measurement of Instrument Current Transformer Burdens", Conference on Precision Electromagnetic Measurements (CPEM), Rio de Janeiro, Brazil, 24-29 August 2014

6. HIGH VOLTAGE LABORATORY

New Facilities/Developments:

Designed and constructed a 200kV AC high voltage measuring system for a cable manufacturer in 2013. These measuring system is used for as a reference divider for AC high voltage calibrations and AC high voltage tests with a low measurement uncertainty. Measuring system, consisting of a 200kV high voltage divider, 6.5 digit multimeter, software, computer and measuring cable.

Also, designed and constructed a reference Partial Discharge Calibrator in 2014. These reference partial discharge calibrator is used for calibration of partial discharge detectors which are measure the dielectric materials partial discharge level. Many electromechanical manufacturers use commercial PD Calibrators in their laboratories. But they are not completely compatible with standards. After all, constructed reference PD detector completely compatible with IEC 60270.

Developed two reference software about AC High Voltage and DC High Voltage measurements in 2014. These softwares base on Agilent VEE programming language. With these software measuring devices can make the measurements precisely and with out human error.

EMRP/EMPIR Project:

Worked an EMRP Project in 2013. The EMRP Project completed in three years. The topic of the EMRP project is about designing of a modular wideband HVDC reference divider with a ratio uncertainty of less than 0.005 % at 1000 kV. The divider has a maximum nominal voltage of 1000 kV when five 200 kV modules are stacked on top of each other. The divider is used for traceable calibration of HVDC measuring systems in customers laboratories.

Comparisons:

- In 2013 TÜBİTAK-UME High Voltage Laboratory participate two international comparison. The international comparison about AC High Voltage measurement and second international

comparison about C/Tand measurement. Tübitak-UME High Voltage Laboratory has completed the comparisons successfully.

- In addition Tübitak-UME High Voltage Laboratory organized a national comparison for Transformer manufacturer in 2014. Tübitak-UME High Voltage Laboratory organized the comparison successfully and prepared the final report.

SCI Papers and Proceedings:

17. J. Hallström, A. Bergman, S. Dedeoglu, A.P. Elg, E. Houtzager, T. Klüss, T. Lehtonen, W. Lucas, J. Meisner, A. Merev, M. Schmidt, E.P. Suomalainen, T. Nieminen and C. Weber, "Performance of a Modular Wideband HVDC Reference Divider for Voltages up to 1000 kV", accepted for publication in IEEE Transaction of Instrumentation and Measurements.
18. A. Merev and J. Hallström, "A Reference System for Measuring High-DC Voltage Based on Voltage References", IEEE Transaction of Instrumentation and Measurements, Vol. 64, Issue 1, pp. 184-189, Jan. 2015.
19. J. Hallström, A. Bergman, S. Dedeoglu, A.P. Elg, E. Houtzager, W. Lucas, A. Merev, M. Meisner, J. Schmidt, E.P. Suomalainen and C. Weber, "Performance of a Wideband 200 kV HVDC Reference Divider", IEEE Transaction of Instrumentation and Measurements, Vol. 63, Issue 9, pp. 2264-2270, Sept. 2014.
20. A. Merev, "Evaluation of the Performance of Portable New Design High DC Voltage Measuring System up to 40 kV", MAPAN-Journal of Metrology Society of India, Vol. 29, Issue 3, pp. 157-161, Sept 2014.
21. A. Merev, S. Dedeoğlu and K. Gülnihar, "Erratum to: Evaluation of the Performance of Portable New Design High DC Voltage Measuring System up to 40 kV", MAPAN-Journal of Metrology Society of India, Vol. 29, Issue 3, pp. 163, Sept 2014.
22. A. Merev and J. Hallström, "Evaluation of Long-Term Stability of HVDC Measuring System Based on Bandgap References", 2014-CPEM (Conference on Precision Electromagnetic Measurements), pp. 376-377, August 24-29, 2014, Rio De Janeiro, Brasil.
23. J. Hallström, A. Bergman, S. Dedeoglu, A.P. Elg, E. Houtzager, T. Lehtonen, T. Klüss, W. Lucas, A. Merev, T. Nieminen, J. Meisner, E.P. Suomalainen, M. Schmidt, and C. Weber, "Performance of a modular wideband 1000 kV HVDC reference divider", 2014-CPEM (Conference on Precision Electromagnetic Measurements), pp. 782-783, August 24-29, 2014, Rio De Janeiro, Brasil.
24. J. Hallström, A. Bergman, S. Dedeoglu, A.P. Elg, E. Houtzager, T. Klüss, T. Lehtonen, W. Lucas, A. Merev, J. Meisner, T. Nieminen, E.P. Suomalainen, S. Svensson and C. Weber, "New references for HVDC metering" Proceedings of 2014 Cigre Session, SC A3 High Voltage Equipment, A3_106_2014, 24-29 August 2014, Paris.
25. A. Merev, A. Bergman, S. Dedeoglu, A.P. Elg, J. Hallström, E. Houtzager, W. Lucas, J. Meisner, M. Schmidt, E.P. Suomalainen and C. Weber, "Construction of a 200 kV HVDC Reference Divider", 2nd International Istanbul Smart Grid Congress and Fair, 8-9 May 2014, Istanbul, Türkiye.
26. DEDEOGLU, S., YILMAZ, S., "Design and implementation of a programmable high voltage impulse measurement system", Turkish Journal of Electrical Engineering & Computer Sciences Paper No:doi:10.3906/elk-1205-82, 17.January.2014
27. J. Hallström, A. Bergman, S. Dedeoglu, A.P. Elg, J. Klüss, T. Lehtonen, W. Lucas, A. Merev, J. Meisner, E.P. Suomalainen and C. Weber, "Design and Performance of a Wideband 200 kV HVDC Modular Reference Divider", 18th. International Symposium on High Voltage Engineering (ISH 2013), Seoul, Korea, 25-30 August, 2013.

Additional:

In 2013 Tübitak-UME High Voltage Laboratory joined the international electrical expert group of CIGRE.

In addition, Tübitak-UME High Voltage Laboratory is a member and administrator of TC42 and MTC144 mirror committee.

7. MAGNETIC LABORATORY

New Facilities/Developments:

- **Measurement of ultra low magnetic fields by construction of fluxgate magnetometer:** This project involves construction of fluxgate magnetometer having dynamic range from 1 nT to 0.5 Oe (50000 nT) with random noise value of $1\text{pT}/\sqrt{\text{Hz}}$ at 1 Hz. This project also includes synthesis of soft magnetic alloys with high permeabilities about which collaboration exist between UME and SAS (Slovakian Academy of Science).
- **Synthesis and characterization of microwave absorbers:** In this Project, microwave absorbers have been synthesized using magnetic and dielectric materials. Microwave characterization have been done in 0- 26.5 GHz range. Several absorbers having different reflection losses at various resonance frequencies have been developed.

EMRP/EMPIR Project:

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Comparisons:

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SCI Papers and Proceedings:

28. Amir, M., Baykal, A., Güner, S., Sertkol, M., Sözeri, H., Toprak, M.
Synthesis and Characterization of $\text{Co}_x\text{Zn}_{1-x}\text{AlFeO}_4$ Nanoparticles
(2014) Journal of Inorganic and Organometallic Polymers and Materials, 8 p. Article in Press.
29. Amir, M., Baykal, A., Sertkol, M., Sözeri, H.
Microwave Assisted Synthesis and Characterization of $\text{Co}_x\text{Zn}_{1-x}\text{Cr}_{0.5}\text{Fe}_{0.5}\text{O}_4$ Nanoparticles
(2014) Journal of Inorganic and Organometallic Polymers and Materials, 8 p. Article in Press.
30. Mehmedi, Z., Sözeri, H., Topal, U., Baykal, A.
Effect of Annealing Temperature and Boron Addition on Magnetic Properties of Hexaferrites Synthesized by Standard Ceramic Method (2014) Journal of Superconductivity and Novel Magnetism, 10 p. Article in Press.
31. Genç, F., Ünal, B., Baykal, A., Sözeri, H.
Electrical Properties of Mn-Doped $\text{Ni}_x\text{Zn}_{0.9-x}\text{Fe}_2\text{O}_4$ Particles
(2014) Journal of Superconductivity and Novel Magnetism, 10 p. Article in Press.
32. Genç, F., Turhan, E., Kavas, H., Topal, U., Baykal, A., Sözeri, H.

Magnetic and Microwave Absorption Properties of $\text{Ni}_x\text{Zn}_{0.9-x}\text{Mn}_{0.1}\text{Fe}_2\text{O}_4$ Prepared by Boron Addition, (2014) Journal of Superconductivity and Novel Magnetism, . Article in Press.

33. Shafiu, S., Baykal, A., Sözeri, H., Toprak, M.S.
Triethanolamine Assisted Hydrothermal Synthesis of Superparamagnetic Co_3O_4 Nanoparticles and Their Characterizations, (2014) Journal of Superconductivity and Novel Magnetism, . Article in Press.
34. Kurtan, U., Esir, S., Baykal, A., Sözeri, H.
Poly(amidoamine)-Grafted Superparamagnetic Iron Oxide Nanoparticles: Synthesis and Characterization, (2014) Journal of Superconductivity and Novel Magnetism, . Article in Press. Cited 1 time.
35. Demir, A., Baykal, A., Sözeri, H., Topkaya, R.
Low temperature magnetic investigation of Fe_3O_4 nanoparticles filled into multiwalled carbon nanotubes, (2014) Synthetic Metals, 187 (1), pp. 75-80. Cited 3 times.
36. Kervan, S., Kervan, N., Sözeri, H.
Magnetic properties of $\text{Pr}_{3-x}\text{Gd}_x\text{Co}_{11}\text{B}_4$ borides, (2014) Journal of Magnetism and Magnetic Materials, 354, pp. 17-20.
37. Esir, S., Baykal, A., Sözeri, H.
Polyol Synthesis of $\text{Fe}_3\text{O}_4@$ Tween20 Nanocomposite in Vaseline Oil
(2014) Journal of Superconductivity and Novel Magnetism, 27 (12), pp. 2835-2839.
38. Alp, U., Yılmaz, F., Uzun, O., Topal, U., Ergen, S., Kölemen, U.
Mechanical Characterization of Ruthenocuprates by Nanoindentation Technique
2014) Journal of Superconductivity and Novel Magnetism, 5 p. Article in Press.
39. Gülce Çoker, E., Kölemen, U., Topal, U.
Physical and Mechanical Properties of B_2O_3 doped YBaCuO Superconductors: Applicability as a Low DC Magnetometer, (2014) Journal of Superconductivity and Novel Magnetism, 6 p. Article in Press.
40. Topal, U., Coker, E.G., Alikma, F., Kölemen, U., Uzun, O.
The role of weak links and Zn-doping on magnetic parameters of high- T_c superconductors
2014) Journal of Superconductivity and Novel Magnetism, 27 (1), pp. 133-141.
41. Topal U., Sözeri H.
A Novel Design of Fluxgate Magnetometer: An Insect like Configuration, (2014) Journal of Superconductivity and Novel Magnetism, 28 (2), pp. 711-714.
42. Topal, U.
Design and performance analysis of three superconducting magnetic sensors for the measurement of small fields (2013) Measurement Science and Technology, 24 (10), art. no. 105110, Cited 1 time.
43. Alikma, F., Topal, U.
Magnetometer design for measuring ultralow DC magnetic fields using $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ superconductors, (2013) Journal of Superconductivity and Novel Magnetism, 26 (4), pp. 1155-1158.

44. Topal, U., Alikma, F., Coker, E.G.
Measuring DC Fields as Low as 0.5 nT by Using Bi-2223 Polycrystalline Superconductors
(2012) Journal of Superconductivity and Novel Magnetism, pp. 1-5. Article in Press.

Notice 1.

UME Watt Balance Project

- In the first quarter of 2014, a Watt Balance project was initiated within the UME.
- The project is officially started in July 2014 and planned to perform final measurements within 2018.
- Moving magnet - static coil concept. Significant reduction of the overall system complexity.
- Simultaneous implementation of weighing and moving. Less sensitive to changes in magnetic field and alignment when compared to a two-phase watt balance systems.
- Oscillatory dynamical mode offers the potential, compared to the constant velocity mode, of faster measurement, improved noise rejection, smaller magnet movements (oscillating amplitudes) and hence a simple magnet designs.

Notice 2.

- In the CMC review of EURAMET.EM.9.2013, the number of CMCs entries of TÜBİTAK UME in EM field was reduced from 188 to 119 by using 52 matrices of uncertainties.
- The number of approved and published CMCs of TÜBİTAK UME in EM field is 119 with 52 matrixes in the BIPM KCDB.
- The number of CMCs entries of TÜBİTAK UME in the CMC review of EURAMET.EM.12.2014 is given below:
 - New : 4 Matrix: 37
 - Improved : 21 Matrix: 5
 - Minor changes : 13 Matrix: 3
 - Deleted : 0 Matrix: 23

Notice 3.

The laboratories except High Voltage and Magnetic have established the turn-key primary calibration systems for Saudi Arabia Metrology Institute (SASO/NMCC).