

News from TÜBİTAK UME

CCEM 2019

NEW FACILITIES/DEVELOPMENTS:

Voltage Laboratory (Contact: mehedin.arifovic@tubitak.gov.tr)

10 V Programmable Josephson Voltage Standard established recently is compared to the conventional JVS of TÜBİTAK UME. It is also used for testing linearity of the high precision Voltmeters and for dynamic ADC testing. Work on the construction of the system operated in Cryocooler is continuing. Project on establishing Josephson Arbitrary Waveform Synthesizer (JAWS) is started. In the scope of the project the probe is constructed. Wideband resistive voltage divider is constructed and tested. This divider will be used for extending traceability of AC voltage to AC Quantum Voltage standards up to 1000 V at 100 kHz. EMPIR 14RPT01, EMPIR 15SIB04 and EMPIR 17RPT03 projects have been continued.

Impedance Laboratory (Contact: enis.turhan@tubitak.gov.tr)

2TP Digital Impedance Bridge: A 2TP digital impedance comparison bridge has been developed. 4 TP digital impedance comparison bridge project has started in the scope of EMPIR 17RPT04 VersICaL project. EMPIR 15SIB08 and EMPIR 17RPT04 have been continued.

High Voltage Laboratory (Contact: ahmet.merev@tubitak.gov.tr)

The projects of establishment of primer lightning and switching impulse measuring and reference partial discharge measuring system supported by TÜBİTAK UME have been finalized successfully. The new research project about the expansion of the frequency range of the AC high voltage measurement system in TÜBİTAK UME supported by internally budget has been started. Laboratory has continued to EMPIR 15NRM02.

Power & Energy Laboratory (Contact: ozlem.yilmaz@tubitak.gov.tr)

High current and high voltage measurement capabilities were re-classified based on the measured transformer types as conventional and non-conventional current and voltage transformers. These minor changes in CMCs were approved through the EURAMET.EM.15.2018. In parallel, TURKAK laboratory accreditation assessment was held and these editorial changes were also approved. Harmonic current and voltage measurement capabilities together with flicker measurements were re-classified according to new category in CMCs. These new capabilities were approved through the TURKAK accreditation assessment. And, inter-RMO reviews of EURAMET.EM.15.2018 has just finished. A new project was started to build up a reference calibration system for high voltage instrument transformers. Some benefits of the project will be: traceability to national standards, extension of measurement range and improving existing uncertainties in ratio and phase error measurements. EMPIR 15RPT04, EMPIR 17NRM01 and EMPIR 17IND07 have been continued.

RF & Microwave Laboratory (Contact: murat.celep@tubitak.gov.tr) Establishment of airline measurement system for 7 mm, Type N, 3.5 mm, 2.92 mm and 2.4 mm connector types is completed. Calibration factor measurement range capability is expanded to 50 GHz frequency. EMPIR 15RPT01, EMPIR 16NRM07 and EMPIR 18SIB09 have been continued.

Electromagnetic Laboratory (Contact: soydan.cakir@tubitak.gov.tr)

A three loop antenna calibration system that covers the frequency range of 30 Hz to 30 MHz was established including a software solution and verified through comparison with existing loop antenna calibration methods. The uncertainty value of three loop antenna calibration results was calculated as less than 1 dB. A high field (up to 10 kV/m) electric field probe calibration system for 50 Hz and 60 Hz was successfully designed, constructed and verified in order to calibrate electric field probes which are used to measure electric fields emitted by high voltage power lines and transformer stations. Laboratory has continued to EMPIR 15RPT01 with together with RF& MW laboratory.

Magnetism Laboratory (Contact: husevin.sozeri@tubitak.gov.tr)

International project, between TÜBİTAK UME and Slovakia Academy of Science (SAS) on the preparation of soft magnetic alloys used in magnetic sensors has started. EMPIR project proposal by INRIM “JRP-h13 Radiotherapy coupled with hyperthermia - adapting the biological equivalent dose concept” was selecting for funding. TÜBİTAK UME takes a part in WP1 about preparation and characterization of magnetic nanoparticles. Research on functional magnetic nanoparticles is continued, 16 SCI-index papers were published. Laboratory has continued to EMPIR 15SIB06.

Quantum Metrology Laboratory (Contact: ekrem.sinir@tubitak.gov.tr)

Establishment of the laboratory infrastructure of the Quantum Metrology Laboratory is in progress. UME Quantum Metrology laboratory have been designed to be active in fundamental research as well as having fabrication and measurement capabilities for the quantum SI standards. The laboratory is expected to be active in several areas including superconducting electronics and solid state qubits; Quantum charge and spin transport in semiconductor nanostructures, III-V based high speed devices for electronics and communication; Nanomagnetism and spintronics.

The infrastructure of the laboratory can be divided into three categories:

- a) Thin film and epitaxial growth
- b) Fabrication and lithographic patterning
- c) Electrical characterization

The laboratory will have state of the art cleanroom for nanofabrication and characterization rooms for ultra-sensitive electrical measurements. Construction process of a new building (2400 m²) dedicated to quantum research at UME has started. The new building with a 700 m² cleanroom, space for several dilution fridges and other cryostats is being constructed.

Some of the interests as well as fabrication and measurement capabilities of UME Quantum Metrology Laboratory shall include but not limited to:

1. Quantum Transport Division: DC and AC resistance standards (Quantum Hall Effect); semiconductor quantum dot and quantum wire thermometers for temperature standards (i.e. new Kelvin), Integer and Fractional Quantum Hall effect, many body interactions in 2-DEGs, charge and spin based transport in GaAs/AlGaAs structures, InAs based single electron devices, semiconducting charge and spin qubits, quantum transport in one (nanowires) and two dimensional (2-DEGs) nanostructures, quantum adiabatic transport.

2. Superconducting Electronics Division: DC Voltage standards (Josephson junctions), AC Josephson devices, temperature standards (Coulomb blockade thermometers), solid state qubits (i.e. charge, flux and transmon), superconducting bolometers and detectors for radio astronomy and space applications, nano-SQUID sensors, design and cryogenic measurements of readout circuits for superconducting devices and detectors (i.e. R/SFQ)
3. Semiconductor Electronics division: High speed and/or low power III-V devices for electronics and optoelectronics applications. Epitaxial III-V materials and nanostructures.
4. Nanomagnetism and Spintronics Division: Spin waves and magnonics, spin torque oscillators and devices, AMR/GMR/TMR and Hall sensors, Magnetic tunnel junctions, Magnetic memory devices, domain walls, skyrmions, magnetic vortices, wide band FMR, on-chip magnetic devices for DC and RF/microwave electronics (i.e. filters), spintronics for bioelectronics applications and sensors.

No	Type of ILC/PT	Field/subfield	Pilot lab	Identification of ILC/PT	Parameters/ range of measurements	Status	Evaluation criterion	Result
1.	CIPM key comparison	EM/Radio frequencies	NMIJ	CCEM.RF-K5.c.CL	Scattering coefficients 100 MHz – 33 GHz 3.5 mm connector	In progress	degrees of equivalence	-
2.	CIPM key comparison	EM/Radio frequencies	NMIJ	CCEM.RF-K26	Attenuation at 18 GHz, 26.5 GHz and 40 GHz using a step attenuator	In progress	degrees of equivalence	-
3.	EURAMET supplementary comparison	EM/High AC current and current transformers	CMI	EURAMET.EM-S37	Primary current: 4 kA, 5 kA, 6 kA, 8 kA, 10 kA; secondary current: 5 A; class: 0.05; nominal burden: 15 VA resistive	Draft B	degrees of equivalence	Passed
4.	EURAMET supplementary comparison	EM/High voltage and current: Lightning impulse voltage	LCOE, VTT, RISE	EURAMET.EM-S42	Lightning impulse: 0.84/50 μ s and 1.56/50 μ s. Lightning impulse voltage (peak) -100 kV, -200 kV, -300 kV, -400 kV, -500 kV, -600 kV, -700 kV and +700 kV. Linear extension in 500 kV steps up to 2 MV.	In progress of preparing the report	degrees of equivalence	-
5.	COOMET key comparison	EM/AC power	SE	COOMET.EM-K5 695/UA/16	Power factor at 50/60 Hz: 1.0, 0.5 Lag, 0.5 Lead, 0.0 Lag, 0.0 Lead	Final	degrees of equivalence	Passed
6.	GULFMET supplementary comparison	EM/DC Resistance	TÜBİTAK UME	GULFMET.EM-S1	DC Resistance: 100 Ω	In progress	E _n criteria	-
7.	GULFMET supplementary comparison	EM/AC power	TÜBİTAK UME	GULFMET.EM-S2	Power factor at 50/60 Hz: 1.0, 0.8 Lag, 0.8 Lead, 0.5 Lag, 0.5 Lead, 0.25 Lag, 0.25 Lead, 0.01 Lag, 0.01 Lead	Final Report	degrees of equivalence	Passed

No	Type of ILC/PT	Field/subfield	Pilot lab	Identification of ILC/PT	Parameters/ range of measurements	Status	Evaluation criterion	Result
8.	GULFMET supplementary comparison	EM/AC Voltage	TÜBİTAK UME	GULFMET.EM-S3	AC-DC Voltage Transfer Difference: 10 mV, 3 V, 1000 V (10 Hz, 55 Hz, 1 kHz, 20 kHz, 100 kHz, 1 MHz)	In progress	E _n criteria	-
9.	GULFMET supplementary comparison	EM/Radio frequencies	TÜBİTAK UME	GULFMET.EM.RF-S1	Correction factor Nominal value : 0 Indicated field levels: 30 V/m Frequency: 100 Hz, 1 kHz, 10 MHz, 100 MHz, 1 GHz, 9 GHz, 18 GHz	Final Report	E _n criteria	Passed
10.	GULFMET supplementary comparison	EM/Radio frequencies	TÜBİTAK UME	GULFMET.EM.RF-S2	RF Power, Calibration Factor: [0.0000, 1.0000] Frequency: 10 MHz, 50 MHz, 1 GHz, 4 GHz, 8 GHz, 12 GHz, 15 GHz, 18 GHz	Final Report	E _n criteria	Passed
11.	Multilateral ILC	EM/Radio frequencies	METAS, UME	EURAMET Project 1426	S-parameter in N-type connector devices	In progress	degrees of equivalence	-
12.	Multilateral ILC	EM/DC voltage, DC current, AC voltage, AC current, Resistance	TÜBİTAK UME	EURAMET Project 1341	DC voltage:100 mV, 10 V, 100 V, 1000 V DC current: 100 µA, 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) Resistance: 10 Ω, 10 kΩ, 1 MΩ	Draft A report under preparation	degrees of equivalence	-
13.	Multilateral ILC	EM/DC Current	TÜBİTAK UME	EURAMET Project 1381	DC Current : 9.5 fA, 95 fA, 0.95 pA, 9.5 pA, 95 pA	In progress	degrees of equivalence	-

No	Type of ILC/PT	Field/subfield	Pilot lab	Identification of ILC/PT	Parameters/ range of measurements	Status	Evaluation criterion	Result
14.	Bilateral ILC	EM/DC Voltage	TÜBİTAK UME	UME-EM-D3-2.20.6.a	DC voltage: 10 V, 1.018 V	Final Report	E _n criteria	Passed
15.	Bilateral ILC	EM/DC Current	TÜBİTAK UME	UME-EM-D3-2.20.6.c	DC Current: 100 µA, 10 mA and 1 A	Final Report	E _n criteria	Passed
16.	Bilateral ILC	EM/AC Current	TÜBİTAK UME	UME-EM-D3-2.20.6.d	AC-DC Current Transfer Difference: 10 mA, 5 A, 10 A (10 Hz, 55 Hz, 1 kHz, 10 kHz, 20 kHz, 50 kHz and 100 kHz)	Final Report	E _n criteria	Passed
17.	Bilateral ILC	EM/DC Resistance	TÜBİTAK UME	UME-EM-D3-2.21.6.a	DC Resistance: 100 Ω	Final Report	E _n criteria	Passed
18.	Bilateral ILC	EM/Capacitance	TÜBİTAK UME	UME-EM-D3-2.21.6.b	10 pF and 100 pF (1 kHz)	Final Report	E _n criteria	Passed
19.	Bilateral ILC	EM/Inductance	TÜBİTAK UME	UME-EM-D3-2.21.6.c	100 mH (1 kHz)	Final Report	E _n criteria	Passed
20.	Bilateral ILC	EM/High AC current and current transformers	TÜBİTAK UME	UME-EM-D3-2.22.6.b	Primary current: 10 A, 100 A, 500 A and 1500 A; secondary current: 5 A; class: 0.2; burden: 12.5 VA, cos β = 0.9	Final Report	E _n criteria	Passed

No	Type of ILC/PT	Field/subfield	Pilot lab	Identification of ILC/PT	Parameters/ range of measurements	Status	Evaluation criterion	Result
21.	Bilateral ILC	EM/AC High voltage and voltage transformers	TÜBİTAK UME	UME-EM-D3-2.22.6.c	Primary voltage: 20 kV and 30 kV; secondary current: 120 V; class: 0.5; burden: 25 VA ($\cos \beta = 0.7$)	Final Report	E_n criteria	Passed

SCI PAPERS AND PROCEEDINGS:

Voltage

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PATENT and OTHERS:

Power & Energy Laboratory

- Frequency adaptive harmonic current generator: National patent application was in 2016 and international was in 2017. International patent application is approved, recently.