15RPT01 RFMicrowave project

Project coordinator: Murat Celep (TÜBITAK UME)

project website: http://rfmw.cmi.cz

Follow us on Twitter: @RFMW_Project

Participant details:

a. Partners (participants who will accede to the Grant Agreement)

no.	Participant Type	Short Name	Organisation legal full name	Country
1	Internal Funded Partner	TUBITAK	Turkiye Bilimsel ve Teknolojik Arastirma Kurumu	Turkey
2	Internal Funded Partner	CMI	Cesky Metrologicky Institut	Czech Republic
3	Internal Funded Partner	GUM	Central Office of Measures	Poland
4	Internal Funded Partner	INTA	Instituto Nacional de Técnica Aeroespacial Esteban Terradas	Spain
5	Internal Funded Partner	SIQ	Slovenski Institut za Kakovost in Meroslovje	Slovenia
6	Internal Funded Partner	SP	SP Sveriges Tekniska Forskningsinstitut AB	Sweden
7	External Funded Partner	NIS	National Institute for Standards	Egypt
8	External Funded Partner	NQIS	National Quality Infrastructure System	Greece
9	External Funded Partner	UPC	Universitat Politècnica de Catalunya	Spain
10	Unfunded Partner	METAS	Eidgenössisches Institut für Metrologie METAS	Switzerland

This project aims to develop research and measurement capacities as well as expertise for emerging EURAMET countries in RF&MW.

It will do this by transferring

- theoretical and
- practical know-how

between the project partners and by combining their skills to focus on microwave and electromagnetic compatibility (EMC) measurements.

EMPIR EURAMET

The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States

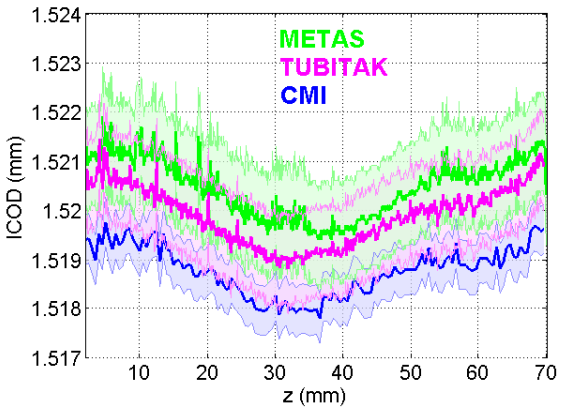
RF MICROWAVE

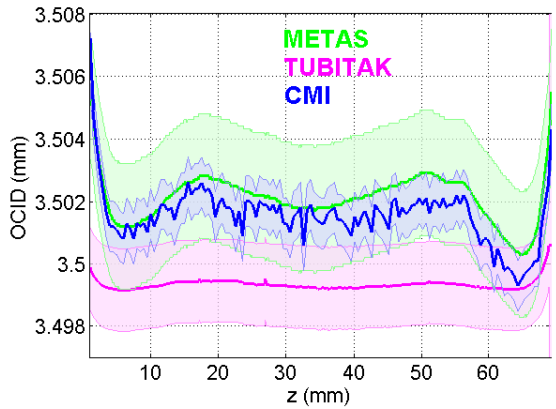
Objective 1:

Improve S-parameter measurements with lower uncertainty and to develop/enhance impedance and S-parameters traceability across Europe by improving the measurement and research capacities of NMI partners.

Current status:

- 3.5 mm airlines fabricated by a Maury as primary standards
- comparison on mechanical and electrical characterization of lines (METAS, TÜBITAK, CMI), numerical simulations
- optimization in METAS VNA Tools II currently ongoing
- establishing of primary traceability for S-parameters





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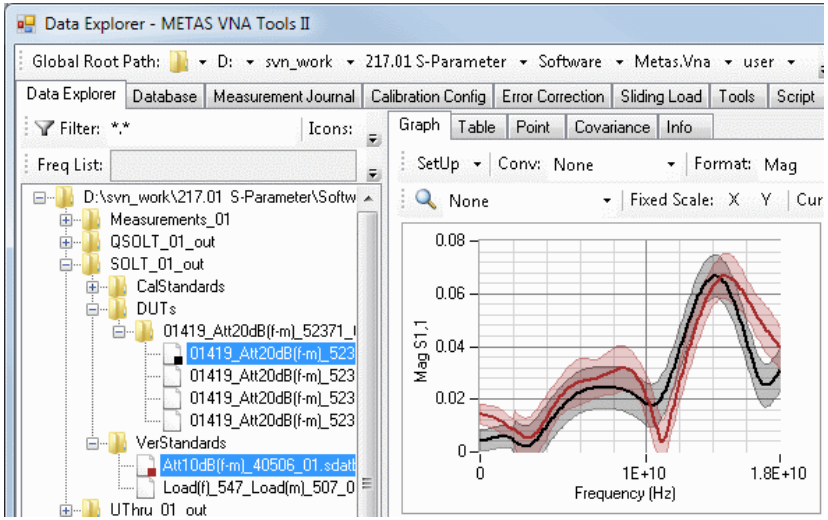
Improve S-parameter measurements with lower uncertainty and to develop/enhance impedance and S-parameters traceability across Europe by improving the measurement and research capacities of NMI partners.

Current status:

- N-Type connector EURAMET comparison registered as no. 1426
- comparison performed at the turn 2017/2018 (power splitter, attenuator)
- results currently being evaluated by the pilot laboratory
- comparison will help NMIs in accreditation process and possibly establish new CMCs

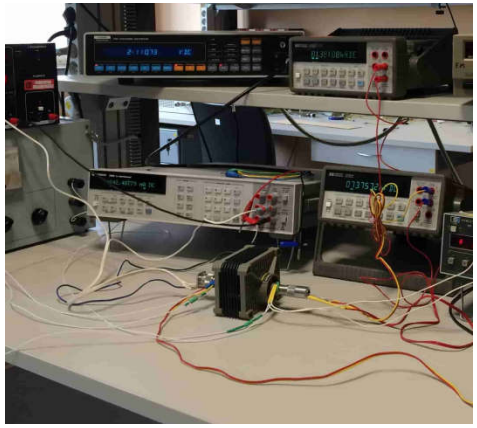


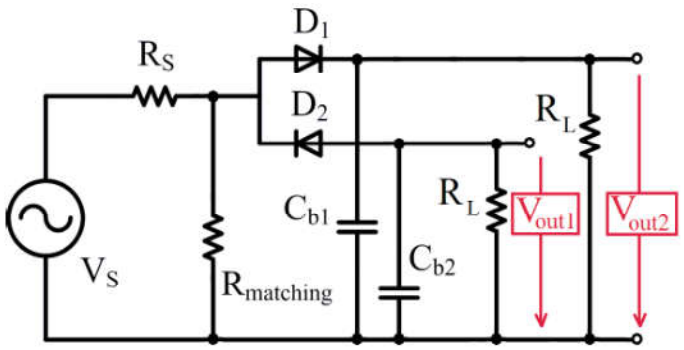
Objective 2:

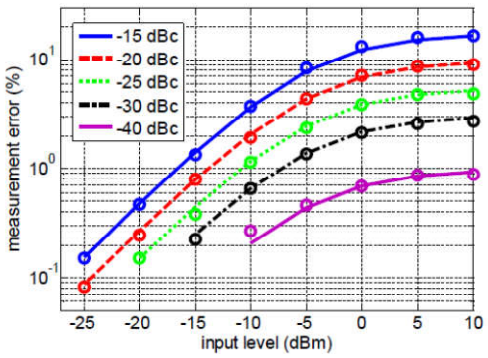
Improve the reliability and precision of RF power measurements under low and high-power conditions, power sensor measurements for low-power, investigate the effects of higher harmonics in the response of power sensors, provide the NMI partners the ability to measure and determine output reflection coefficients of signal generators.

Current status:

- comparisons of power sensor for low-power measurement and output voltage reflection coefficient of a microwave generator organized (ongoing)
- effect of higher harmonics on diode power sensors investigated
- high-power attenuator comparison ongoing (measurement under hot/cold conditions)





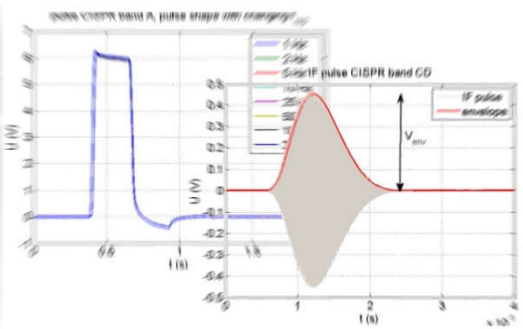


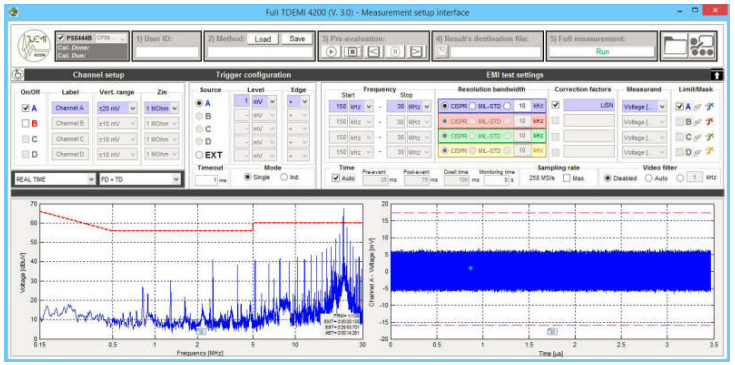
Objective 3:

Investigate advanced calibration methods and established test procedures for EMC with use of RF&MW metrology. EMC calibration methods will be improved for traceability of loop antennas and pulse generators and existing verification methods will also be improved for EMC immunity/emissions.

Current status:

- workshop on traceable pulse measurements (May 2017, INTA)
- comparison on CISPR pulse generator finished in July 2018, evaluation of results ongoing
- just-before-test verification research has been expanded to low-frequency immunity tests which have a dire need for just-before-test verification
- improvement of measurement capabilities and possible CMCs of partners





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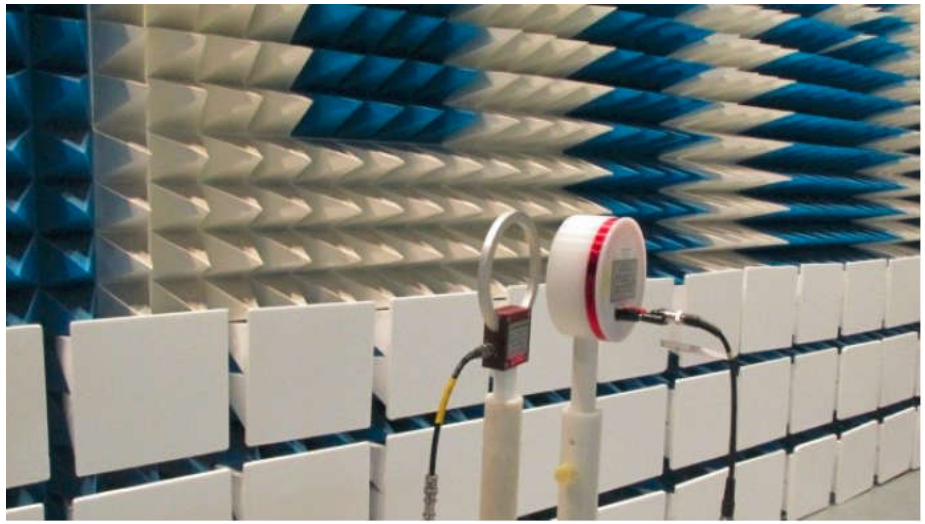
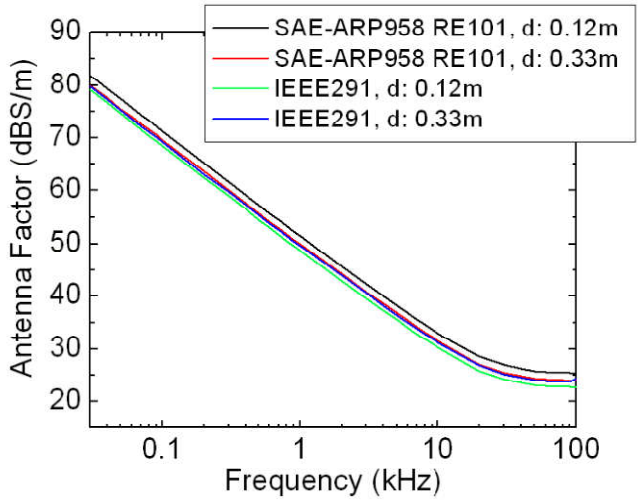
Current status:

- loop-antenna calibration using VNA established at CMI, TÜBITAK, SP
- TUBITAK and UPC theoretically defined the CM and DM circuit models of conducted emission and immunity tests to be used in just-before-test verifications





Objective 4:

Develop an individual strategy for each partner for long-term operation of capacity development, including regulatory support, research collaborations, quality schemes and accreditation. Each partner will also develop a strategy to offer calibration services in their own country and in neighbouring countries.

Current status:

- some of NMI partners have already started to build short/long term strategies for uptake of the project results and knowledge gained
- improved capabilities and involvement in comparisons may help the institutes to establish new CMCs or support current capabilities during accreditation audits
- technical areas are being identified, which the institutes will continue to develop in the future

List of publications (1/2):

Journal papers:

M. A. Azpúrua, M. Pous, J. A. Oliva, B. Pinter, M. Hudlička and F. Silva, "Waveform Approach for Assessing Conformity of CISPR 16-1-1 Measuring Receivers," in *IEEE Transactions on Instrumentation and Measurement*, vol. 67, no. 5, May 2018, pp. 1187-1198.

Conference proceedings:

Osman Şen, Soydan Çakır, "Improved Just-Before-Test Verification Methods with VNA for Conducted EMC Tests," in *Proc. of EMC Europe 2018, Amsterdam*, The Netherlands, August 2018.

Soydan Cakir, Osman Sen, Mesut Ozturk, "Investigation of Ripple Voltage Across Capacitor in Military CS101 Test by Using FFT-Based Time Domain Solution," in *Proc. of the IEEE EMC SIPI Symposium*, Long Beach, CA, USA, August 2018.

M. Celep, Y. Abdo, K. Dražil, J. Grajciar, M. Hudlička, B. Pinter, "Harmonics Effects on Microwave Low-Power Measurement," *Conference on Precision Electromagnetic Measurements (CPEM)*, Paris, France, 8-13 July 2018.

S. Cakir, M. Oztürk, B. Tektas, O. Şen, S. Acak, M. Pous, "FFT-Based Time Domain Solution to Power Frequency Issue of CS101 Testing for Military and Aerospace Equipment," in *Proc. of the 2018 IEEE International Symposium on Electromagnetic Compatibility and 2018 IEEE Asia-Pacific Symposium on Electromagnetic Compatibility (EMC/APEMC)*, May 2018, Singapore, pp. 177-182.

List of publications (2/2):

Conference proceedings:

S. Cakir, M. Oztürk, B. Tektas, O. Şen, S. Acak, M. Pous, "FFT-Based Time Domain Solution to Power Frequency Issue of CS101 Testing for Military and Aerospace Equipment," in *Proc. of the 2018 IEEE EMC/APEMC*, May 2018, Singapore, pp. 177-182.

O. Sen, S. Cakir, "Loop Antenna Calibrations with Inclusion of Vector Network Analyser and Comparison Between Calibration Methods," *2017 International Symposium on Electromagnetic Compatibility - EMC EUROPE*, Angers, France, 2017, pp. 1-6.

M. Pous, M. A. Azpúrua and F. Silva, "APD oudoors time-domain measurements for impulsive noise characterization," *2017 International Symposium EMC EUROPE*, Angers, France, 2017, pp. 1-6.

M. A. Azpúrua, J. A. Oliva, M. Pous and F. Silva, "Robust extreme value estimation for full time-domain EMI measurements," *2017 International Symposium EMC EUROPE*, Angers, France, 2017, pp. 1-6.

O. Sen, S. Cakir, S. Acak, "More Insight into Conducted Immunity Tests and Investigation of Support Influences," in *Proc. of APEMC Symposium*, Seoul, Korea, June 2017, pp. 124-126.

M. Azpurua, J. Oliva, M. Pous, F. Silva, "Fast and Automated Verification of Multi-channel Full Time-Domain EMI measurement systems," in *Proc. of the 2017 I^2MTC*, Torino, Italy, 22-25 May 2017, pp. 785-790.

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