EMPIR Call 2015 – Health, SI, Normative and Research Potential

Selected Research Topic number: **SRT-r06**
Version: 1.0

Title: Development of RF and microwave metrology capability

Abstract

The measurement of RF and microwave (MW) parameters is important in many fields such as healthcare, communications, security, environmental monitoring, traffic management, advanced industrial production and the development of innovative products. In addition measurements of these parameters are also required for EMC pre-compliance testing or compliance testing. The frequencies, complexity of systems and data rates required are increasing which brings new challenges to the underpinning metrology.

This topic is focussed on improving the research capability and availability of associated services in the field of S-parameters, RF power and microwave measurements, within countries or regions in Europe where access to this capability is currently limited.

Keywords

Vector network analyser, S-parameters, RF power, measurement uncertainty, microwave metrology

Background to the Metrological Challenges

Currently new technologies in the fields of health care, security, traffic management, environmental monitoring, advanced industrial production, quality testing and communications require novel measurement methods and devices. The frequencies, complexity of systems and data rates required are still increasing which brings new challenges to the underpinning metrology.

Several crucial fields, such as S-parameters and RF power measurements influence the measurement capability and traceability in many other areas. The range of complex measurements required in both the time-and-frequency domains will continue to grow.

There is demand from industrial companies in several European countries, where less experienced NMIs are located, for improved metrology supporting their innovative products. For instance many countries have their own EMC laboratories either for pre-compliance testing or compliance testing, however as EMC procedures become more complex and measurements are made at higher frequencies, the calibration of the equipment used during EMC testing is becoming more critical for quality of the test results. Many calibrations of EMC equipment utilise vector network analysers (VNA) measurements of S-parameters, which are then used to calculate different quantities (impedance, attenuation, gain…) which characterise the unit under test. It is therefore crucial to have good quality S-parameter measurements with associated uncertainties which are traceable to international standards.

Existing techniques for measurement uncertainty evaluation might be adequate at lower frequencies but are not fit for purpose at higher frequencies and ignore uncertainty contributions that are not negligible. There are indications that these effects also play a non-negligible role at lower frequencies. Current guidance in this field will soon be updated. Laboratories that follow this guidance will need to make adjustments to their procedures, which are not trivial and require training in best measurement practice and software use.

In addition to establishing traceability and reducing the uncertainty of existing quantities, there are measurements and metrology challenges which are not even supported by NMIs with greater experience. Such challenges include new nano-devices, measurements at extreme impedances, new transmission media (dielectric waveguide, micro-coax, quasi-optical propagation etc.), performance evaluation of alternative EMC test methods, efficient antenna calibration algorithms, high-speed differential measurements, electronic calibration units and many others. Metrology supporting state-of-the-art technologies in RF and microwave field currently only exists in very few European countries, with a few top-level NMIs undertaking research in the field of S-parameters, RF power, antenna measurements and other areas. The capability level of national metrology institutes in particular areas differs across countries for historical and economic reasons. Effective cooperation of European NMIs on these big challenges and

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

development of new and improved measurement techniques necessitates reducing the capability gap between NMIs.

Objectives

Proposers should address the objectives stated below, which are based on the PRT submissions. Proposers may identify amendments to the objectives or choose to address a subset of them in order to maximise the overall impact, or address budgetary or scientific / technical constraints, but the reasons for this should be clearly stated in the protocol.

The JRP shall focus on the development of metrological capacity in RF and microwave metrology.

The specific objectives are

1. To identify key industrial and scientific needs in RF and microwave metrology. The S-parameters and RF power parameters addressed must cover existing documented industrial and stakeholder needs and the research to be undertaken in the project to address these needs and build capability must be clearly described in the proposal.
2. To develop relevant facilities and operating procedures for the participating countries wishing to develop research capabilities in RF and microwave metrology.
3. To develop measurement methods and calibration procedures for EMC measurement equipment using a vector network analyser.
4. To develop a unified approach and methods for measurement uncertainty evaluation for RF and microwave metrology, particularly for S-parameter measurements.
5. For each participant, to develop an individual strategy for the long-term operation of the capacity developed, including regulatory support, research collaborations, quality schemes and accreditation. They should also develop a strategy for offering calibration services from the established facilities to their own country and neighbouring countries. The individual strategies should be discussed within the consortium and with other EURAMET NMIs/DIs, to ensure that a coordinated and optimised approach to the development of traceability in this field is developed for Europe as a whole.

Joint Research Proposals submitted against this SRT should identify

- the particular metrology needs of stakeholders in the region,
- the research capabilities that should be developed (as clear technical objectives),
- the impact this will have on the industrial competiveness and societal needs of the region,
- how the research capability will be sustained and further developed after the project ends.

The development of the research potential should be to a level that would enable participation in other TPs.

Proposers should note that the programme funds the activity of researchers to develop the capability, not the required infrastructure and capital equipment, which must be provided from other sources.

EURAMET has defined an upper limit of 500 k€ for the EU Contribution to any project in this TP, and a minimum of 100 k€.

EURAMET also expects the EU Contribution to the external funded partners to not exceed 10 % of the total EU Contribution to the project. Any deviation from this must be justified.

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the “end user” community, describing how the project partners will engage with relevant communities during the project to facilitate knowledge transfer and accelerate the uptake of project outputs. Evidence of support from the “end user” community (e.g. letters of support) is also encouraged.

You should detail how your JRP results are going to:

- Address the SRT objectives and deliver solutions to the documented needs,
- Provide a lasting improvement in the European metrological capability and infrastructure beyond the lifetime of the project,
- Facilitate improved industrial capability or improved quality of life for European citizens in terms of personal health or protection of the environment,
- Transfer knowledge to the EMC testing and manufacturing sectors and the metrology community.

You should detail other impacts of your proposed JRP as specified in the document “Guide 4: Writing Joint Research Projects”

You should also detail how your approach to realising the objectives will further the aim of EMPIR to develop a coherent approach at the European level in the field of metrology and include the best available contributions from across the metrology community. Specifically the opportunities for:

- improvement of the efficiency of use of available resources to better meet metrological needs and to assure the traceability of national standards
- the metrology capacity of EURAMET Member States whose metrology programmes are at an early stage of development to be increased
- organisations other than NMIs and DIs to be involved in the work

Time-scale

The project should be of up to 3 years duration.