European Metrology Programme for Innovation and Research

Delivering Impact

# Better electromagnetic compatibility measurements for electronic devices

Electronic devices generate low-power radio frequency and microwave fields during use. These electromagnetic fields can interact adversely with other nearby electronics, damaging or impairing their function. To minimise this electromagnetic 'emissions' and 'immunity' testing of devices are required before market release. However, the simplified characterisation and modelling approaches currently used are insufficient for more advanced, modern devices.

**Europe's National Measurement Institutes working together**

The European Metrology Programme for Innovation and Research (EMPIR) has been developed as part of Horizon 2020, the EU Framework Programme for Research and Innovation. EMPIR funding is drawn from 28 participating EURAMET member states to support collaborative research between Measurement Institutes, academia and industry both within and outside Europe to address key metrology challenges and ensure that measurement science meets the future.

# Challenge

The number of electronic devices prevalent in society has grown rapidly over the last 40 years and by 2025 it is projected the global market for consumer electronics and appliances alone will reach around 745 billion Euros. Regardless of type, from smart phones and smart meters to wideband radio and radar systems, almost all electronic devices emit low-power radio frequency (RF) and microwave (MW) fields. These 'emissions' can interact adversely with other nearby devices, damaging or impairing their function. Therefore, electromagnetic compatibility (EMC) testing and 'immunity' measurements need to be performed by a manufacturer before releasing a product onto the market. EMC is the interaction of electrical equipment with the electromagnetic environment and 'immunity' measurements determine a devices ability to withstand RF&MW interference. Instruments performing EMC tests rely on making accurate 'Scattering parameter' (S-parameter) measurements which describe the behaviour of electrical networks when undergoing various steady state stimuli by electrical signals. For EMC testing equipment this value is obtained through comparison with calibration standards. However, the simplified characterisation and modelling approach currently used to obtain S-parameter values for these standards is inadequate for advanced, modern devices. This could result in products entering the marketplace with degraded performance, damaging consumer confidence.

# Solution

The EMPIR project *Development of RF and microwave metrology capability* created new research, expertise and measurement capabilities in Europe in the field of RF&MW. The National Metrology Institute of Switzerland, METAS developed an improved Vector Network Analysis tool (VNA Tools II) to support the modelling of calibration standards for S-parameters measurements. In order to test the reliability of the uncertainties obtained with the new VNA Tool an inter-comparison exercise was performed by all project partners on a set of stable calibration artefacts. Results from this fed into a second S-parameter inter-comparison exercise using one-port, two-port and three-port standards (composed of one, two and three pairs of terminals respectively). The improved S-parameter measurements obtained allowed the Slovenian designated institute SIQ to extend the frequency measurement range for this parameter from 3 GHz up to 26.5 GHz, which they now offer as part of their calibration services.

# Impact

Founded in 1945 Iskraemeco D.D. is a producer of smart electricity meters with 100 million meters installed worldwide. The company is accredited for performing EMC tests on the products and, using the extended S-parameter frequency range, SIQ calibrated Iskraemeco's Transverse Electro-Magnetic (TEM) cell used in-house for immunity and emission testing. Iskraemeco believe that the work SIQ performed not only reduces the testing time for the meters that they provide but also ensures faster implementation of their approval processes, faster elimination of uncertainties, and faster elimination of potential equipment defects. Through SIQ's work Iskraemeco's customers can be confident that the products the company supply will be able to operate efficiently in a world where the number of electronic devices continues to proliferate.

## Building capability in the field of radio frequency and microwave measurements

The EMPIR project *Development of RF and microwave metrology capability* increased expertise for emerging EURAMET countries in the area of radio frequency (RF) and microwave frequency (MW) measurements. Capabilities in making S-parameter measurements, important in electromagnetic compatibility (EMC) testing, were improved along with the reliability and precision of RF power measurements under low and high-power conditions. Advanced calibration methods were investigated and new test procedures for EMC established. New Vector Network Analysis software was used to develop a world-first verification method to detect insidious issues before conducting emission and immunity tests, resulting in a significant increase in the quality of EMC measurements. Four freely available best practice guides were produced, and new calibration services established. The more precise and reliable methods developed will improve the performance of new electronic products, supporting the prevention of incorrect testing of devices, thereby making a positive financial impact on the European economy.



EMPIR EURAMET

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**www.euramet.org/project-15RPT01**

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