

National Standards Laboratory of High Frequency Quantities in Finland

Kari Ojasalo⁽¹⁾, Heikki Koivula⁽¹⁾, Antti Manninen⁽¹⁾

**⁽¹⁾*CENTRE FOR METROLOGY AND ACCREDITATION (MIKES)*
P.O. Box 9 (Tekniikantie 1), FI-02151 Espoo, Finland
*Email: kari.ojasalo@mikes.fi***

Traceability is a key word in metrology and reliability of measurements. Traceability means that the result of a measurement, no matter where it is made, can be related to a national or international measurement standard, and that this relationship is documented. The degree of equivalence between national standards of different countries is established by international comparisons. Traceability is transferred from the national standards to other standards and devices by an unbroken chain of calibrations, each with a stated uncertainty. National measurement standards are maintained and developed by National Standards Laboratories (NSL). In Finland, NSLs of different quantities are nominated by the Centre for Metrology and Accreditation (MIKES), which is the National Metrology Institute of Finland (NMI).

National high frequency metrology was started in late 1970's by the Posts and Telecommunications of Finland. Between 1999 and 2006 Finland had no NSL in the field of high frequency electrical measurements. MIKES started developing radio frequency and microwave measurements in 2000. After two international comparisons and evaluation by an international expert, high frequency quantities have been included in the scope of the NSL of electrical quantities of MIKES since 19 June, 2006.

High frequency power in MIKES is based on thermistor sensors. In these sensors high frequency power is substituted with DC-power. Traceability to internationally accepted primary standards is provided by calibration of the power sensors at National Physical Laboratory (NPL), U.K.. DC voltage and resistance are traceable to MIKES. MIKES uses a power splitter system for power sensor calibrations.

High frequency impedance is traceable to airlines and step attenuators. Impedance calibrations include voltage reflection coefficient (VRC) and attenuation. Calibrations are carried out with Vector Network Analysers (VNA). Uncertainty assessment is performed regularly with the aid of airlines, whose precise dimensions are measured at MIKES, and step attenuators calibrated at NPL.

Most of the high frequency measuring instruments are connected to 10 MHz reference frequency distribution network, provided by MIKES time and frequency laboratory. The time and frequency laboratory of MIKES maintains Finnish official time and provides traceability for time interval and frequency used in other calibration laboratories. Frequency is the most accurately measurable quantity. Using the Hydrogen maser and Cs atomic clocks of MIKES, frequency can be realised with a relative uncertainty of $3 \cdot 10^{-13}$.