European Research Project:
‘Metrology for New Electrical Measurement
Quantities in High-Frequency Circuits’

An Overview of Activities
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Overview

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EMRP – European Metrology Research Programme

The EMRP is a metrology-focused European programme of coordinated R&D that facilitates closer integration of national research programmes.

The EMRP is jointly supported by the European Commission and the participating countries within the European Association of National Metrology Institutes (EURAMET e.V.).

The EMRP will ensure collaboration between National Measurement Institutes, reducing duplication and increasing impact.

SIB62 / ‘HF-Circuits’ Project

The principal goal of this project is to develop the SI system in a way that impacts emerging areas of technology that utilise RF, microwave, millimetre-wave and submillimetre-wave electromagnetic science and technology.

Research and development is being undertaken to achieve traceability between existing SI units, and, the new and evolving quantities and units that are being used in these sectors of ‘applied’ metrology.
# SIB62 / ‘HF-Circuits’ Project

## Project Partners

| National Metrology Institutes | CMI, Czech Republic  
LNE, France  
METAS, Switzerland  
NPL, UK  
PTB, Germany  
SP, Sweden  
VSL, Netherlands |
|-----------------------------|----------------------------------|
| Industrial Partners         | Agilent Technologies, Belgium   
Rohde & Schwarz, Germany     |
| Researcher Excellence Grants| CTU, Czech Republic  
FBH, Germany  
KUL, Belgium  
ULE, UK |

## Project Work Packages

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**Work Package 1**

Traceable Reflection and Transmission Measurements in Metallic Waveguides to 1100 GHz and Coaxial Lines to 110 GHz

Work Package Leader: PTB  
Participants: NPL, CMI, METAS, LNE, VSL, R&S, FBH, ULE

Task 1.1: VNA modelling and characterisation for waveguide measurements  
Task 1.2: Waveguide measurements  
Task 1.3: VNA modelling and characterisation for coaxial measurements  
Task 1.4: Coaxial measurements

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**WP1 – Tasks delivery**

**Metallic waveguides to 1.1 THz**

Participants: **NPL, PTB, CMI, LNE, R&S, FBH, ULE**

**Coaxial lines to 110 GHz**

Participants: **METAS, VSL, NPL, LNE, PTB, R&S**
Work Package 2

Traceable Multi-port Vector Network Analyser Techniques and Automatic (Electronic) Calibration Techniques

Work Package Leader: SP
Participants: NPL, METAS, LNE, PTB, R&S

Task 2.1: Multi-port up to 65 GHz
Task 2.2: Uncertainty in two-port electronic calibration units
Task 2.3: Stability in electronic calibration units

WP2 – Tasks delivery

Multi-ports

Participants: NPL, LNE, PTB, R&S

Electronic Calibration Units (ECU)

Participants: SP, METAS, NPL, PTB
Work Package 3

Traceable Differential S-parameter Measurements on Planar Circuits to Test Signal Integrity

Work Package Leader: NPL
Participants: CMI, LNE, PTB, R&S, CTU, FBH

Task 3.1: Standards and calibration techniques
Task 3.2: Interconnects and signal integrity in both time- and frequency-domains
Task 3.3: Modelling and measurement uncertainty

Work Package 4

Traceable Nonlinear Measurements and Extreme Load Impedances

Work Package Leader: CMI
Participants: NPL, AGILENT, CTU, KUL

Task 4.1: Nonlinear measurements
Task 4.2: Extreme load impedances
WP4 – Tasks delivery

Nonlinear measurements
Participants: **NPL**, CMI, Agilent, KUL

Extreme load impedances
Participants: **CMI**, NPL, CTU

Work Package 5

Vector Measurement Uncertainty and Verification, and, International Guides and Standards

Work Package Leader: METAS
Participants: NPL, LNE, PTB, SP, VSL, R&S

Task 5.1: Vector uncertainties
Task 5.2: Verification schemes
Task 5.3: Input to IEEE standards
Task 5.4: Rewrite of EURAMET Guide
WP5 – Tasks delivery

Vector measurement uncertainty and verification

Participants: PTB, VSL, LNE, METAS, NPL, R&S

International Guides and Standards

Participants: NPL, METAS, LNE, PTB, SP, VSL

Work Package 6

Creating Impact

Work Package Leader: LNE
Participants: NPL, CMI, METAS, PTB, SP, VSL, AGILENT, R&S, CTU, FBH, KUL, ULE

Task 6.1: Knowledge transfer
Task 6.2: Training
Task 6.3: Exploitation
WP6 – Knowledge Transfer

- Stakeholder Advisory Group (SAG)
- Project web-site
- Internet Social Media
- Publications: Metrologia, IEEE T-IM, T-MTT, T-TST
- Conferences: ARFTG, IMS, CPEM, EuMC
- Trade journals: Microwave J, IEEE Microwave Magazine
- Standardisation Committees: IEEE P287, P1785
- Technical Committees: EURAMET TC-EM

WP6 – Training

- European ANAMET meetings (six)
- Technical Workshops (three)
- Training Courses (three)
  - ECUs
  - Revised EURAMET VNA Guide
  - etc
- On-line videos (YouTube, etc)
- Guest working
Summary

- SIB62 / ‘HF-Circuits’ project launched in July 2013
- Web-site launched
- Discussion Group on LinkedIn launched
- Stakeholder Advisory Group set up
- Several presentations and papers already given
- Good progress to date (18 completed deliverables)
- Future meetings: June and November each year
- Need meeting hosts for November 2014 and June 2015

Acknowledgement

This work was funded through the European Metrology Research Programme (EMRP) Project SIB62 ‘Metrology for New Electrical Measurement Quantities in High-frequency Circuits’.

The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union.