NPL

## European Research Project:

## ‘Metrology for New Electrical Measurement Quantities in High-Frequency Circuits’

## An Overview of Activities

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## Overview

NPL National Physical Laboratory

- EMRP
- SIB62 / ‘HF-Circuits’ project
- Work Packages
- Project – Current Status
- Summary

## 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

EMRP
European Metrology Research Programme
Programme of EURAMET

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

## 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.

HF-Circuits

# SIB62 / 'HF-Circuits' Project

## Project Partners

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

# SIB62 / 'HF-Circuits' Project

## Project Work Packages

| No | Title | PM |
|---|---|---|
| 1 | Traceable Reflection and Transmission Measurements in Metallic Waveguides to 1100 GHz and Coaxial lines to 110 GHz | 69 |
| 2 | Traceable Multi-port Vector Network Analyser Techniques and Automatic (Electronic) Calibration Techniques | 36 |
| 3 | Traceable Differential S-parameter Measurements on Planar Circuits to Test Signal Integrity | 27 |
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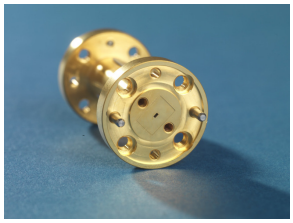
## Work Package 1



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

## 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

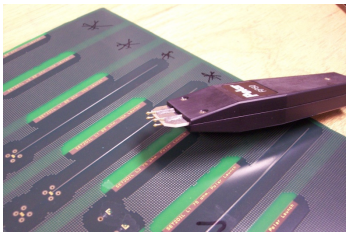
### Multi-ports

Participants: **NPL**, LNE, PTB, R&S

### Electronic Calibration Units (ECU)

Participants: **SP**, **METAS**, NPL, PTB

# Work Package 3



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

Work Package Leader: NPL

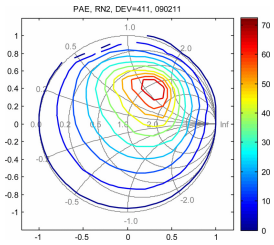
Participants: CMI, LNE, PTB, R&S, CTU, FBH

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

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## 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

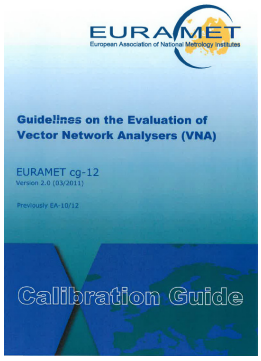
Participants: **CMI**, NPL, CTU

## 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.

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