EMRP

European Metrology Research Programme

Programme of EURAMET

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

European Research Project ‘HF-Circuits’:

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

Overview and Update of Activities

Nick Ridler

03 June 2015

Overview

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- EMRP
- SIB62 / ‘HF-Circuits’ project
- Work Package reviews
- Project – Mid-term Review
- Summary

EMRP – European Metrology Research Programme

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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

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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 (NMIs)	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 (REGs)	CTU, Czech Republic FBH, Germany KUL, Belgium ULE, UK

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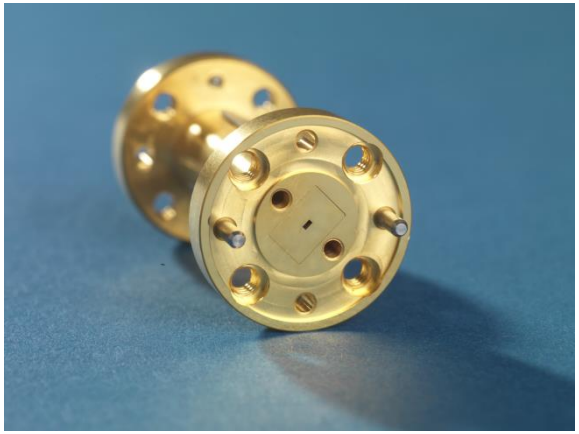
SIB62 / 'HF-Circuits' Project

Project Work Packages

No	Title	Person Months
1	Traceable Reflection and Transmission Measurements in Metallic Waveguides to 1100 GHz and Coaxial lines to 110 GHz	69 (28%)
2	Traceable Multi-port Vector Network Analyser Techniques and Automatic (Electronic) Calibration Techniques	36 (15%)
3	Traceable Differential S-parameter Measurements on Planar Circuits to Test Signal Integrity	27 (11%)
4	Traceable Nonlinear Measurements and Extreme Load Impedances	43 (18%)
5	Vector Measurement Uncertainty and Verification, and, International Guides and Standards	44 (18%)
6	Creating Impact	10 (4%)
7	Project Management and Coordination	14 (6%)

Work Package 1



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

Work Package Leader: PTB

Main research areas:

- Metallic waveguides to 1.1 THz
  - Participants: CMI, LNE, NPL, PTB, 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

Main research areas:

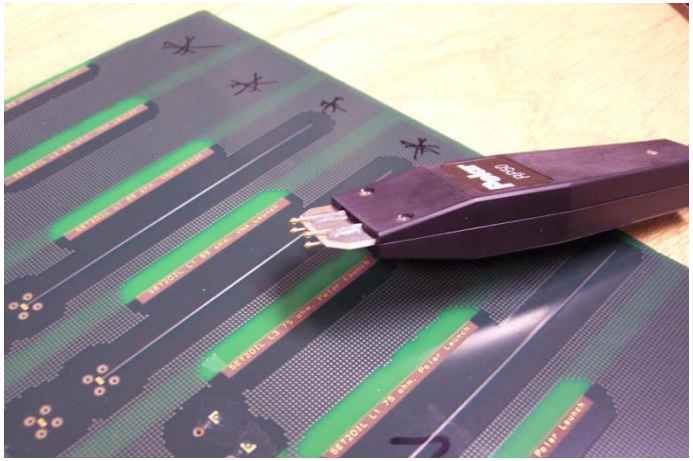
Multi-ports

Participants**:** LNE, NPL, 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

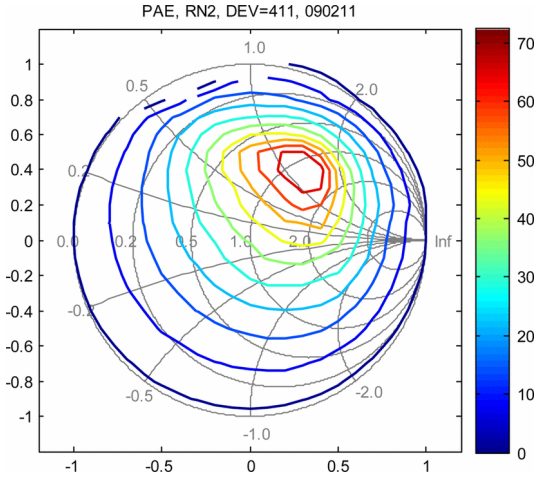
Work Package Leader: NPL

Main research area:

Multi-layer PCBs

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

Work Package 4



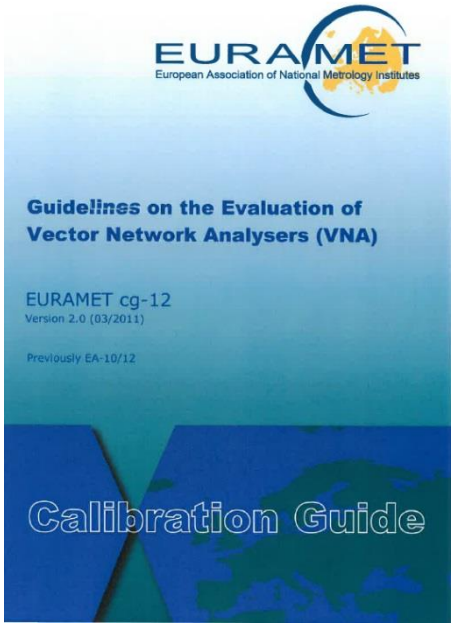
Traceable Nonlinear Measurements and Extreme Load Impedances

Work Package Leader: CMI

Main research areas:

- Nonlinear measurements
  - Participants: NPL, CMI, Agilent, KUL
- Extreme load impedances
  - Participants: CMI, NPL, CTU

Work Package 5



Vector Measurement Uncertainty and Verification

International Guides and Standards

Work Package Leader: METAS

Main research areas:

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: All project partners

Main areas:

- Knowledge transfer
- Training
- Exploitation

WP6 – Knowledge Transfer

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- Stakeholder Advisory Group (SAG)
- Project web-site
- LinkedIn social media page
- Publications: Metrologia, IEEE Trans-IM, IEEE Trans-MTT
- Conferences: ARFTG, IMS, CPEM, EuMC
- Trade journals: Microwaves & RF, IEEE Microwave Magazine
- Standardisation Committees: IEEE P287, IEEE P1785
- Technical Committees: EURAMET TC-EM

WP6 – Training

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- European ANAMET meetings (six meetings scheduled)
- 3 Technical Workshops; 3 Training Courses
  - ECUs
  - VNA Best Practice
  - Revised EURAMET VNA Guide
  - Multiport VNA measurements (this meeting)
- Guest working
  - KU Leuven ⇒ NPL
  - University of Leeds ⇔ NPL
  - VSL ⇒ METAS
  - Others from outside the Consortium

Mid-term Review

- Review meeting held at PTB, Berlin
- 24th March 2015
- 10 projects were reviewed (including HF-Circuits)
- All projects were in SI Broader Scope
- 5 ‘external’ Reviewers
- Also, EMRP and MSU staff were present

Mid-term Review

Reviewers' comments of HF-Circuits:

"The reviewers considered this to be a very good project and acknowledged the end user need for metrology in high-frequency devices. They were also pleased to note the good links with instrument manufacturers"

"The reviewers were pleased with the ongoing dissemination of the project results to standardisation bodies and asked if the consortium had good links with those. The coordinator clarified that some of the partners are chairing relevant standardisation bodies and contributing as appropriate"

Reviewers' recommendations:

"The Consortium should continue the good work but look for more opportunities for training early stage researchers"

Mid-term Review

- Reviewers' evaluation (i.e. 'scores'):

Category	All reviewed projects	HF-Circuits
Technology Position	6 to 9	**9**
Impact	2 to 4	**4**

9 = "dominant"

4 = "high"

'HF-Circuits' was one of only two projects to receive these maximum scores ☺

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Summary

- Project launched: July 2013
- Web-site (www.hfcircuits.org)
- LinkedIn Group 'HF-Circuits: EMRP Project'
- Stakeholder Advisory Group – 6 key 'industrialists'
- Many presentations and papers already given
- Good progress to date (Mid-term review)
- Future meetings: Nov/Dec 2015 – venue??
  June 2016 – NPL, UK

- **Project completes: June 2016**

Acknowledgement

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

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