

Report on the 27th meeting of the GT-RF

March 2023

M. Zeier

Outline

- Meetings
- New chairman
- Comparisons
- RF topics for CCEM webinar

Meetings

- Informal online GT-RF meeting in December 2022, before CPEM
- Meeting on March 7:
 - 25 onsite registrations
 - 16 online registrations
- Next meeting: informal, in approx. 1 year (online or at CPEM, to be decided)

New GT-RF chairman: Paul Hale (NIST)

- Chief of the RF Technology Division in NIST's Communications Technology Laboratory (Presentation at GT-RF meeting)
- Work has focused on providing traceability to microwave, high speed electronics and optoelectronics industries
- Co-developer of «full waveform metrology» concept
- Recent focus on 5G supply chain security and coordination of NIST R&D effort in response to the CHIPS act.
- Fellow of IEEE and has/had other positions
- More than 110 technical publications
- Several awards
- PhD in Applied Physics from Colorado School of Mines, Golden, CO



→ To be formally approved by CCEM

Completed comparison 1/1

- CCEM.RF-K27.W: Power in WR15, 50 – 75 GHz (NIM)
 - Participants: KRISS, LNE, NIST, NMIJ, NPL, PTB, VNIIFTRI
 - 2019 - 2022
 - Approved for equivalence
 - Final report: *Metrologia 2023 60 Tech.Suppl. 01001*
 - Short presentation by pilot (Xiaohai Cui)

Ongoing comparisons 1/4

- CCEM.RF-K26: Attenuation in PC-2.4 mm, up to 40 GHz and 90dB (NMIJ)
 - Measurements 2015 – 2018
 - Delays due to shipping problems
 - Delays in preparing report due to resources
 - 2023-03: Draft B approved by CCEM and GT-RF
 - Pilot is preparing executive report

Ongoing comparisons 2/4

- CCEM.RF-K5c.CL: S-parameter PC-3.5 mm (NMIJ)
 - Measurements started in 2012
 - Numerous delays
 - 2023-01: Draft B reviewed by GT-RF
 - Pilot in the process of implementing the requested changes and collecting statements for executive report.
 - Analysis does not link the two parallel loops → non-conclusive results
 - Withdrawal: NMIA, Trescal, NIST (at their own request), NIM, KRISS (due to the report submission deadline).

Ongoing comparisons 3/4

- Pilot Study: EM properties of materials (NMIJ)
 - 5 participants
 - Draft A promised for end of March 2023

Ongoing comparisons 4/4

- CCEM.RF-K28.W: Power in WR42 waveguide (18 GHz – 26.5 GHz)
 - Piloted by NIM
 - Participants: LNE, NPL, PTB, UME, CMI, SCL, NMC, KRISS, NIST
 - Technical protocol accepted
 - Measurements started early 2023

Planned comparisons 1/4

- CCEM.RF-K5.d.CL: S-parameters in 2.4 mm coaxial (up to 50 GHz)
 - Pilot: METAS
 - Participants: CENAM, CMI, INRIM, INTA, KRISS, LNE, METAS, NIM, NIST, NMC, NMISA, A*STAR, NMCC, NPL, NRC, PTB, RISE, SNIIM, UME, VSL
 - Collapsing star type scheme
 - Analysis of full data set (12 standards = 16 measurands, each with 501 datapoints)
 - Feb 2023: Technical protocol and templates finalized
 - Measurements planned for late 2023, but might be shifted by another year (currently discussed among participants)

Planned comparisons 2/4

Noise in 3.5 mm coaxial line (up to 26 or 33 GHz)

- Participants: KRISS, METAS, INTA, NIST (all with CMCs) and UME (no CMCs)
- Open question
 - Can INTA (as a DI and non-member of CCEM) act as pilot laboratory?

A non-member DI as coordinator of a CCEM KC?

CIPM-MRA-G-11 (Measurement comparisons in the CIPM MRA):

- Participation in a CIPM key comparison is open to laboratories having the highest technical competence and experience, **normally** the member laboratories of the appropriate Consultative Committee

CIPM-MRA-P-13 (Participation in the CIPM MRA):

- Active participation of DIs in MRA activities is expected:
 - Publication of CMCs
 - Participation in relevant measurement comparisons
 - Participation in relevant technical committee activities of their RMO and, if relevant, Consultative Committees
- **A DI as coordinator is unusual**
 - No objections at GT-RF meeting
 - Any feedback from CCEM?

Planned comparisons 3/4

Antenna gain with secondary parameters (Tilt angle, axial ratio)

- NIST coordinates planning and will act as pilot
- Frequencies range: between 110 and 325 GHz, probably in WR 05 (140-220 GHz)
- Participants: NIST, NMIJ, NPL, PTB
- Technical protocol announced for end of June.

Planned comparisons 4/4

Field strength

- NPL coordinates planning
- Interested parties: NIST, KRISS, METAS, RISE, NPL, AIST, CMI, PTB, UME, NIM, INRIM, LNE
- Frequency range and travelling standard under discussion
- Many options, probably not possible to do all in a single comparison
- Discussion to be continued

Ideas for future comparisons 1/2

- Follow-up of attenuation comparison
 - Discussion coordinated by INRIM (Luca Oberto)
 - Interested labs: CENAM, NMISA, METAS, PTB, INRIM
 - Next: contact interestees to determine frequency range etc
- S-parameter in waveguide
 - KCDB CMC evaluation by CMI (Martin Hudlicka)
 - CMC landscape would favor WR42 (18 - 26.5 GHz) or WR28 (26.5 – 40 GHz)
 - CMI has sent out questionnaire to potential participants

Ideas for future comparisons 2/2

- S-parameter in planar structures (on wafer)
 - Currently only one NMI with CMCs (PTB), VSL has plans to do so as well
 - Difficulty: Many configurations possible (frequencies, substrates, geometries, probes)
 - Perhaps pilot study in the future
- Voltage/Waveform
 - NIM, NIST and PTB performed already a comparison in the past
 - JAWS at higher frequencies could be a topic for a pilot study in a few years

RF topics for CCEM webinar

- Introduction into VNA measurements + application (ev industry speaker)
 - Similar for RF power?
 - Electric field measurements
 - Traceability of RF on-wafer measurements
 - Metrology challenges for 6G development
 - Microwave measurements traceable to SI (via Rydberg constant)
 - RF measurements at cryogenics
 - RF applications in space
- Further evaluation of interest and possible speakers by GT-RF chair (poll, email)