





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

System for electromagnetic characterization of ceramics

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System for traceable electromagnetic characterization of ceramics is being developed for



Calibration and measurement routine

- Calculation of needed parameters (effective permittivity, loss, composition layers ratios)
- Grained structure of PTC ceramic samples

Goals

- Develop and build test cell for use on 4TP analyzers and a test cell for use on VNA's
- Calibration and measurement routine
- Characterize reference samples and calculate uncertainty budged
- Automation of the measurement procedure for use in industrial or R&D environment



- Modeled using lumped element models with capacitors, resistors and constant phase elements (CPE or Q)
- Measured data fitted to the model



Reference samples and uncertainty

- Reference samples provide traceability
- Uncertainty of instruments
- Effects of test cells
- Uncertainty of fitting routine and other calculations



Test cell design

- One prototype has been built for 4 TP analyzers.
- New design in production with micrometer for sample thickness measurement is ongoing.
- Prototype of VNA test cell also built for reflection (S11) measurement
- Prototype for VNA using micrometer for S11 measurements is being developed.
- Prototype for VNA which will enable full 2-port measurements (S11, S21, S12 and S22).



Automation of measurement

- Remote control software for instruments and other equipment
- Software for sample traceability and chart generation
- Cole-Cole, Nyquist, Bode plot





5 10 15 20 25 30 Real [Ω]

Conclusion

- Initial measurements and calculations show good agreement with the models
- System shows good potential to achieve goal design
- System could also be used for electromagnetic characterization of other kinds of materials

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