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BOOK OF ABSTRACTS

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On the determination of uncertainty budget of electromagnetic field spectrum analyzers – A case study

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This paper presents detailed, step by step determination of uncertainty budget of a typical lab-grade electromagnetic field spectrum analyzer. Such analyzers exist for various parts of electromagnetic spectrum, and while this paper is mainly focused toward general principles, a case study that illustrates development of uncertainty budget for a high frequency electromagnetic field meter that has a frequency range of up to 6GHz (NARDA SRM-3006 with suitable probes) is presented alongside the general principles.

First, a general model of the electromagnetic field spectrum analyzer, consisting of field probe, cable and spectrum analyzer is presented. Most common ways of describing the performance of the individual components of electromagnetic field spectrum analyzer are stated. Each individual component can be described in a number of ways, and with different level of sophistication of the models used for description, e. g. models ranging from full wave representations to equivalent circuit models. This is an important step in the development of uncertainty budget, since data sheets and calibration sheets may use different models and simplifications, and it is important to have them in mind during uncertainty budget formulation.

Typical individual components of uncertainty budget such as probe isotropy, linearity, mismatch loss, temperature dependence etc. are considered in detail along with possible ways of modeling their share in combined uncertainty. Justification for use of specific probability distributions for individual components of uncertainty is thoroughly explained. Special attention is given to the mismatch loss. Furthermore, a commonly overlooked component of uncertainty budget, namely, a choice of measurement point is briefly discussed.

Once the final set of considered uncertainty budget components is determined, combined uncertainty is calculated. Two approaches are used and results of each approach are compared. In the first approach, combined uncertainty of the field level is estimated using analytical formulas, under typical assumptions (e.g. uncorrelated input variables). In the second approach, tools of numerical statistics are applied in order to check validity of the analytically obtained model. This yields more information about estimated uncertainty distribution, and offers a way of checking analytical estimates. Finally, obtained results are compared to the requirements of the relevant international standards for electromagnetic field meters.

References

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