



POSUDEK OPONENTA DISERTAČNÍ PRÁCE

Assessment of the Dissertation

Titul, jméno a příjmení studenta:

Title, name, surname of student

Abdalghafor Almtrod

Doktorský studijní program:

Doctoral study programme

Elektrotechnika a informační
technologie

Téma disertační práce:

Topic of the dissertation

Design and Modelling of Compact
Electromagnetic Sensors for EMC
Applications

Školitel:

Supervisor

Ing. Zdeněk Kubík, Ph.D.

Oponent:

Opponent

Ing. Jan Mráz, Ph.D.

Zhodnocení významu disertační práce pro obor

Evaluation of the importance of the dissertation for the field

In his dissertation, the student designed a complex set of sensors and antennas for easier evaluation of electromagnetic compatibility of tested devices. By the comprehensiveness of his work and especially by the design of a novel magnetic field sensor, he has delivered a certain contribution to the field.

Vyjádření k postupu řešení problému, použitým metodám a splnění určeného cíle

Evaluation of the problem-solving process, the methods used and the goal to be met

The thesis is divided into six parts. In addition to the introduction and conclusion, the state of the art, objectives, methods and results are presented. The results delivered correspond to the stated objectives. However, the description of the state of the art is provided as a general overview without a critical discussion and an indication of some directly resulting motivations for the choice of methods. In the implementation part, the ad-hoc chosen sensors or antennas that meet the requirements are the directly proposed.

Stanovisko k výsledkům disertační práce a

k původnímu konkrétnímu přínosu předkladatele disertační práce

Statement to the results of the dissertation and on the original contribution of the submitter of the dissertation

The radiation and impedance characteristics of the proposed sensors or antennas in combination with their mechanical properties represent an unambiguously useful result for the field of electromagnetic compatibility. Above all, the novel magnetic field sensor proposed within the set of sensors and antennas corresponds to what is expected to be achieved in doctoral theses, i.e., to provide an original scientific outcome.

Vyjádření k systematice, přehlednosti, formální úpravě

a jazykové úrovni disertační práce

Statement to the systematics, clarity, formal adaptation and language level of the dissertation

The thesis itself generally corresponds to the standard of scientific or technical documents in terms of the structure of the document. However, there are several issues in the thesis that should have been feasible and desirable avoided. Values of quantities and their units are wrapped in the middle, dashes are used instead of hyphens for intervals, passive voice is not

strictly abided, informal or popular formulations are involved (“two sides of the same coin”), expressive terms as well (“impressive AR”).

There are other formal and/or technical issues in the thesis, for instance:

Strange general depiction of EMI types on page 1 (conductive in series with capacitive or inductive).

There is introduced a false dilemma regarding relevant properties of antennas and sensors on page 3.

The depiction on page 5 inconsistently categorizes bands of radio-frequency spectrum. EMI and EMC are confused.

On page 6, antenna factor is introduced as a quantity derived from antenna gain because field strength may be hard to evaluate as if antenna gain were not the same case.

Phasor representation of electrical quantities is suddenly utilized without having been introduced a priori and combined with temporal representation, as on page 10.

Maxwell equations are imprecisely introduced on page 14, with partially missing vectoral denotations and confused integration elements (length vs area).

Antenna factor is repeatedly introduced on page 39 in the results chapter even if defined previously.

On page 75, axes in depiction are not described.

The list of quantities is inconsistent. Several quantities are not involved or missing, as v_0 and w on page 78 or 84.

On page 98, error indicating a missing link to reference remained in the document.

Vyjádření k publikacím studenta

Statement to student's publications

The student's publications are adequate to what is specified in the Dean's directive, including the impact factor of particular publishing platforms expected for the key achievements of the thesis.

Celkové zhodnocení a otázky k obhajobě

Total evaluation and questions for defence

The thesis fulfils the substantial criteria for dissertations, therefore I recommend it for the defence. Questions follow:

1. On page 29, it is simply stated, that microstrip reference board performs better than conventional reference board. In terms of what is the latter reference worse? Perhaps, this is connected to discussion on page 76: Could it not happen that very sharp notches coming from the simulation can diminish when reference board is manufactured?
2. What characteristics of FR-4 make it a reliable choice compared to other substrate materials, as stated on page 30?
3. Throughout the thesis, the term “realized gain” is utilized. Is really realized gain considered including mismatch, or may there be a confusion with gain, as on page 39?
4. An extra conventional dipole was added to the biconical array on page 48 without previous discussion. Why not a biconical additional dipole?

Doporučuji disertační práci k obhajobě

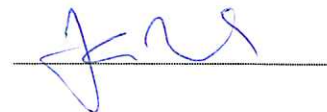
I recommend the dissertation for the defence

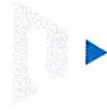
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Datum
Date

4.12.2023

Podpis oponenta:
Signature of opponnent





POSUDEK OPONENTA DISERTAČNÍ PRÁCE

Assessment of the Dissertation

Titul, jméno a příjmení studenta:

Title, name, surname of student

Ing. Abdalghfor A. A. ALMTROD

Doktorský studijní program:

Doctoral study programme

Elektrotechnika a informační technologie

Téma disertační práce:

Topic of the dissertation

Design and Modelling of Compact
Electromagnetic Sensors for EMC
Applications

Školitel:

Supervisor

Ing. Zdeněk, Kubík, Ph. D

Oponent:

Opponent

Prof. Ing. Aleš Richter, CSc.

Zhodnocení významu disertační práce pro obor

Evaluation of the importance of the dissertation for the field

The output of the work is a compact electromagnetic sensor applicable for the determination of EMI, Electromagnetic Interference. The current standard 3D antennas used in practice are quite large and, in some cases, not very suitable in terms of their electrical parameters.

The main contributions of this work to the scientific field can be categorized into two parts:

1. The research of near-field probes: Near-field EMC measurements are often overlooked by the community; however, from the perspective of the interference source localization, these measurements are indispensable. In the presented work, the design of near-field probes was carried out, and optimized for sensitivity and signal suppression from directions other than the measurement direction. The depicted probe design is unique in using PIN and varactor diodes and that is where the work highlights its originality. This novel design allows the retuning of the probe's frequency range to increase its sensitivity for specific frequencies and suppress signals at other frequencies. The simulation results have been verified by measurements. The concept of the presented probe design is novel in the EMC field and has not been reported in other research.

2. The research of antenna for EMC measurements: As for the far-field contribution, the novelty of the proposed antennas for EMC measurements is based on the significant reduction of the antenna's size and weight. The new size and weight reduction techniques have been employed through PCB technology, while meeting the requirements for EMC measurements, including wide bandwidth, wide beam-width, high gain and good antenna factor. A basic structure of a biconical dipole was developed and it was subsequently implemented in other antenna designs. All of these proposed structures are novel and have not been previously documented in other research.

Vyjádření k postupu řešení problému, použitým metodám a splnění určeného cíle

Evaluation of the the problem-solving process, the methods used and the goal to be met

The student uses contemporary tools for modelling and especially for the design of the functional model. The solution of work is efficient, from bibliographic search, the initial calculation, verification by modelling, to design and implementation of the functional model. The results are confirmed by measurements in the EMC laboratory.

Comment:

In the theoretical introduction, in the calculating antennas, the student uses and further applies mostly empirical relations, equations. The theoretical background on which the empirical relations are based is not presented.

Stanovisko k výsledkům disertační práce a k původnímu konkrétnímu přínosu předkladatele disertační práce

Statement to the results of the dissertation and on the original contribution of the submitter of the dissertation

The result of the work is an interesting unique technical solution of *Compact Electromagnetic Sensors for EMC Applications* that takes advantage of the current PCB technology and state of art.

Vyjádření k systematice, přehlednosti, formální úpravě a jazykové úrovni disertační práce

Statement to the systematics, clarity, formal adaptation and language level of the dissertation

Formal and typing errors are minimal (e.g. pages 30, 73 ...). The work is logically structured. The content and titles of the chapters correspond to the research problem solving. Figures and tables appropriately complement the text and illustrates the results.

Vyjádření k publikacím studenta

Statement to student's publications

The results of the PhD thesis were published 7 times. Significant publications include A2, A6, A7 (pg. 106). The other 7 publications of the student demonstrate a deep knowledge in high frequency technology and EMC. All the student's publications are related to the field of EMC and the doctoral study programme of faculty.

Celkové zhodnocení a otázky k obhajobě

Total evaluation and questions for defence

The thesis meets the requirements for the award of the PhD degree. The results of the work were presented at international level.

The question for defence:

What simplifications of the basic relationships, equations can be applied in the design of PCB antennas versus conventional ones?

Doporučuji disertační práci k obhajobě

I recommend the dissertation for the defence

ano
yes

Datum

Date

17.11.2023

Podpis oponenta:

Signature of opponent





POSUDEK OPONENTA DISERTAČNÍ PRÁCE

Assessment of the Dissertation

Titul, jméno a příjmení studenta:

Title, name, surname of student

Doktorský studijní program:

Doctoral study programme

Téma disertační práce:

Topic of the dissertation

Ing. Abdalghfor Abdalghfar A. Almtrod

Elektrotechnika a informační technologie

Design and Modelling of Compact
Electromagnetic Sensors for EMC
Applications

Ing. Zdeněk Kubík, Ph.D.

doc. Ing. Mikuláš Šostronek, PhD.

Školitel:

Supervisor

Oponent:

Opponent

Zhodnocení významu disertační práce pro obor

Evaluation of the importance of the dissertation for the field

The submitted dissertation is at the required level. The author deals with the issue of design, construction, and parameter evaluation of selected types of electromagnetic and magnetic field sensors used in EMC. The aim of the work was to reduce their dimensions and weight while maintaining their large bandwidth. This issue is highly relevant in the field of EMC measurements. Besides of other dissertation outputs, I highly appreciate the realization of the novel high sensitivity switchable magnetic probe, which has been designed, simulated, and evaluated.

Vyjádření k postupu řešení problému, použitým metodám a splnění určeného cíle

Evaluation of the the problem-solving process, the methods used and the goal to be met

In Section 3, the author has clearly defined five sub-goals, which are design, modelling, simulation, realization, and testing of three compact antennas for far field measurements and two structures of printed magnetic probes. The procedure for solving these goals is presented in section 5 of the dissertation and it is characterized by logical continuity.

The chosen methods of processing the dissertation correspond to the level of knowledge and possibilities of the doctoral student.

I conclude that the author has fully fulfilled the goals he set.

Stanovisko k výsledkům disertační práce a k původnímu konkrétnímu přínosu předkladatele disertační práce

Statement to the results of the dissertation and on the original contribution of the submitter of the dissertation

The results and conclusions of the work are clearly justified, their processing and interpretation is at the required level.

I consider the design, modelling, simulation, fabrication, and testing of the following sensors to be the original contribution of the dissertation:

- printed biconical dipole antenna with tapered balun.
- broadband printed log-periodic biconical dipole array antenna.
- dual-stacked log-periodic biconical dipole array.
- one-face three-loops (1F3L) probe and a two-face three-loops (2F3L) probe
- switchable broadband to tuneable narrowband magnetic probe.

All above mentioned outputs of the dissertation were published in impact factor journals and international conferences.

The mentioned practical outputs of the dissertation were also transformed into three registered functional samples.

I note that the results of the work are original and presented solutions brings new partial knowledge, which can be considered a good basis for solving the design and implementation of sensors for measurements not only in EMC field.

Vyjádření k systematice, přehlednosti, formální úpravě a jazykové úrovni disertační práce

Statement to the systematics, clarity, formal adaptation and language level of the dissertation

The dissertation thesis is clearly written. A bit confusing is the different title of the dissertation thesis on p. 2 opposite the title on the title page.

Furthermore, I have the following comments on the work:

- on p. 5 abbreviations should be arranged alphabetically.
- in several places, the units of meters are mistakenly given in millimetres (e.g., on p. 8, par. 2) and vice versa (on p. 95, the last sentence)
- throughout the work, a letter "w" indicates the angular frequency (in rad/sec) but at the same time it also indicates the „width of the microstrip” (e.g., on p. 95; in eq. (5.19), (5, 20) etc.). I think that the Greek symbol "omega" (ω) is commonly used to denote the angular frequency.
- in the equation (p. 7, eq. 6 from the top) for computation of an antenna factor the value of 50 Ohm is missing in denominator.
- I think the equation for calculating the characteristic impedance is $\eta = \sqrt{\frac{\mu_0}{\epsilon_0}}$ and not $\eta = \frac{\mu_0}{\epsilon_0}$ as stated in the last sentence at the bottom of page 10.
- on p. 73, in Table 19, there are missing units for E-plane and H-plane half-power beamwidth.
- on p. 78, Fig. 66, the antenna factor should be given in (dB/m), and not in (dB).
- on p. 93, in Fig. 93, the schematic symbol of the PIN diode is drawn incorrectly.

Since English is not my native language, I cannot comment on the language level of the dissertation.

Vyjádření k publikacím studenta

Statement to student's publications

The student is the author or co-author of 18 publications, of which 8 are related to the dissertation.

I consider number and quality of publications to be sufficient for the mentioned type of work.

Celkové zhodnocení a otázky k obhajobě

Total evaluation and questions for defence

On the professional side, the dissertation is written in a very comprehensible and clear manner. It demonstrates the author's scientific and professional abilities.

However, I have several comments regarding the professional level of the work, which I request to answer in a discussion:

1. Please, explain the term „matric relative bandwidth FBW“, used on p. 5, par. 1.
2. On p. 46, par. 2 and 3 you state that parameters of scaling factor (τ) and spacing factor (σ) were obtained from Carrel diagram. However, this diagram and the method of obtaining the mentioned parameters are missing in the work. Can you demonstrate the procedure to get τ and σ parameters from Carrel diagram?

Doporučuji disertační práci k obhajobě

I recommend the dissertation for the defence

ano
yes

x

ne
no

Datum

Date

November 29, 2023

Podpis oponenta:

Signature of opponent

doc. Ing. Mikuláš Šostronek, PhD.