Dissertation Thesis Review

Ing. Miroslav CUPAL

Textile Integrated Waveguide Components

Topicality of the dissertation thesis. Dissertation thesis of Ing. Miroslav Cupal is dedicated to the research of microwave components implemented in Textile Integrated Waveguide (TIW) as a textile variant of Substrate Integrated Waveguide (SIW). TIW technology, introduced in the last 20 years, especially in the context of implementation of wearable electronics and wireless and sensor body communication networks (Wireless Body Area Networks, WBAN, Body Sensor Networks, BSN), has received much attention in the last decade, as evidenced by a large number of publications at conferences and in IEEE magazines incl. their abundant quotes. **The work therefore deals with a current scientific topic and corresponds to the field of Electronics and Communication Technology**.

Original contribution and original results. The work focuses on investigating the properties of transitions between classical microstrip line and waveguide integrated into textile, design and optimization of waveguide T-divider parameters in TIW technology with active switching of shorting pins using PIN diodes realizing a switch, design and analysis of circularly polarized slot antenna in waveguide realized by TIW technology in the ISM bands 5.8 GHz and 24 GHz and electrical characterization of conductive textile threads and TIW waveguides formed from them.

The core of the work consists in investigating the properties of these components through a series of parametric studies using the EM simulator CST MWS and their comparison with measurement.

The work is written in English, the text is well and logically organized, graphical outputs are at the appropriate level. Individual chapters summarize the achieved results.

In particular, the original results can be considered:

- finding the optimal setting of coupling pin parameters in the transition of the microstrip line to TIW waveguide for required impedance properties of the transition,
- finding the significant impact on the properties of a microwave switch in the form of a T-divider with active switching of short-circuit pins (especially for broadband and frequency detuning) depending on the choice of switch parameters (size of circular coupling slot, position of switched pins, number of switched PIN diodes, ..); and the resulting component design methodology,
- demonstrated high sensitivity of a circularly polarized circular slot antenna loaded with a cross slot to its wideband performance and frequency tuning; and the resulting finding of the optimal setting of geometric parameters for the required impedance parameters and directional characteristics of the radiator,
- performing a comparative study of the transmission properties of a TIW waveguide with sidewalls formed of different types of conductive textile threads; the resulting recommendation for the choice of threads for optimal performance of the studied TIW waveguides.

I have the following formal comment:

- the respective pairs / triples of graphs should have the same scale on the y-axis for easier comparison of results, e.g. see S-parameters of the switch: for parabolic and linear position of the pins, p. 22, fig. 15 and 16; for different number of PIN diodes, page 26, Fig. 25 etc.

Publication results, scientific erudition.

The candidate presents 18 conference papers as the author or co-author, of which 8× is the first author, two published articles in impacted journals (IET MAP and MOTL), where he is the first author in one of them and three other articles submitted for review to impacted journals in which he is the first author. This testifies mastering publishing skills. The scientific erudition of the author can therefore be considered sufficient to obtain a doctoral qualification.

Conclusion. The thesis contains the original published scientific-research results of the candidate and meets the conditions of independent creative scientific work for awarding the academic title of Ph.D. Therefore, I

RECOMMEND

the submitted thesis for the defense.

Kvetnice, April 27, 2020

… ……...

Assoc. prof. Ing. Milan Polívka, Ph.D.

Questions for the defense:

1. How do the higher number of shorting pins and a different position other than on the linear or parabolic curve affect the properties of the microwave switch? For example, the position of three pins on the "L" shaped curve. A comparison of Figs. 15 and 16 shows that S11 is better for the position of the pins on the parabolic curve, i.e. further apart from the input port.
2. In chapter 6, tab. 8 shows the measured values of the resistivity of the threads up to the frequency of 100 kHz. However, you use the threads at frequencies significantly higher, i.e. at 5.8 GHz and 24 GHz. What resistivity values do you consider at these frequencies?
3. How do you explain that the transmission of a TIW waveguide, whose walls are made of threads no. 7 and 8, see fig. 72 on p. 58, improves with increasing frequency while deteriorates when using the other threads presented?

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