**Low-loss microwave circuits in strip transmission line technique. Analysis, design and experimental investigations**

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**Dyscyplina:** Elektronika

**Abstract:**

Currently observed increasing demand for telecommunication systems` bandwidth and range results in necessity of increasing transmitting power or multiplication of transceivers while keeping transmitting power and with limitation on dimensions. In order to fulfill those requirements, it is necessary to research for novel solutions and technologies allowing for realization of compact and lightweight systems with high level of components integration and increased power efficiency. One of the development direction is a wider application of strip transmission line technique. Circuits realized in such technique are quasi-planar structures, what allows for not only relatively easy modeling and fast design but also for easy integration of passive and active, low and high frequency circuits into one board. Such an approach can reduce mechanical design complexity and allow for more compact components as well as reduction of the entire system costs. However, such circuit suffer from relatively high power losses (which is mostly converted into heat) in comparison to e.g. metal waveguides which is a result of partial or full propagation of electromagnetic wave within lossy dielectric substrates (laminate) preventing such circuits from application in high power circuits.

This Thesis includes and is dedicated for analysis, design and experimental verification of microwave circuits designed in strip transmission line technique. The main goal of this work it to investigate the possibility of realization as well as development of new design methodologies and circuits topologies of microwave filters, including directional filters, as well as directional couplers utilizing sections of coupled transmission lines, which are going to feature high selectivity/directivity and relatively low power losses. In this work, following is considered:

• application of novel realization schemes and constitutive elements topologies to improve performance and minimize power loss;

• circuit power loss reduction by improving subcircuits topology and altering realization technique;

• circuit topology optymalisation focused on performance improvement as a way of power loss reduction;

• combination of different functionalities into one circuit as a way of power loss reduction;

• introduction of novel materials and manufacturing technologies for low-loss circuits realization;

• power loss reduction as a way for circuits‘ functionality improvement.

All of the above-listed aspects have been comprehensively investigated and widely described by the Author in the journal papers and conference proceedings, which are included in this Thesis. The result of a theoretical work as well as experimental investigation is a variety of novel circuit solutions and design methodologies, including:

• realization of band filters has been proposed utilizing periodic structure approach composed of electrically short, identical unit cells as well as novel unit cell topologies have been developed realized using coupled and uncoupled sections of transmission lines and lumped elements featuring bandpassand bandstop response together with their theoretical model and design methodology;

• realization of broadband bandpass filters utilizing periodic structure approach in suspended stripline techniqe utilizing novel unit cells composed of solely coupled and uncoupled transmission line sections;

• development of novel topologies of directional filters allowing to introduce transmission zeroes to improve their selectivity and directional filters with appropriate phase shifters allowing in increase operational bandwidth;

• development of novel impedance transforming directional couplers and baluns and development of frequency channel multiprexer in which cascade connection of directional filters has been used for additional channels` selectivity improvement.

• a 3rd dimension has been introduced due to utilization of 3D printing technology to the design process of suspended stripline directional coupler allowing to realize high performance, self-contained and lightweight circuit.

• development of novel topology of directional-coupler based impedance tuner with extended impedance range allowing for push-pull measurement of power transistors and development of an exemplary high power transceiver based on such transistor

All of the developed methods and circuits have been experimentally verified proving their applicability. The obtained results presented in this Thesis will allow for better integration of particular blocks of high power transceiver front-ends of telecommunication equipment as well as reduction of overall dimension and weight by replacement of metal waveguide based components with uniform, integrated system designed with the use of strip transmission line techniqe.