Institut für Mikroelektronik Stuttgart
Stiftung des bürgerlichen Rechts

Stand:
02.09.2021

Arbeitsbereich:
RF circuit design & Sensor System

Ausrichtung:

☒Entwicklung & Simulation
☒Leiterplattenlayout
☒Charakterisierung
☐Programmierung
☒Hardware-Entwicklung
☒Messtechnik
☒Machbarkeitsstudie

Studiengang:
☒Elektro- und Informationstechnik

Einstieg:
01.10.2021

Umfang:
6 Monate

Vorkenntnisse:
☒RF Schaltungstechnik
☒analoge Schaltungstechnik
☒RF Simulation
☒PCB Design & Layout-Erfahrung

Masterarbeit

Miniaturized Signal Source for Control of Mini-Robots

Motivation

Miniaturized robots hold great potential for biomedical applications, including drug delivery, in vivo sensing and stimulation. Their small footprints allow increasing precision of surgical interventions, and minimize patient discomfort and recovery time. However, current microrobots lack of efficient miniaturized actuation and propulsion mechanisms in fluids, which severely hamper the development and wide application of microrobots. We proposed a new kind of micro-propulsion mechanism, i.e. using the acoustic streaming (a water jet) generated by a miniaturized radio-frequency resonator to delivery drug on demand underwater. The overall research goal of the RF-bot project is to develop an integrated millimeter-scale robotic system with miniaturized electronics and sensors, aiming at a useful prototype for wireless micro-pump for controlled drug delivery in the human body.

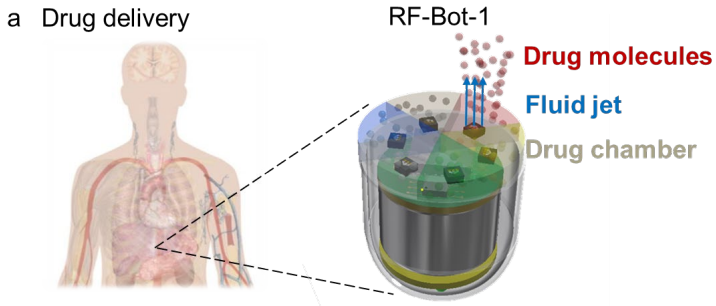

Fig. 1 Schematic of the RF-Bot for controlled drug delivery in the human body.

Description/ Aufgabenstellung

The specific aim of the MSc thesis work is to design and test of an RF-powering miniaturized circuit board that uses DC-power and outputs stable high-power RF signal. The detailed tasks are summarized below:

- ✓ Literature study and get a comprehensive overview of the RF-robot system.
- ✓ Analyze the specifications of the RF-powering circuit board and propose a suitable circuit design scheme.
- ✓ Select proper RF components and design the miniaturized PCB.
- ✓ In depth simulation of the circuit, including the PCB parasitic.
- ✓ PCB manufacturing and components assembly.
- ✓ Measurement of the designed RF-powering PCB.
- ✓ Thesis writing and final presentation.

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Prerequisites/Voraussetzungen

- ✓ Knowledge of RF circuit design
- ✓ Knowledge in high frequency PCB design and layout

Design Specifications

An RF-powering module will be designed and tested. The detailed technical requirements are listed below.

- ✓ Output frequency = 2580 MHz +- 5MHz @ 20-40°C
- ✓ Maximum output power >= 23 dBm (OP1dB >= 19dBm) at 2580 MHz
- ✓ DC power supply needed for maximum power output: <= 8 V maximum DC supply current <=150 mA
- ✓ Size of the board: as small as possible, ideally the volume is smaller than 1x1x0.5 cm³ (including all electronic components, but not the DC power source and the RF output connector). The size can also be larger on one side but smaller on the other, e.g. 2 x 0.5 x 0.5 cm³. The PCB can also be two-sided.
- ✓ DC power and RF output use pin connectors that are as small as possible.
- ✓ Impedance = 50 ohm
- ✓ OP1dB >= 19dBm
- ✓ VSWR < 2:1
- ✓ Optional: 4 output channels, of which only one can be active at a time and which can be controlled externally via one or more digital inputs.

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Remarks

The project is a collaboration among:

- ✓ IMS CHIPS: www.ims-chips.de
- ✓ Cyber Valley University Stuttgart, Biomedical Microsystems Group: https://www.cyber-valley.de
- ✓ Institute of Robust Power Semiconductor Systems (ILH) University Stuttgart: https://www.ilh.uni-stuttgart.de