UNIVERSITÄT DUISBURG ESSEN

Fachgebiet Hochfrequenztechnik

H F T

Fachbereich Ingenieurwissenschaften
Abteilung Elektrotechnik und Informationstechnik

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Aufgabe der Abschlussarbeit im EIT Bachelorstudiengang

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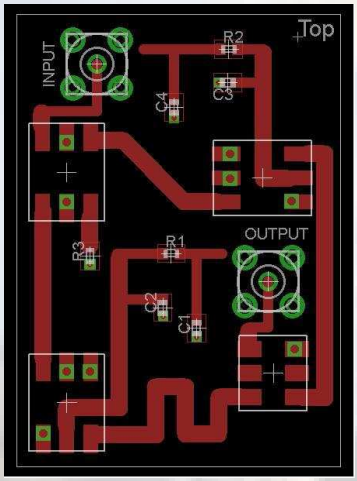
Thema: **I/Q-Demodulator Circuit for 7-Tesla Magnetic Resonance Tomograph (MRT)**

Beschreibung:

Our research project “7-Tesla MRT Ganzkörperspule” provided an array of coils (antennas) which are connected to high-power radio frequency (RF) transmitters at 300 MHz; the transmit signals are electronically steered in phase and amplitude by electronic vector modulators (on the low-power side of the transmitters) in order to compensate inhomogeneous field distributions inside the patient body. In order to guaranty proper operation of the high-power system (patient safety), one work package requires the implementation of an electronic I/Q-demodulator for phase/amplitude measurement of the actual RF signals at the output of the eight high-power amplifier stages. The amplifiers provide low-level samples of the high-power output signals via directional couplers which couple to the forward and reverse (reflected) power waves. The two coupled signals from each of the eight transmitters have to be analyzed with respect to their amplitude and phase in order to allow a comparison with the intended (safe) signal formats.



The thesis task is to design, build and test a circuit for the 16 signal channels of forward and reflected power. The complete circuit comprises a bank of RF I/Q-demodulator circuits, a sample/hold circuit for each output signal with external trigger input and an amplifier chain for the provision of local oscillator power for the demodulators. The realization technology is to be RF-printed circuit technology (microstrip line); a design for a four-channel I/Q-demodulator circuit has been realized in an earlier Bachelor Thesis and can be used as a building block. The remaining RF circuits will employ commercial amplifier blocks and commercial passive power splitter/combiner circuits in surface mount technology. The sample/hold (S/H)-circuit employs an integrated circuit in printed circuit technology.

Left: PCB-layout of single channel I/Q-demodulator

In particular the task is to

- design the local oscillator power amplifier chain and lay-out a microstrip (or grounded coplanar) circuit realization on Rogers RO4003 laminate,
- prepare the data files for production of printed circuit boards,
- assemble and test the circuits (match, gain, amplitude- and phase balance) using the network analyzer,
- design the S/H circuits and lay-out a printed circuit board and prepare the data files for production of the board,
- assemble and test the S/H circuits,
- assemble four I/Q-demodulator circuit boards and test the demodulator accuracies of each channel,
- integrate all sub-circuits on a mounting plate and connect signal and power supply lines (cable) and test the functionality of the complete circuit.

At the end of the work, a public presentation of results is to be given.