UNIVERSITÄT DUISBURG ESSEN

Fachgebiet Hochfrequenztechnik

H F T

Fachbereich Ingenieurwissenschaften
Abteilung Elektrotechnik und Informationstechnik

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Aufgabe der Abschlussarbeit im ISE Bachelorstudiengang

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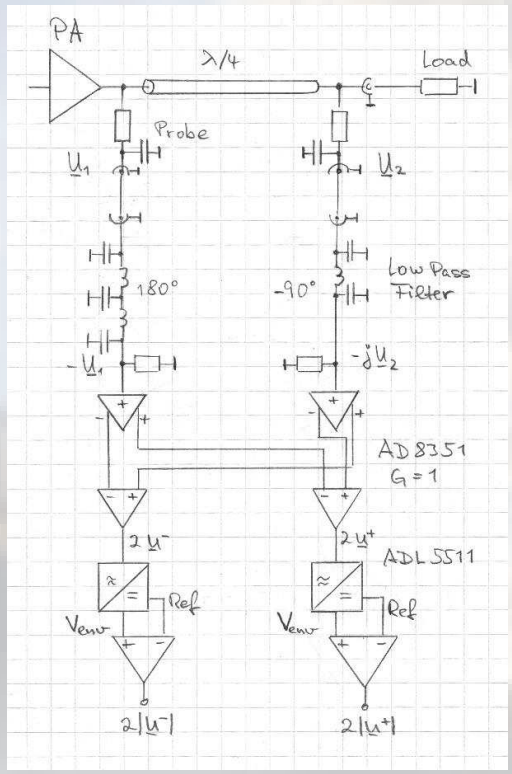
Thema: **Analogue Signal Processor for 7-Tesla MRI Power Amplifier**

Beschreibung:

In a research project, the department develops a high pulse-power amplifier for a 7-Tesla Magnetic Resonance Imaging (MRI) system. The power amplifier (PA) employs a high pulse-power final stage with a maximum of 1 kW output power into a load at an operating frequency of 298 MHz. In case of a mismatched load, the forward wave from the amplifier is partially reflected. The reflection coefficient can be calculated from the voltages of the forward and reflected waves. The amplifier samples the total voltages at its output at two positions along a transmission line in a distance of a quarter wavelength, as shown in the schematic. The two voltages may be combined by summation and subtraction to form the voltages of the forward travelling wave and of the reflected wave. In a realization, the two input signals are first low-pass filtered and phase-shifted and optionally may be attenuated. The combination processing can be performed using fast operational amplifiers AD8351 and the measurement of the peak voltage values can be performed in an integrated circuit ADL5511.



Thesis Task:

The task of the thesis is to build a processor circuit and demonstrate its performance parameters, like impedance match, amplification gain, dynamic range, linearity and orthogonality of the channels.

In particular, the task entails the following steps:

- Make a simulation of the low-pass filter and attenuator circuit using the Advanced Design System (ADS) network simulation tool and optimize the component values.
- Design a circuit layout using SMA board connectors and circuit components in surface mount technology (SMD) as far as possible. Provide ground potential on both front and back of the substrate; use both sides for signal lines in order to keep lines as short as possible. Include test points (eyes) in the design. Include trim capacitors for fine adjustment of the filters' insertion phase. Include the operational amplifiers and the two envelope detector integrated circuits in the layout based on the manufacturer data sheets. Note: both circuits have been used in earlier designs produced at the department.
- Assemble the circuit after production of the PCB at our workshop.
- Test the circuit regarding impedance match, amplification gain, dynamic range and linearity. Check the phase and amplitude balance of signals at the input and output of the operational amplifiers and verify the summation and subtraction of the input signals.
- Verify the proper functioning of the processing circuit using signals probed at a high-power amplifier in CW- and pulsed excitation and using a matched and a mismatched load.

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