

**Aufgabe der Abschlussarbeit im
ISE Bachelorstudiengang**

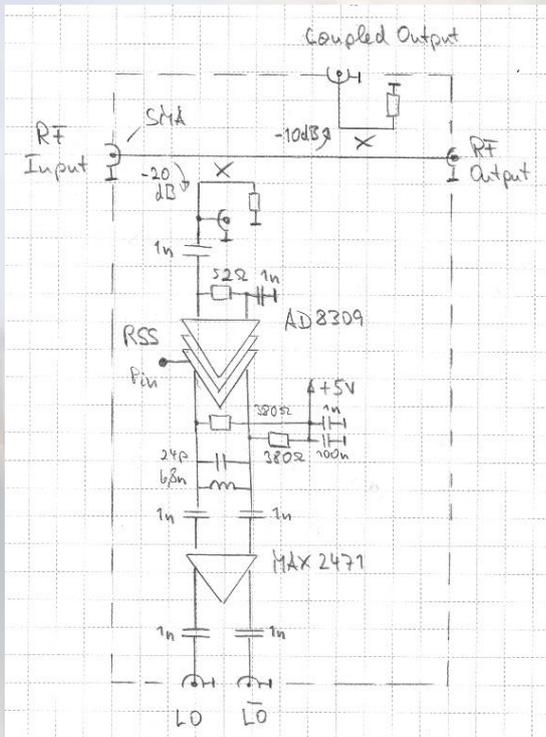
für: Frau Yuting Wang

gestellt von: Prof. Dr.-Ing. Klaus Solbach
Fakultät für Ingenieurwissenschaft - HochfrequenztechnikThema: **LO Signal Generation Circuit for Power Amplifier in a 7 Tesla MRI System****Beschreibung:**

Description:

In our project *MRexcite* we develop a 32-channel RF transmit power amplifier array for a 7 Tesla MRI system. The design of the amplifiers includes probes which provide RF signals proportional to the currents in the MR coils (I_i). The signal is used to control the power amplifier in a Cartesian feed-back loop which is based on a down conversion process. The down conversion is realized in a mixer circuit which requires a balanced local oscillator (LO) signal of fixed amplitude. The LO signal has to be derived from the RF input signal which drives the power amplifier. Since this RF signal is amplitude modulated, a circuit is required which generates a constant amplitude signal (nearly) independent of the momentary RF input signal amplitude.

The task of this thesis is to design, build and test a suitable circuit based on a logarithmic limiting amplifier AD8309 and a buffer amplifier MAX2471. The simplified schematic of the circuit shows the input signal at RF of 300 MHz, a directional coupler coupling out a small part (-20 dB) to the limiting amplifier and a second directional coupler that couples out another small part (-10 dB) of the signal for monitoring purposes while the larger part of the signal goes out to the power amplifier at the RF output SMA connector. The limiting amplifier provides extremely high amplification with a signal at its output clipped to a square wave shape (limiting) of about $2 V_{pp}$. The signal shape of sinusoid is restored by using a resonant circuit filter at 300 MHz and this signal is then buffered by another amplifier which provides a balanced LO-signal to the down converter.



Task:

The task of the thesis is to build such a circuit on a printed circuit board (PCB) and using the integrated circuits as given in the schematic.

The task entails the following steps:

1. Familiarize with the function of the circuit components, in particular the ICs and the directional coupler, using the data sheets of the manufacturers.
2. Familiarize with EAGLE, the CAD tool for the design of printed circuits boards, using the EAGLE tutorial.
3. Design the circuit schematic, including all necessary SMD components for the operation of the ICs based on the examples and evaluation board proposals given in the data sheets.
4. Transfer the circuit to the board layout in EAGLE and optimize positions of components.

5. Deliver the PCB data set to the in-house PCB workshop which will provide the PCB with the ICs assembled. Assemble the SMD components to the fabricated PCB and test the functionality of the circuit. In particular:
 - a. Test the current consumption of the circuit and compare to the data sheet values,
 - b. check the dc voltages at the power supply pins of ICs as well as at the input / output pins of ICs,
 - c. apply an RF signal at the input ports and check the correct coupling levels of the directional couplers and check the generated signals at the limiting amplifier and the buffer amplifier using a spectrum analyzer and an oscilloscope,
 - d. investigate the dynamic range of the circuit, i.e., down to what input level will the circuit provide a valid LO signal at its output?
6. In case of any flaw in the circuit, redesign and repeat the production process.

After delivery of the thesis, a public presentation of the results is to be given at the HFT department.