UNIVERSITÄT DUISBURG ESSEN

Fachgebiet Hochfrequenztechnik

H F T

Fachbereich Ingenieurwissenschaften
Abteilung Elektrotechnik und Informationstechnik

Prof. Dr.-Ing. K. Solbach
Prof. Dr.-Ing. A. Beyer

Aufgabe der Abschlussarbeit im ISE Bachelorstudiengang

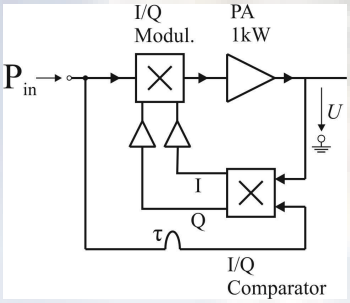
für: Herr Bin **Sun**

gestellt von: Prof. Dr.-Ing. Klaus Solbach
Fakultät für Ingenieurwissenschaft - Hochfrequenztechnik

Thema: **I/Q-Modulator Circuit for 7-Tesla MRI Smart Power Amplifier**

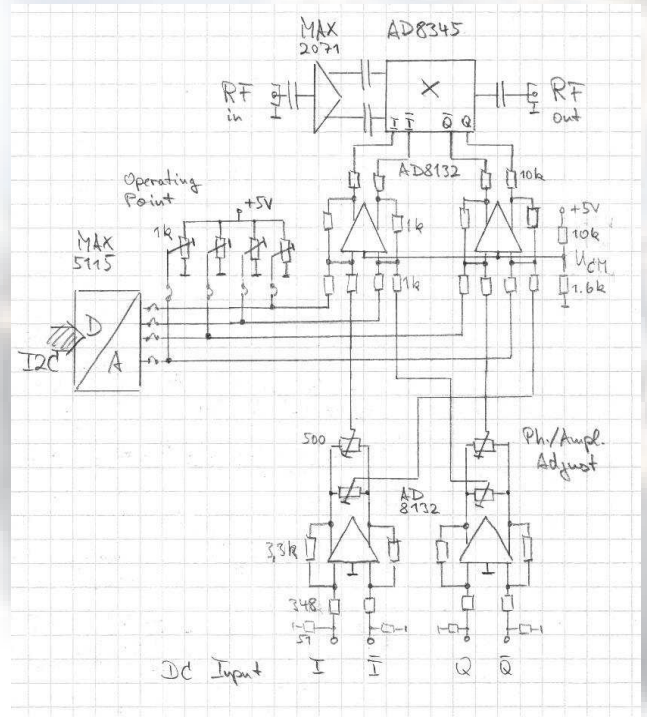
Beschreibung:

In our project MRexcite, the department develops a high pulse-power amplifier for a 7-Tesla Magnetic Resonance Imaging (MRI) system. The power amplifier employs a high pulse-power final stage with a driver amplifier chain and a Cartesian feedback loop to control amplitude and phase of the generated power signal. The feedback loop is based on the translation of the RF signal at 300 MHz to baseband (zero frequency) with in-phase and quadrature-phase components.



One component of the smart power amplifier control loop is a circuit that modulates the RF signal at the input side of the power amplifier by changing its amplitude and phase depending on the analog control voltage which is produced by an I/Q-comparator placed at the output side of the power amplifier. The modulation function can be performed by an I/Q-modulator circuit which is controlled by the analog I/Q baseband voltage and which receives the RF input power P_{in} and delivers the modulated RF signal at its output to the input of the power amplifier.

The thesis task is to design and produce an I/Q modulator circuit which employs the vector modulator integrated circuit AD8345 and network of operational amplifiers AD8132 for the conditioning of the baseband voltages (amplification and cross-coupling for amplitude and phase control). For the setting of the DC operating point of the modulator circuit, a quad-DAC MAX5115 is to be implemented which can be controlled via an I2C bus; as an alternative, the circuit is to offer the setting of DC voltages by potentiometers, see the attached simplified schematic.



The task entails the following steps:

1. Set up the complete schematic for the circuit based on the data sheets of the IC manufacturers and based on earlier thesis reports.
2. Design a PCB layout which also includes suitable test points and assemble (after production of the PCB at our workshop) the circuit.
3. Check the DC current consumption and DC operating points of the active components of the circuit and correct any errors in the design and assembly.
4. Test the functionality of the phase/amplitude adjustment circuit, the DC operating point adjustment (using the potentiometers) and the RF functionality of the IQ modulator.
5. Activate the DC operating point adjustment by the DAC and verify its functionality using the I2C bus control via a PC modem available at the department.

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