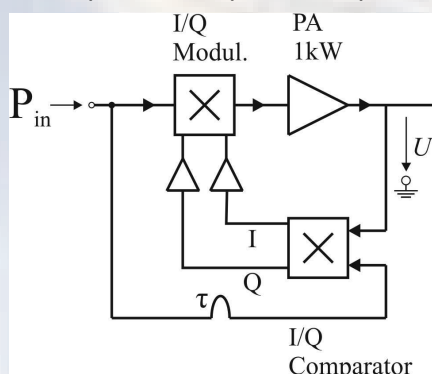


**Aufgabe der Abschlussarbeit im
EIT Bachelorstudiengang****für:** Herr Khaled Al Rifai**gestellt von:** Prof. Dr.-Ing. Klaus Solbach
Fakultät für Ingenieurwissenschaft - Hochfrequenztechnik**Thema:** I/Q-Modulator Circuit for 7-Tesla MRI Smart Power Amplifier**Beschreibung:**

In a research project, 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.

Thesis Task:

The thesis task is to design and produce a suitable I/Q modulator circuit. The vector modulator circuit is to employ the integrated circuit AD8345 (Analog Devices Inc.) and schematics of the circuit and the board layout may be derived using examples given in the manufacturer's data sheet. Before application of the I/Q baseband control voltage (from the I/Q comparator), the voltage has to be amplified in a pair of operational amplifiers to achieve the required feed-back loop gain. For the adjustment of the feed-back phase, a resistive cross coupling network at the output of the operational amplifiers has to be realized.

The task entails the following steps:

1. Design a circuit layout and assemble (after production of the PCB at our workshop) the I/Q-modulator circuit using the AD 8345 with a buffer amplifier (active balun) MAX2420 at its RF input.
2. Test the functionality of the circuit and verify the dynamic range of the RF path using a vector network analyzer.
3. Design and build a pair of operational amplifiers of 1 MHz corner frequency and a gain of 20 dB.
4. Design and build a resistive network for cross-coupling of the output signals of the operational amplifiers and test the functionality of the circuit in combination with the operational amplifiers.
5. Combine the layouts of the I/Q-modulator and operational amplifiers using as little as possible board area.
6. Assemble the circuit (after fabrication of the PCB) and demonstrate the functionality using a vector network analyzer.

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