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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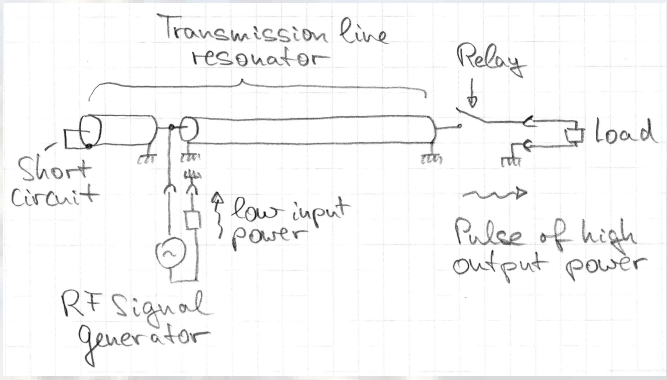
Thema: **RF Pulse Compression Circuit for High-Power Testing of RF Components**

Beschreibung:

In a present cooperation with the Erwin L. Hahn Institute for Magnetic Resonance Imaging, the department has designed and produced circuits for the distribution of high power pulses of RF signals in the 300 MHz range. Testing of the circuits has been done using a low-power (small-signal) vector network analyzer, which allows for the determination of insertion loss and phase errors but does not give any indications concerning the power handling capabilities of the circuits when power levels are applied in the kW-range; due to a lack of a suitable high-power signal generator, this has to be tested in the real environment of the MR-Tomograph by operating the circuits as part of the intended system application. This procedure introduces schedule delays and has to be replaced by proper high-power testing in the laboratory before system application. Therefore, it is intended to adopt a simple and cost-effective way for the production of high-power test pulses: The *RF Pulse Compression Circuit* which is fed by a low-power signal generator and produces short pulses of much higher output power. This concept has been used for 30 years in High Energy Physics (particle accelerators) at microwave frequencies and is now applied to much lower frequencies; preliminary experiments around 20 MHz using simple coaxial transmission line resonators have shown feasibility and verified approximate formulas and simulator results.



The task of the thesis is to

- investigate the concept by applying fundamental transmission line theory for the derivation of design equations (line length, tap distance from short, feed impedance,Q-factor, pulse length, pulse power gain)
- check the calculations using a microwave network simulator
- predict the achievable power gain for a number of coaxial cables at frequencies from 20 MHz to 300 MHz; propose a cable size for a power gain of 80 at 300 MHz and 100 µsec pulse length
- measure the attenuation constant of a number of laboratory coaxial cables
- build transmission line resonators using the cables and check the Q-factors
- verify the predicted gain by operating the resonators with an electro-mechanical switch (relay) and measuring pulse amplitudes with an oscilloscope.

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