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## Diplomarbeit / Masterarbeit

### **Aufgabe der Masterarbeit im Studienprogramm**

International Studies in Engineering (ISE)

**für:** Herrn Xiaoning Wang  
**gestellt von:** Prof. Dr.-Ing. K. Solbach  
Fakultät für Ingenieurwissenschaften - Hochfrequenztechnik

**Thema:** **Linear Zero-IF Direct Conversion Receiver**

#### **Description of Problem:**

In receivers for communications, Radar and navigation systems the weak antenna signals are amplified and converted into an intermediate frequency band where they are further amplified. These functions are realized by amplifier and mixer circuits which operate weakly nonlinear so that intermodulation products and harmonics are produced apart from the desired fundamental signals and mixing products. In zero-IF receivers, apart from the third-order intermodulation products, the second-order intermodulation products and harmonics of fundamental signals are all produced by the mixer and amplifier circuits and are present in the base-band frequency range output. Contrary to conventional heterodyne receivers, second-order products and harmonic products may not be filtered out in the zero-IF system, which makes linearity even more important in this type of receiver.

**Diplomarbeit / Masterarbeit****Task**

The thesis task is based on a circuit description of a zero-IF receiver for short wave application, designed by Rick Campbell, KK7B and presented and discussed in CQ DL 10 – 2004 to 12 – 2004.

- The critical parts of the receiver, namely the RF mixer, the diplexer filter and the base-band small-signal amplifier with low-pass and high-pass filters (for SSB operation) are to be built in printed circuit technique. An RF low-noise amplifier of about 10 dB gain is to be added and the local oscillator (LO) is to be replaced by a laboratory signal generator. Consequently, the properties of the receiver are to be determined experimentally. In particular, the following receiver parameters are to be tested and compared to conventional receiver characteristics and known data (mixer data sheet):
  - Noise figure across the base-band
  - Gain
  - $IP_2$ ,  $IP_3$  and suppression of fundamental signal harmonics
  - Spurious-free-dynamic range and its dependence on local oscillator power
- From the measured intermodulation products for various input signal levels the coefficients of a Taylor series are to be derived in order to model the nonlinearity of the complete receiving system.
- The last task is to design a post-distortion circuit that can be introduced into the receiver base-band amplifier chain in order to cancel intermodulation products. The design of this circuit is to be based on one earlier thesis (of 8.3.2004) which demonstrated the concept, and the results of one present thesis work which applies the concept to the linearization of conventional heterodyne receivers (high IF).

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