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**Schnelle Parallel-Datenübertragung  
mit zeitbegrenzten Impulsen**

ABHANDLUNG

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des Titels eines Doktors der technischen Wissenschaften  
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## Abstract

The use of frequency-division-multiplex methods ("parallel transmission") permits high-speed transmission of data signals over nonideal media (e.g. telephone channels) without any equalization of the transmission channel.

In a first part the theory of a frequency-division-multiplex (FDM) system is derived by means of the sampling theorem in the frequency domain. It is shown that the so-called "parallel data transmission" with time-limited orthogonal sine and cosine pulses results in a simple manner from a special case of general FDM system theory.

In a second part a brief introduction to parallel data transmission is given. Some time-limited waveforms which are suitable for parallel transmission are discussed. An approximation method for the determination of transmission impairments caused by envelope delay distortions is given.

The realization of parallel data transmission systems is strongly dependent of the solution of synchronization problems. In each subchannel carrier- and clockoscillators have to be synchronized independently. After a brief survey of some known synchronization principles new methods of obtaining carrier phase and clock frequency references in the receiver are proposed. A simple high-speed parallel data modem equipped with the proposed synchronization systems is described. Since its properties allow for simple implementation possibilities through integrated circuits and good signal transmission performance in the presence of Gaussian and impulse noise and both amplitude and phase distortions the modem is well suited for data transmission over telephone channels.