Radioelectronics and Communications Systems
Vol. 49, No. 10, pp. 16–24, 2006

Izvestiya VUZ. Radioelektronika
Vol. 49, No. 10, pp. 25–38, 2006
UDC 621.391.14

CLASSES OF MINIMAX BI-PHASE SIGNALS BASED ON PERFECT BINARY ARRAYS

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Based on the full class of perfect binary arrays of the order $N = 8$ and of the volume $J = 688128$, an ensemble of minimax bi-phase signals of the length $n = N^2 = 64$, with their correlation parameter $R_{\min\max} = 6$, is set up. It is established that the correlation properties of normal systems (64×64) of bi-phase signals based on perfect binary arrays are best from the viewpoint of minimax criterion, as compared with known derived Walsh-Hadamard systems used in the CDMA standard technologies.

The technology of CDMA standard evolves steadily [1], while the principles of IS-95A technology remain unchanged. The basis of this technology represents the derivative systems of Walsh-Hadamard orthogonal functions of the order $n = 64$, built with the aid of the generating segments of dimension $n = 64$ of long M-sequences. Methods of synthesis of the derivative systems of signals with good correlation properties have been considered in [2]. However, to our opinion, many theoretical and practical aspects of systems of signals with length $n = 64$ were not investigated in literature in full extent. Particularly, little attention was paid to the possibility for construction and to properties of bi-phase signals with minimax levels of their periodic and aperiodic auto- and cross-correlation functions (PACF, AACF and ACCF) based on full classes of perfect binary arrays.

The purpose of this paper is construction of ensembles of minimax bi-phase signals, and of normal systems of bi-phase signals with good auto- and cross-correlation properties based on various classes of perfect binary arrays (PBA) having order $N = 8$.

The methods of synthesis and properties of perfect binary arrays were investigated in [3–6]. By the perfect binary array (PBA) is meant an N-order two-dimensional sequence-matrix

$$H(N) = \| h_{i,j} \|, \quad i, j = \overline{0, N-1}, \; h_{i,j} \in \{-1, +1\}, \quad N = 2^k, \quad \text{or} \quad N = 3 \cdot 2^k, \tag{1}$$

with the ideal two-dimensional periodic autocorrelation function

$$B(\tau_1, \tau_2) = \sum_{\tau_1=0}^{N-1} \sum_{\tau_2=0}^{N-1} h_{i,j} h_{i+\tau_1, j+\tau_2} = \begin{cases} N^2, & \text{at} \quad \tau_1 = \tau_2 = 0, \\ 0, & \text{at other} \;\; \tau_1 \text{ and } \tau_2. \end{cases} \tag{2}$$

The method of generation of a full class of PBA $H(N)$ of the order $N = 8$, and of their rarified arrays, was proposed in [6]. The method consists in realization of the following seven rules (П1—П7) of alternation of rarified matrices of different structures having the order $N/2 = 4$: