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REDUCTION OF THE SIDE AND REAR RADIATION LEVEL OF ANTENNAS BY USING IMPEDANCE STRUCTURES

D. D. Gabriel'yan, M. Yu. Zvezdina, and P. I. Kostenko

Rostov-on-Don, Russia

The authors consider the opportunity for using the impedance coatings to reduce the side and rear radiation levels of antenna systems. With an arc-shaped antenna array composed of longitudinal slot radiators taken as an example, the authors have estimated the lowering of side and rear level of radiation in the case of surfaces with capacitance nature of their impedance. These data are compared with the results obtained based on realization of the descending amplitude-phase distribution in the antenna without impedance coatings.

The current tendency of extending of the electromagnetic wave range suitable for utilization, increased number of transmitting and receiving antennas mounted on the same supporting structure, complicates the problem of electromagnetic compatibility (EMC) of various radio and electronic devices incorporated in a single radio-engineering complex [1–3]. For supporting structures used in such systems, metal cylinders of circular cross-section are typical — for instance, in TV and radio broadcasting centers, telescopic masts, etc. — where the issue of suppression of the side and rear radiation to provide the necessary EMC is especially critical.

One of the possibilities to reduce the level of side and rear radiation is the use of the amplitude-phase distribution (APD) decreasing at the edges of the antenna array opening [4]. Another approach consists in creation of impedance-type coatings on the supporting structures [3, 5]. In should be stressed that the latter solution may be realized either by itself or in combination with other measures.

Application of coatings with impedance properties, based on comb structures or magnetodielectrics [3, 5, 6], makes it possible to transform the spatial fields into surface waves, whose amplitudes can be adjusted so as to attain substantially lower side and rear radiation than for the same antennas mounted on metal frameworks. However, despite a number of publications on the issue [5–8], this problem, as applied to an arbitrary and, especially, anisotropic impedance, is not fully understood. Thus, the topic considered in this paper is pressing both from the scientific and practical viewpoint.

The purpose of this work is investigation of the impact of surface impedance on the side and rear radiation level of an arc-shaped antenna array (AA) composed of longitudinal slot radiators located on a circular cylinder surface.

Consider an arc AA consisting of N longitudinal slot radiators located on the surface of a round cylinder with its radius a. The problem geometry is shown in Fig. 1. On the cylinder surface the impedance boundary conditions are set characterized by the tensor $Z = \begin{pmatrix} Z_E & 0 \\ 0 & Z_H \end{pmatrix}$. The dependence of all the values on time, reflected by the multiplier $\exp(i\omega t)$, will be omitted.

By analogy with the radiation field inherent in an electric dipole located in the vicinity of an impedance circular cylinder [9, 10], the expression for the χ-component ($\chi = \theta, \varphi$) of radiation pattern (RP) (this component corresponds to

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