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EHF Band Linear Antenna Array Based on Surface Wave Transformation

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Abstract—The experience of using of experimental samples of diffraction radiation antennas shows the need to expand the list of options and modifications of the technical solutions for such antennas. One of variants is the modification of a linear dielectric waveguide for rigidly fixation of the dielectric rod. H-shaped surface-wave waveguides in the form of combination of dielectric rod and rigid metal elements have been proposed for a basic element of diffraction radiation antennas designed for operation in conditions of increased mechanical loads and vibrations at frequencies above 80 GHz. The results of experimental studies of the near-field distribution, radiation patterns, gain and energy losses of the antenna are presented. The obtained results show the effectiveness of the implemented constructive approach. The configuration of the linear antenna grating of diffraction radiation with a modified dielectric waveguide is proposed, which can be applied for the development of scanning antennas in the 80–100 GHz frequency range.

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INTRODUCTION

The development of means of communication, navigation, radiolocation, and monitoring of the environment is provided at the expense of utilizing the ever-more shorter wavelength bands of electromagnetic waves. Besides the upgrade of existing radio devices involves the need of creating fundamentally new technical specimens, e.g., diffraction radiation antennas.

The development of antenna systems resulted in the separation of a direction related to the application of linear, plane and conformal phased antenna arrays [1]. Generally, complex two-dimensional arrays are created from linear arrays located on the specified surface. Therefore, the designers of antenna systems are always interested in theoretical and experimental investigations of linear arrays.

Dipole and slot radiators, as well as horn antennas are traditionally used as radiators in linear arrays of decimeter- and centimeter-wave bands. The excitation of such radiators is achieved by employing the series or parallel feeding with the use of a large number of controlled elements of waveguide transmission line.

However, the implementation of such systems operating in the millimeter wavelength band (MWB) and especially in its short-wavelength part (EHF) using hollow metal waveguides or striplines of different configurations presents engineering and technological difficulties in manufacture and mounting, as well as in tuning and adjustments. Therefore, the search for other technical solutions, which could be free from the specified disadvantages, is of considerable interest.

One of the possible solutions consists in the use of the phenomenon of surface wave-to-spatial mode conversion (SSMC) at the expense of diffraction of plane inhomogeneous electromagnetic waves on periodic structures [2].

Such antenna (Fig. 1) represents single-mode linear dielectric waveguide (DW) *1* and reflection-type diffraction grating *2* coupled electrodynamically, the radiation characteristics of which depend on mutual arrangement of DW and grating [3–7]. The reliable mutual fixing of dielectric waveguides and diffraction gratings is particularly important for linear antennas of diffraction radiation operating in conditions of

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

ADDITIONAL INFORMATION

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