Chapter 5
Antenna for ADS-B Signals

ABSTRACT

This chapter deals with calculations of the microstrip antenna and the linear phased array that were based on the method of moments using Antenna Magus software. The analysis of the characteristics of these antennas at different emitter numbers and different types of the amplitude distribution was carried out. Calculations of electric field intensity and directional patterns for collinear antennas were provided. The method of moments in the framework of two program complexes was used. Comparison has shown high level of results coincidence. The sample of the antenna is described, which is used in operating system for reception of ADS-B signals from airborne transponders.

INTRODUCTION

The direction of radiation and the shape of the corresponding radiation pattern in phased array antenna is controlled by a change in the amplitude-phase distribution of currents or excitation fields on the radiating elements. The radiating element is a component of the antenna array with a given relative excitation. The required directional pattern is formed due to the interference of electromagnetic waves radiated into space by its radiating elements. For this, the necessary relative amplitudes and initial phases of the alternating currents or excitation fields of each radiating element is provided. The amplitude-phase distribution is not fixed, it can be controlled during operation. Due to this, it is possible to move the beam (the main lobe of the radiation pattern) of the antenna array in a certain sector of space. These and some other properties
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of phased arrays, as well as the ability to use modern means of automation and computer technology, have made them promising and widely used in radio communications. Phased array antenna containing a large number of controllable elements are part of various ground (stationary and mobile) aviation and space radio engineering systems. Intensive developments are underway in the direction of the further development of the theory and technology of phased arrays and the extension of their field of application.

An antenna array of N radiating elements allows an increase in the directional effect factor by approximately N times, and to narrow the beam for increasing noise immunity. An increase of electric field intensity in the antenna array is possible in comparison with an aperture antenna equipped with a single irradiator. An important advantage of the phased array is the ability to scan quickly the space by “swinging” the beam of the radiation pattern by electric methods. Such a phased array is an antenna with electric beam scanning. Functional capabilities of the phased array are expanded by using the active transceiver module. There are a number of design and technological advantages in comparison with other classes of antennas.

The excitation of radiators is performed either by feeder lines or by freely propagating waves (in the so-called quasioptical phased array). The feeder paths of excitation, along with the phase shifters, sometimes contain complex electrical devices (so-called diagrammering circuits). That ensure the excitation of all radiators from several inputs, which allows creating in the space simultaneously scanning rays. Quasi-optical phased arrays are basically of two types: through-pass (lens), in which the phase shifters and main radiators are excited (by means of auxiliary radiators) by waves propagating from the common illuminator, and reflective - the main and auxiliary radiators are combined, and reflector outputs are installed at the outputs of the phase shifters. Multibeam quasioptical phased arrays contain several irradiators, each with its own beam in space. Sometimes focusing devices (mirrors, lenses) are used. The above-mentioned phased arrays are sometimes called passive.

The most powerful are active phased arrays, in which each transmitter or module is connected to a phase-controlled transmitter or receiver. Phase control in active phased arrays can be performed in intermediate frequency paths or in excitation circuits of coherent transmitters, receiver heterodynes, etc. Thus, in active phase shifters, phase shifters can operate in wave bands different from the frequency range of the antenna. Losses in a phase shifter in some cases do not directly affect the level of the main signal. Transmitting
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